RESEARCH ARTICLE

Thai Engineer ASEAN Readiness: A Structural Equation Model Analysis

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Abstract At the start of 2016, the 10-member nation of the Association of Southeast Asian Nations (ASEAN) entered a new era. With it, came the decade old start of the implementation of the 2005 mutual recognition arrangement (MRA) on engineering services and the free flow of skilled labor (FFSL). Although noble intentions, actual specifications and qualifications for this movement heavily restrict its actual implementation. This study therefore conducted both a quantitative and qualitative analyse of 412 engineers selected from a population of 1,211 Thai Federation of Industries companies to investigate how need, gap, and competency affect readiness. The structural equation model was conducted with AMOS 21 software and from the analysis, competency (b =0.16) and needs (b =0.77) demonstrated a significant effect on readiness, while needs demonstrated a significant effect on gap. Finally, the research determined that less than 1% were certified as ASEAN engineers, which is a pre-condition for registration for work as an engineer in another ASEAN country, with cultural awareness of other member nations ranked as the weakest link in an engineer's readiness perception.

Keywords ACPE, APEC, competency, FFSL, gap, MRA, need, registered foreign professional engineer

ASEAN, and by extension the ASEAN Economic Community (AEC), is an incredibly diverse and dynamic region representing 10 member nations whose combined population exceeds 622 million people. Economically, in 2015 this community had a market value of US$ 2.5 trillion (ASEAN Economic Community, 2015).

Thailand is a key member of this community and promotes itself as the "hub" of many industrial and technology sectors, such as automotive manufacturing, computer disk-drive manufacturing, smartphone mobile technology, and renewable energies. And whether a desired outcome or not, Thailand has also become a hub for foreign worker migration (mostly unskilled), as between 1990 and 2013, intra-ASEAN migration increased from 1.5 million to 6.5 million, with Malaysia, Singapore, and Thailand emerging as the major migration hubs of the region (International Labour Organization & Asian Development Bank [ADB], 2014).

The reality of a single common market and production base became reality at the end of 2015, but unfortunately there is a persistence of poor quality jobs (International Labour Organization & Asian Development Bank, 2014). According to an ILO (International Labour Organization, 2014) survey of ASEAN enterprises and business associations, less than one in three surveyed agreed that secondary school graduates were equipped with the relevant skills needed by their enterprises, with Singapore being rated the highest with seven out of 10. Some good news, however, can be found in another ASEAN ILO study which indicated that 80% of these same organizations felt it important to invest in human resource development, with 90% reporting that training investment is an important way to address performance gaps, promote continuous development of the workforce, and improve productivity (International Labour Organization, 2014).

It seems however that ASEAN managers feel that education beyond high school (tertiary education), especially vocational education and training systems, is better aligned with industry requirements. What was interesting to also note from the survey was where the greatest skill gaps were, with training needed greatest in management and leadership skills (29%), followed by vocational training (17%), and customer service training (15%) (International Labour Organization & Asian Development Bank, 2014).

Depending on which ASEAN country you choose to establish your business, you can also determine what skill shortage a manager might expect. In Cambodia, communication and foreign language skills are in great shortage (Bruni, Luch, & Kuoch, 2013). In Vietnam, a World Bank (2014) company survey identified job related technical skills gaps which included cognitive skills such as problem solving and critical thinking and core skills such as teamwork and communication. It was indicated by the study that unless these shortages are addressed, employers will face higher staff turnovers, and be forced to recruit skilled workers from other ASEAN member nations. Domestically, employers will have to fill skilled positions with marginally capable workers, with an end result of low productivity (Aring, 2015).

In Thailand, the World Bank's analysis of skill shortages and foreign recruitment for Vietnamese skilled workers is already being played out—in 2016 the Thai government announced a US$ 1 billion program to produce 12,290 post-doctoral researchers. This Thai government program is designed to assist with the development of 10 targeted industries (under the banner "Thailand 4.0"), which focuses on technological development and innovation. What is interesting to note is that in the first scholarship cycle, 300 scholarships were being awarded to produce doctoral researchers, but 60 scholarships (20%) are slated for outstanding researchers from ASEAN and six other countries to conduct research in Thailand ("Govt designs 20-year plan," 2016).

ASEAN Labor Mobility

Mobility of service providers within the Southeast Asian region was not part of the original ASEAN declaration but subsequently has become an important aspect of regional economic integration with the adoption of the 1995 ASEAN Framework Agreement on Services (AFAS) and then later with the initiative to conclude an agreement on Movement of Natural Persons (MNP) (Jurje & Lavenex, 2015). Mobility of skilled labor within ASEAN is also promoted through the Mutual Recognition Arrangements (MRAs) of professional services. In addition, aspects related to migrant workers' rights are covered in a regional declaration signed by ASEAN leaders in 2007 (Jurje & Lavenex, 2015).

With the tighter integration of the AEC at the end of 2015, came the beginning of the actual ability for the free flow of skilled labor (FFSL) initially envisioned in the AEC blueprint signed in 2007 (Sugiyarto & Agunias, 2014). The FFSL refers to the actions taken by the AEC to allow the free movement of skilled labor, including engineers in the AEC member countries, without any legal limitations, according to the mutual recognition agreements (MRA) (Fukunaga, 2015; Chia, 2011).

Under the above provisions, only architectural and engineering services stipulate eligibility as either an ASEAN Chartered Professional Engineer (ACPE) or an ASEAN Architect. However, to obtain the ASEAN standard certification, the applicant must hold a professional license issued by the regulatory body in their home country, which then is reviewed by the ASEAN Chartered Professional Engineers Coordinating Committee. If the application is approved, an engineer is allowed to work as Registered Foreign Professional Engineer (RFPE) in another ASEAN country. The foreign employment however, is further regulated by domestic rules and regulation. Nationality/citizenship requirements could thus constitute barriers to the movement of professionals within the region (Jurje & Lavenex, 2015). Hence, an MRA does not equate to automatic recognition and does not imply free movement of professionals in the ASEAN region (ASEAN Secretariat, personal communication, June 19, 2014). The reality however, seems to be significantly different than what was envisioned (Jurje & Lavenex, 2015).

The year 2016 has come and gone, and there are very mixed signals coming from various industries, sectors, and ASEAN countries as to the success or failures thus far of the MRA's FFSL. Therefore, the following questions were introduced for further study:

1. Why is the Thai government recruiting 12,290 post-doctoral researchers, many of whom are foreigners, to work and research within 10 targeted Thai industries?
2. What is the level of preparedness of Thai engineers to work in other ASEAN nations, including their certification, language, and cultural skills?
3. What are the requirements for Thai engineers to work outside Thailand in AEC member countries on engineering projects?
4. How does need, competency, and gap affect a Thai engineer's readiness to work in AEC member countries on engineering projects?

Literature Review

Readiness

The Korn Ferry Institute (2015) has indicated that individual readiness is the crucial link between high potential and success in a new job, which is not the same as potential, as readiness is the ability to act "now," while already having the experiences and competencies for successful decisions.

As a knock-on effect from American's space program in 1974, and in a search for a contractor support criterion, the Technology Readiness Level (TRL) metric was developed, which assessed the maturity of evolving technologies prior to incorporating them into a system or sub-system on a scale of 1 to 9 (9 indicating highest level of maturity) (Fedkin, 2015), which later became a standard metric for communication of a technology's development status (Mankins, 2002).

Although the TRL is not a scale to directly measure an engineer's readiness, it does however require a high level of professional capability to search out the most recent information from a multitude of sources concerning the characteristics of the new systems, prototypes, and competition, as well as understanding and justifying the economic viability of the project (Fedkin, 2015). This is consistent with Davis, Beyerlein, and Davis (2006) which investigated the roles that professional engineers utilize in their careers, and indicated that information retrieval and evaluation skills are important for five of the 10 readiness roles described which included analyst, problem-solver, designer, researcher, and communicator.

Buzdar, Ali, and Tariq (2016) examined emotional intelligence's effect on readiness and indicated that there is a large effect on students' readiness for online learning, with Denham, Zinsser, and Bailey (2011) also referring to e*motional intelligence* (EI) as *emotional* competence.

The Consortium for Research on Emotional Intelligence in Organizations (CREIO, 2016) identified 19 areas concerning how emotional intelligence contributes to organizational profitability and, based on a meta-analysis, manager's emotional intelligence (EI), positively relates to subordinates' job satisfaction (Miao, Humphrey, & Qian, 2016). This is consistent with Parke, Seo, and Sherf (2015) which concluded that a worker or manager's EI is a key factor for higher income and advancement, while Elegbe (2015) indicated that EI was a missing priority in engineering programs education curriculum.

After a review of the concepts and theories as mentioned above, two elements from the literature review were selected and included in the research framework for readiness, which are: 1) *environment* and 2) *emotion, motivation, and personality (EMP)*.

Competency

A brief study on the theory of competency can begin with Flanagan's (1954) "Critical Incidents Technique" which is thought of as a key methodology in competency studies. McClelland (1973) later adopted Flanagan's work which led to the adoption of the term "competency" and the separation of competency and "intelligence." This is in agreement with Gipps and Stobart (2003), which defined "competent" as educational training and experience, rather than a natural feature such as intelligence. Using this definition, UK engineering employers find 76% of their job applicants incompetent as they view experience a factor leading to competency (Institution of Engineering and Technology, 2015).

The next milestone in competency modeling occurred when Boyatzis (1982) introduced his book on competency modeling which emphasized the importance of systematic analysis. Boyatzis also introduced the behavioral event interview (BEI) which today is part of many interview processes for the Fortune 500, universities, and organizations such as the World Bank.

According to Myatt (2013), organizations which value technical competency more than personal competency and an individual's "soft skills," are missing the real value as it is not what a person knows so much as it is how they're able to use their knowledge to inspire and create brilliance in others that really matters. "A leader's job is to close gaps – not create them" (Myatt, 2013, par. 8).

More recently, from the development of the Collaborative Intercultural Competence Model (CICM), Matveev (2016) indicated that the most critical issue facing global business leaders and the multicultural workforce today is how to work and relate effectively in an intercultural context. As a component of this, Deardorff (2009) indicated that there is a surprising absence of second-language learning and overseas experience in the competencies identified as most important. Implications suggest that language learning is secondary to the basic motivational and cognitive orientations that permit movement in and among such cultures with or without language competence.

Specifically, Asamoah, Okuada, and Hayfor (2014) discussed competency as a tool and indicated there were three components including *knowledge* (informational expertise such as in automotive engineering), *skills* which is the ability to demonstrate one's expertise (such as in contract negotiations), and finally, *attitude* which involves how one perceives themselves.

Mansfield (1989) indicated the importance of competency by stating that it is the key to vocational and education training (VET). This is consistent with directives from the European Union (2015) which stated that there need to be relevant and high-quality knowledge, skills, and competences developed throughout lifelong learning, which focuses on learning outcomes for employability, innovation, active citizenship, and well-being.

Along with the concepts of competency theories mentioned above, competency has a variety of elements; therefore, we selected the first three elements most mentioned by the scholars to set the conceptual framework to study: knowledge, skill, and attitude. These and other scholars' research has therefore led to the following hypotheses concerning competency:

H1: Competency has a direct and significant influence on readiness.

H2: Competency has an indirect and positive effect on readiness through gap.

Needs

In ABET's criteria guide, "*Accrediting Engineering Programs, 2016 – 2017*" (used in 30 countries, 752 colleges, and 3,709 engineering programs), the curriculum necessary for preparation of students in an engineering profession should include, in part: 1) leadership, 2) professional ethics, and 3) a recognition of the need for, and an ability to engage in life-long learning (ABET, 2014). As previously mentioned, both the ILO and the ADB (International Labour Organization & Asian Development Bank, 2014) agreed with this assessment. Additionally, ABET also indicated that responsibility must be instilled in students in both a professional and ethical way. General knowledge or basic knowledge is imperative as well, which includes the necessary basics in the math and sciences to do a job in a related engineering field.

After graduation, the concept of *needs* is normally associated with the discrepancy or gap between what the company expects to happen and what actually happens (Rouda & Kusy, 1995). For example, if the company wants to promote an engineer to a higher position that involves working and interacting with foreigners from other ASEAN countries, that engineer will need to improve his or her English proficiency (Joungtrakul, 2013). This discrepancy may become a reason for a training or HRD need (Lim, Werner, & Desimone, 2013). Many motivational theories are rooted in the concept of needs. Needs are a deficiency state or imbalances, either physiological or psychological, that drive or direct employee behavior. Although needs are internal states of individuals, they are influenced by forces in the companies (Lim et al., 2013). Needs drive behavior through a combination of need activation and need satisfaction. Only activated needs can be motivational because only an activated need generates the tension the person is motivated to get rid of (Noe, Hollenbeck, Gerhart, & Wright, 2014)

Two well-known need-based theories of motivation are Maslow's (1943) need hierarchy theory and Alderfer's (1969) existence, relatedness, and growth (ERG) theory. Alderfer (1969) emphasized the importance of emotional and material well-being, the desire to satisfy interpersonal relationships, and the need for continual psychological growth and development.

A review of the human motivation theories literature quickly identifies other popular scholars, including McClelland's "Need theory of motivation" (Royle & Hall, 2012) and the Basic Needs Theory (BNT) by Deci, Koestner, and Ryan (2001). McClelland's (1965, 1973) need theory is particularly interesting as it focuses on needs for motivation/achievement (nACH), affiliation (nAFF), and power (nPOW), which are also indicated as traits which can be learned.

Needs theories tend to suggest that to motivate employee learning, companies should identify employees' needs and inform them how training programs relate to fulfilling these needs (Redmond & Subedi, 2016). As an offshoot of the Self-Determination Theory (SDT), BNT investigated the driving forces for motivation and personality and concluded that "humans function and develop effectively as a consequence of the social environment and its potential for basic need satisfaction" (Adie, Duda, & Ntoumanis, 2008, p. 189).

From the above short list of need theorists, Maslow's Need Hierarchy Theory is probably most recognized which visualized the theory in a hierarchy, ascending from the lowest to the highest (Maslow, 1943). Lower ordered needs are experienced first which must be satisfied before higher ordered needs are perceived. Therefore, before employees can be trained and developed, it is important to determine what type of training is necessary and whether employees are willing and ready to learn.

In a discussion about need and the evaluation of it, there is an operational definition problem of what exactly they are and what it entails. It seems at times that "assessment" and "analysis" are used interchangeably, but in fact they are two different ideas (Kaufman & Guerra-Lopez, 2013). Simply stated, an assessment is designed to identify gaps in results, while analysis seeks to understand the root causes and essential elements of such gaps. Needs assessment provides data about gaps in results, and therefore sets up the evaluation framework to be used when evaluating the solutions that were implemented to close such gaps (Guerra-López, 2008).

According to the U.S. Office of Personnel Management (n.d.), the purpose of a training needs assessment is to identify performance requirements and the knowledge, skills, and abilities needed by personnel to accomplish the requirements. This helps organizations direct their resources to help with the organizational mission, its productivity, and help with providing quality products and services. A needs assessment is the process of identifying the gap between performance required and current performance. When a difference exists, it explores the causes and reasons for the gap and methods for closing or eliminating the gap.

According to the needs theories mentioned above, need has a multitude of elements depending on a wide array of conditions and circumstances. However, we made our best effort to narrow the discussion to professionals and management in engineering related disciplines. From this, the following observed variables were determined which included *ethics, collaborative management, response management, leadership, life-long learning*, and *basic knowledge.* These and other scholars' research have therefore led to the following hypotheses concerning need:

H3: Need has a direct and positive influence on gap.

H4: Need has a direct and positive influence on readiness.

Gap

Professional knowledge and skills have been thought of "soft skills" and are frequently thought to include teamwork skills, communication skills, and leadership skills (ABET, 2014; Knight, 2012; Shuman, Besterfield-Sacre, & McGourty, 2005). Brunhaver, Korte, Barley, & Sheppard, 2016). This is consistent with survey data from the National Association of Colleges and Employers (NACE, 2015), which indicated that 75% of all hiring managers seek new graduates who can work as part of a team, while 80% were looking for evidence of leadership skills which had the greatest influence on hiring one candidate over another. Written communication skills and problem-solving skills—which are both sought by more than 70% of employers—are also highly valued, as are verbal communication skills and a strong work ethic (Table 1).

Table 1
Attributes Employers Seek on a Candidate's Resume

Attribute	respondent %
Leadership	80.1%
Ability to work in a team	78.9%
Communication skills (written)	70.2%
Problem solving skills	70.2%
Communication skills (verbal)	68.9%
Strong work ethic	68.9%
Imitative	65.8%
Analytical/quantitative skills	62.7%
Flexibility/adaptability	60.9%
Technical skills	59.6%
Interposal skills (relates well to others)	58.4%

Table 2 continued...

Computer skills	55.3%
Detailed-oriented	52.8%
Organizational ability	48.4%
Friendly/outgoing personality	35.4%
Strategic planning skills	26.7%
Creativity	23.6%
Tactfulness	20.5%
Entrepreneurial skills/risk-taker	18.6%

According to the Australian researchers Male, Bush, and Chapman (2010), competency deficiencies in new graduates is also referred to as "skill gaps" and according to the World Chemical Engineering Council (WCEC, 2004), new engineering undergraduates' management and administration skills had the highest gap level. Research from Passow (2007) concluded that there were 11 skills required for industrial competency, and of these, the four most important were 1) problem solving and communications skills, 2) ethics, 3) learning, and 4) teamwork.

Patil, Nair, and Codne (2008) studied competency gaps and found that there were 23 related competency variables, 10 of which were crucial: 1) oral communication, 2) interpersonal skills, 3) written communication, 4) solving problem, 5) new concept development, 6) time management, 7) teamwork, 8) knowledge application in working, 9) stress management, and 10) learning new things.

Torrente's (2014) discussion concerning Philippine transnational entrepreneurs, successful personality traits included the need for achievement, an internal locus of control, and the willingness to take risks.

Zaharin (2009) researched the gap between employers' perception and engineering undergraduates in Malaysia and found that there were six important competencies: 1) communication, 2) problem solving, 3) teamwork, 4) learning, 5) knowledge application in working, and 6) ethics. In Thailand, Cheerakarn (2012) discussed required competencies in the banking sector that human resource staff needs to identify. These key attributes analyzed were innovation, leadership, flexibility, motivation, and building relationships.

As aforementioned, there are a variety of competency gap elements with scholars indicating that the two elements—management and teamwork—as strong concepts from theory to be included in the conceptual model, as shown in Table 1, and stated in the following hypothesis:

H5: Gap has a direct and positive influence on readiness.

Conceptual Framework

Based on the above hypotheses and review of the literature, we have developed the conceptual framework (see Figure 1) which includes the causal relationships between competency, gap, needs, and readiness of Thai professional engineers to work within the ASEAN Economic Community (AEC).

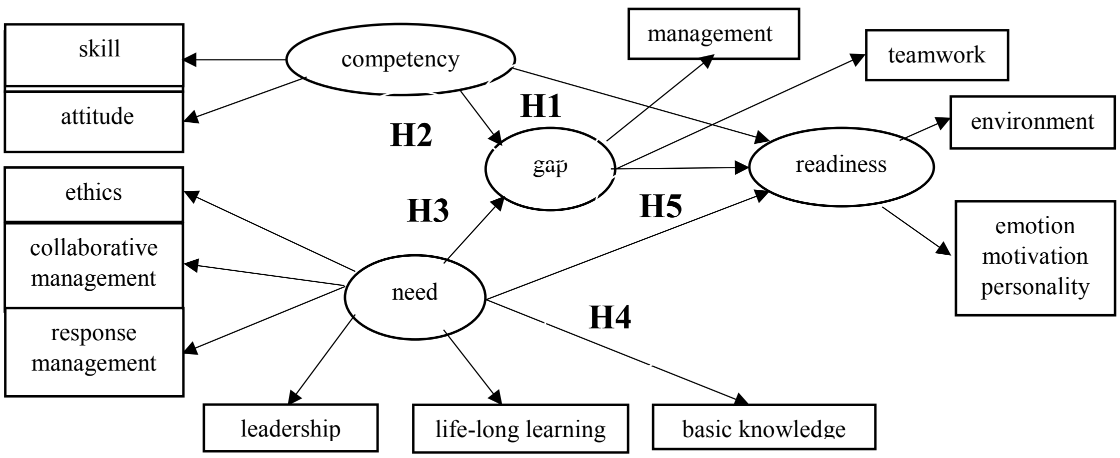

Figure 1. *Conceptual model.*

Note. For the study, both competency and needs were identified as the exogenous latent variables. Competency gap was identified as the mediator latent variable, while readiness as the endogenous latent variable. The dashed line represents the indirect hypothesis.

Methods

Sampling and Data Collection

The population of this study was engineers who worked in Thai industrial companies which were registered members of the Federation of Thai Industries (FTI). For the study, the 1,211 companies were divided into 12 industrial sectors as shown in Table 2.

Table 2
Sample Source

Rank	Sector	Companies in Sector	Percent of FTI	Number of study samples
1	Environmental Management Industry	56	4.62	19
2	Chemical Industry	157	12.96	54
3	Agricultural Machinery industry	160	13.21	55
4	Machine Tooling Industry (CNC)	88	7.27	31

Table 2 continued...

5	Air-conditioning and Cooling Industry	78	6.44	27
6	Automotive Parts Manufacturers	204	16.85	71
7	Software Industry	67	5.53	23
8	Petrochemical Industry	28	2.31	10
9	Cement Industry	8	0.66	3
10	Industrial Power Producers	16	1.32	6
11	Plastics Industry	162	13.38	56
12	Electrical, Electronics and Telecommunications	187	15.44	65
	TOTAL	1,211	100	420

Note. 420 questionnaires were received but only 412 were deemed complete and usable.
Source: FTI (2013).

Krejcie and Morgan (1970), in researching for the US National Education Association (NEA), has indicated that sample sizes larger than 380 is unnecessary in statistical sampling. As a total of 412 samples were collected and analyzed for the study, this is deemed to be highly reliable.

Of the questionnaires sent and returned, 412 questionnaires were deemed complete and usable. Furthermore, the questionnaire was divided into two parts, with Part 1 consisting of the respondent's general and personal information while Part 2 consisted of 60 items concerning the engineer's perception of his/her readiness for work within an AEC member country. Furthermore, Part 2 was divided into four parts with competency consisting of 12 questions, needs with 24 questions, competency gap with 11 questions and readiness with 11 questions (Table 3 and Table 4). Respondents were required to determine the degree to which each statement reflected the degree of their readiness. Each statement was measured using a Likert scale of 1-7 (Likert, 1932), ranging from 1 for "strongly disagree" to 7 for "strongly disagree" (Table 4).

Table 3
Thai Engineer Readiness to Work in AEC Engineering Projects

Dimensions	Questions/Items
Part 1–Competency	1–12
Part 2–Needs	12–36
Part 3–Gap	37–48
Part 4–Readiness	49-60

Therefore, according to the seven levels of frequency (Table 4), the interpretation of these responses was calculated by using the formula:

$$\text{Interval} = \frac{\text{the highest score} - \text{the lowest score}}{\text{the number of interval}}$$

Therefore, there was a 0.86 (rounded) interval level for the seven levels of frequency as detailed in Table 4.

Furthermore, qualitative research was conducted by use of in-depth, semi-structured, guided interviews with five experts (three university engineering lecturers and two Council of Engineers of Thailand (COE) certified) to determine the questionnaire's content validity which covered the following four topics that were revised based upon comments/feedback from each expert:

1. The measurement of readiness
2. The measurement of competency
3. The measurement of gap
4. The measurement of need.

For the study, Cronbach's alpha (Cronbach, 1951) was used to evaluate an initial 30 samples which used a 7-point, bipolar scale survey rating matrix, with 7 indicating strongly agree and 1 indicating strongly disagree. According to Tavakol and Dennick (2011), the number of test items, item interrelatedness, and dimensionality affect the value of alpha, with various scholars reporting different acceptable values of alpha, ranging from 0.70 to 0.95 (Hair, Hult, Ringle, &

Table 4
Thai Engineer Readiness for ASEAN Projects Likert Scale Interpretation

Mean range	Likert Scale Responses	Interpretation
6.14 – 7.00	7 - strongly agree	High level of readiness.
5.28 – 6.14	6 - agree	Confident. I am ready.
4.42 – 5.28	5 - somewhat agree	I would like to think I am ready.
3.56 – 4.42	4 - undecided	I am not sure.
2.70 – 3.56	3 - somewhat disagree	I have some doubts as to my readiness.
1.84 – 2.70	2 - disagree	I am not confident at all I am ready.
0.00 – 1.84	1 - strongly disagree	No level of readiness.

Sarstedt, 2013). The correlation coefficient indicated high reliability however with a score of 0.958.

Further feedback and recommendations led to use of the Index of Item-Objective Congruence (IOC) which was used so as to find the content validity. In this process, the questionnaire was checked by five experts in their related fields. The Item-Objective Congruence (IOC) was used to evaluate the items of the questionnaire based on the score range from -1 to +1.

The items that had scores lower than 0.5 were revised or eliminated.

Furthermore, the study identified two exogenous latent variables which consisted of two observed or manifest variables (Hancock & Nevitt, 1999), including competency (knowledge, skill, and attitude), and needs (ethics, collaborative management, response management, leadership, life-long learning, and basic knowledge).

The study's mediator latent variable is gap which consisted of two observed or manifest variables, including management and teamwork. Mediating variables are important in psychological theory and research and transmit the effect of an independent variable on a dependent variable (MacKinnon, Fairchild, & Fritz, 2007).

In addition, the endogenous latent variables relating to readiness consisted of four observed or manifest variables including environment and emotion, motivation, and personality (EMP). Readiness is the moderator variable of the research, which can be divided into readiness and un-readiness components.

From literature reviews and theory, the following exogenous latent variables, the mediator latent variable, and the endogenous latent variables were analyzed (Table 5).

Table 5 *Summary of Exogenous Latent Variables, the Mediator Latent Variable, and the Endogenous Latent Variables Along with Associated Theory*

Latent Variables	Observed variables	Knowledge Base (Theory)
Exogenous latent variables		
Competency		
	knowledge skill attitude	(Brunhaver et al., 2016; NACE, 2015; ABET, 2014; Knight, 2012: Shuman et al., 2005; Male et al., 2010; Zaharin, 2009; Patil et al., 2008; Passow, 2007; WCEC, 2004)
Needs	ethics collaborative management response management leadership life-long learning basic knowledge	(Redmond & Subedi, 2016; ABET, 2014; International Labour Organization & Asian Development Bank , 2014; Rouda & Kusy, 1995; Joungtrakul, 2013; Lim et al., 2013; Noe et al., 2013; Kaufman & Guerra-Lopez, 2013; Royle & Hall, 2012; Deci et al., 2001; Alderfer, 1969; McClelland, 1965, 1973; Adie et al., 2008; Guerra-López, 2008; Maslow, 1943).

Table 5 continued...

Mediator latent variable		
Gap		
	management teamwork	(Brunhaver et al., 2016; NACE, 2015; ABET, 2014; Knight, 2012; Male et al., 2010; Zaharin, 2009; Patil et al., 2008; Passow, 2007; Shuman et al., 2005; WCEC, 2004)
Endogenous latent variable		
Readiness		
	environment emotion, motivation, and personality (EMP)	(*Buzdar* et al., *2016;* CREIO, 2016; Miao et al., 2016; Parke et al., 2015; Korn Ferry Institute, 2015; Fedkin, 2015; Denham et al., 2011; Davis et al., 2006; Mankins, 2002**)**

Results

Respondent's Demographic Characteristics

Table 6 shows the results from the 412 Thai engineering professionals surveyed. Of those respondents, the clear majority were male (85%) and were 40 years old or younger (80.80%) as was expected. Engineers with undergraduate degrees represented 74% while 19.90% had a Master's degree. Civil engineers (38.80%) led the professional list, followed by electrical engineers (18.90%), and mechanical engineers (14.80%). The ratios between operations and management were as anticipated at 64.80% and 35.20%, respectively. Work experience was nearly a perfect match with the operations/management ratio when it was discovered that 63.11% had 10 years of experience or less, while the remaining (management) had 11 years or more experience (36.85%).

When the survey focused on professional membership in the Council of Engineers of Thailand (COE), 36.20% indicated that they were not a member while 51.20% indicated they were registered as Associate Engineers, with another 11% registered at higher levels. This is in line with the question about readiness to work in another ASEAN country in which 67.50% indicated they were, but the data suggests this is not true, as only three, or 0.70% were ACPE certified, which is a criterion for application as a Registered Foreign Professional Engineer (RFPE) and work outside Thailand as an engineer in an ASEAN member country (Hamanaka & Jusoh, 2016).

For clarification, Thailand's COE is a statutory body under the Engineers Act B.E. 2542 (1999) which provided for the registration of professional engineers and the associated qualifications and conduct regulations for both them and the Thai companies they work in (Council of Engineers of Thailand). With COE membership, it is possible to become an ACPE (Council of Engineers of Thailand) which allows a registered member to work with or in foreign enterprises in their respective countries (but not independently).

Table 7 shows that the factors that affect Thai engineering professional readiness to work within the ASEAN community (AEC) includes readiness, competency, gap, and need, while Table 8 sho $\bar{x}$ the specific question in Part 4 (Readiness) and their and standard deviation averages as well as the interpreted results from the 7-point survey which ranged from 4.87–5.84 (Best & Kahn, 2003; Likert, 1932).

Table 6
Respondents Overview (412 samples)

Profile	Respondent Number	Percent
Sex		
male	350	85.00
female	62	15.00
Age		
Under 30 years	160	38.80
31–40 years	173	42.00
41–50 years	62	15.00
More than 51 years	17	4.10
Education Level		
High school diploma or vocational certificate	24	5.80
Bachelor's degree	305	74.00
Master's degree	82	19.90
PhD	1	0.20
Engineering Field		
Civil	160	38.80
Mining	1	0.20
Mechanical	61	14.80
Electrical	78	18.90
Industrial	42	10.20
Chemical	12	2.90
Environmental	5	1.20
other	53	12.90
Company Position		
Operations	267	64.80
Management	145	35.20
Work Experience		
0–10 years	260	63.11
11–20 years	99	24.00
21–30 years	48	11.65
More than 31 years	5	1.20
Thai Council of Engineers (COE) Member		
Not a member	149	36.20
A Level Engineer	6	1.50
Associate Engineer	212	51.50
Corporate Engineer	4	1.00
General Engineer	37	9.00
Senior Engineer	4	1.00
Prepared to work in another ASEAN country		
I'm ready	278	67.50
Not ready	134	32.50
Do you desire to register as an ASEAN Chartered Professional Engineer (ACPE)?		
I intend to.	328	79.60
I do not intend to.	81	19.70
I am already registered.	3	0.70

Table 6 continued...

At what level (50 percent lower or higher), do you feel AEC membership will allow professional engineering opportunities for you? (Both directly and indirectly.)		
Below 50 percent	299	72.57
Higher than 50 percent	113	27.43
Company capital authorized		
Less than 50 million baht (US$ 1.44 million)	119	28.90
51–200 million baht	107	26.0
More than 200 million baht (US$ 5.7 million)	186	45.10

Table 7
Mean, Standard Deviation, and Survey Interpretation

Thai Engineer Readiness Factors	$\bar{x}$	Standard Deviation	Survey Interpretation
Readiness	4.87	1.211	I would like to think I am ready.
Competency	4.94	1.066	I would like to think I am ready.
Gap	5.42	1.044	Confident I am ready.
Need	5.84	1.263	Confident I am ready.

Note. $\bar{x}$ = the standard mean.

Table 8
Mean, Standard Deviation (SD) of Thai Engineering Readiness Levels to Work Within AEC Member Countries.

Thai Engineer's perception of readiness to work in another AEC member country.	$\bar{x}$	SD	Readiness Level
49. I have knowledge about both ASEAN and the AEC (ASEAN Economic Community), its guidelines, and the purpose of operation.	4.01	1.187	undecided
50. I have the knowledge and ability to communicate in English or the language of another ASEAN country.	4.06	1.263	undecided
51. I have knowledge of geography, society, and culture of the ASEAN community.	3.81	1.231	undecided
52. I have knowledge about international safety standards.	4.28	1.316	undecided
53. I think training about international standards for work is important.	5.39	1.325	agree
54. I think increasing my knowledge and self-ability is important to increasing my compensation in a foreign project.	5.63	1.244	agree
55. I think additional training in language skills such as English or other ASEAN countries (such as Vietnam, Burma, etc.) is important.	5.64	1.211	agree
56. I think I have engineering competency readiness to participate in a competitive AEC environment.	4.86	1.177	somewhat agree
57. I think I have the skills and am flexible enough to adapt to working in a wide range of ethnic, linguistic, and cultural environments.	5.68	1.194	agree

Table 8 continued...

58. I think I can learn and comply international standards such as being on time, taking responsibility, and handling criticism.	5.45	1.116	agree
59. I think that having awareness and a positive attitude about the ASEAN community in important.	5.57	1.082	agree
60. I think motivation to succeed, encouraging members of the work group, and the promotion of the use of knowledge can be important.	4.01	1.187	undecided

Pearson Product-Moment Correlation Coefficient (PPMCC)

The Pearson product-moment correlation coefficient (r) was used to test the 13 observed variables (Table 9). The sign of the correlation coefficient indicates the direction of the relationship, while the magnitude of the correlation (how close it is to –1 or +1) indicates the strength of the relationship (Cohen, 1988).

Results from the study shown in Table 9 indicate the positive relationships. Additionally, the variables are most correlated at the statistically significant level of $p < 0.05$. The study also considered the pairs of observed variables' correlation coefficients (Table 9) where values were over 0.85. An examination of the path significance of the hypothesized relationships and the variance explained (R^2) by each path is carried out as shown in Table 9. Figure 2 depicts the results of the path coefficients. As presented, competency (b =0.16) and needs (b =0.77) demonstrate a significant effect on readiness. Needs demonstrate a significant effect on gap. The relationships between competency and gap (b =0.17) and gap and readiness (b =0.11) are significant.

According to the statistical values in the SEM model, R^2 of gap is at 0.12 meaning that the gap can be predicted by exogenous latent variables of competency and needs (12%). In terms of readiness, it is found that the R^2 of the endogenous latent variables is at 0.51 revealing the readiness can also be predicted. Total percentage of competency, needs and gap variables are 51%, which indicates that the model to develop the engineers' competency has the prediction power at 51%.

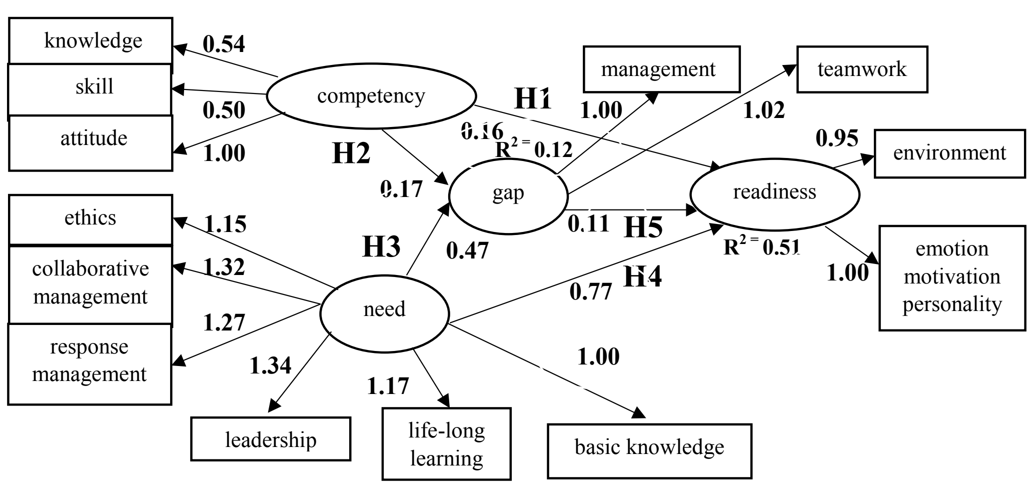

Figure 2. *Final model.*

Note. X2 = 64.239, df =50, p = .085, CMIN/DF = 1.285, GFI = .971, RMSEA = .030.

Table 9
Pearson Product Moment Correlation Coefficient (PPMCC)

	emotion	Environment	intelligence	team	manage	communicate	ethic	cooperate	response	lead	learn	basic	know	skill	Attitude
emotion	1.000														
environment	.717	1.000													
intelligence	.323	.291	1.000												
team	.233	.210	.095	1.000											
manage	.250	.225	.101	.735	1.000										
communicate	.124	.111	.050	.365	.390	1.000									
ethic	.378	.340	.153	.249	.266	.132	1.000								
cooperate	.440	.396	.179	.290	.310	.154	.663	1.000							
response	.452	.407	.184	.298	.319	.158	.681	.793	1.000						
lead	.439	.395	.178	.290	.310	.154	.661	.770	.791	1.000					
learn	.432	.389	.175	.285	.305	.151	.651	.758	.779	.756	1.000				
basic	.373	.336	.152	.246	.263	.131	.563	.655	.673	.654	.644	1.000			
Know	.289	.261	.118	-.027	-.029	-.014	.000	.000	.000	.000	.000	.000	1.000		
skill	.285	.257	.116	-.026	-.028	-.014	.000	.000	.000	.000	.000	.000	.789	1.000	
attitude	.159	.143	.065	-.015	-.016	-.008	.000	.000	.000	.000	.000	.000	.441	.434	1.000

Structural Equation Model Analysis

A structural equation model and all the variables that affect Thai engineers' readiness after the final model modification is demonstrated in Figure 2. The analysis of variables that affect Thai engineers (after adjustment of the model) is found to be consistent with empirical evidence as shown in Figure 2. The statistical data of the SEM model for engineers' AEC work readiness was $X^2 = 64.239$, df =50, p = 0.085, CMIN/DF = 1.285, GFI = 0.971, RMSEA =0 .030. The SEM is found to be consistent with the collected empirical data. The mutual predication could be done from Thai engineers' competency, needs, and gap = 51% (Figure 2). We compared work from various scholars to obtain goodness-of-fit criteria which is shown in Table 10. Please note that AMOS 21 reports the value of chi-square as CMIN. Figure 2 and Table 11 show the hypotheses results.

According to Hooper, Coughlan, and Mullen (2008), items with low multiple R^2 (less than 0.20) have been removed from the analysis as this is an indication of very high levels of error. This is confirmed by Hair et al. (2013) which indicated that R^2 values should be higher than 0.25. From Figure 2, GFI is indicated to be 0.971 which is the Goodness-of-Fit statistic (GFI). Traditionally an omnibus cut-off point of 0.90 has been recommended for the GFI (Hooper et al., 2008). Values for the AGFI also ranged between zero and one and it is generally accepted that values of 0.90 or greater (Table 10) indicate well-fitting models (Hooper et al., 2008).

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Table 12 shows the *direct effect*, *indirect effect*, and *total effect* of each construct with the sum of direct and *indirect effects* is referred to as the *total effect* (Zou & Fu, 2011; Bollen, 1987). The "p" value is the level of significance with a $p<0.05$ indicating that the probability that the result is observed due to chance is 5% (a "false positive" result). Conventionally, the *p* value of 5% ($p = 0.05$) or 1% ($p = 0.01$), which means 5% (or 1%) chance of erroneously reporting a significant effect is accepted.

Table 11 shows readiness is influenced by the direct positive recognition of need the most due to the value of 0.768. Gap also has a direct positive influence on readiness as total effect was shown to be 0.472 as well.

Table 10
Criteria and Theory of the Values of Goodness-of-Fit Appraisal

Criteria Index	Criteria	Values	Results	Supporting theory
Chi-square: $\chi 2$	(p >0.05)	0.085	passed	(Rasch, 1980; Jöreskog & Sörbom, 1996)
Relative Chi-square (AMOS: CMIN): $\chi 2$/df	≤ 3.00 ≤ 2.00	1.285	passed	(Byrne, 2010) (Byrne, 2010)
Goodness of Fit Index: (GFI)	≥ 0.90	0.971	passed	(Hair et al., 2010; Jöreskog & Sörbom, 1996)
Pearson Product-Moment Correlation Coefficient (PPMCC)	+1	+1 to –1	passed	(Cohen, 1988)
Root Mean Square Error of Approximation: (RMSEA)	≤ 0.08 ≤ 0.07 ≤ 0.06	0.030	passed	(MacCallum, Browne, & Sugawara, 1996) (Steiger, 2007) (Hu & Bentler, 1999)
Cronbach's Alpha	≥ 0.70	0.958	passed	(Hair et al., 2013; Tavakol, & Dennick, 2011; George & Mallery, 2010;; Cronbach, 1951)

Table 11

Relative Influence of Items (Unstandardized Regression Weights) Used to Access Thai Engineering Readiness (N=412) Results After Adjusting the Model

Correlating Variables Path	Estimate	S.E.	C.R.	*p*-value	Results
H1: Competency has a direct and significant influence on readiness.	0.163	0.031	5.256	$p < 0.001$	supported
H2: Competency has an indirect and positive effect on readiness through gap.	0.172	0.033	5.175	$p < 0.001$	supported
H3: Need has a direct and positive influence on gap.	0.472	0.094	5.033	$p < 0.001$	supported
H4: Need has a direct and positive influence on readiness.	0.768	0.093	8.272	$p < 0.05$	supported
H5: Gap has a direct and positive influence on readiness.	0.113	0.059	1.97	$p < 0.05$	supported

Note. Critical ratios (t-values) more than 1.96 are significant at the 0.05 level. S.E. = standard error, CR = critical ratio (t-value).

Table 12

Direct Effect (DE), Indirect Effect (IE), and Total Effect (TE) of the SEM Analysis

			Antecedents		
Dependent Variables		R^2	Gap	Competency	Need
Readiness	DE	0.51	0.113	0.163	0.768
	IE		0.000	-0.002	0.053
	TE		0.113	-0.183	0.821
Gap	DE	0.12	0.000	0.172	0.472
	IE		0.000	0.000	0.000
	TE		0.000	0.172	0.472

Note. DE=direct effect, IE=indirect, TE=total effect.

Discussion

Trade in services is one of the core fundamentals in ASEAN economic integration (ASEAN, 2015), and despite the increasing significance of MRAs in trade policy for the service sector, scholarly knowledge of MRAs is however limited (Hamanaka & Jusoh, 2016). Specifically, the ASEAN MRA on Engineering Services, which aims to faciliate the mobility of engineering service professionals, as well as the the exchange of information to promote the adoption of best practives on standards and qualificatins (Fukunaga, 2015) has been of very limited success (Pruksacholavit, 2014; Hamanaka & Jusoh, 2016). Actually, MRA provisions do not provide many incentives to encourage mobility among other skilled workers who still reside in their home country (Pruksacholavit, 2014), which was consistent with the results from this research as well.

Competency

For this study competency was selected as a latent variable contributing to the a Thai engineer's ability to participate in a foreign engineering project. According to Hamanaka and Jusoh (2016), there needs to be importance placed on the differentiation between qualifications and licenses; as in ASEAN, there is no consensus about the exact meaning of these terms. Usually however, in order to obtain a license, qualifications are usually required. Competency is therefore viewed as both having a license which is supposedly obtained from "qualifications."

This was confirmed in the study's results, as competency was determined to have had a direct (0.16) and positive affect ($p<0.001$) on readiness, which supports hypothesis H1. Furthermore, competency was shown to have an indirect, but positive effect on readiness through gap (H2), which is supported by research from Barrington, Casner-Lotto, and Wright (2006), which indicated that competency is the ability to use knowledge, facts, and data to solve workplace problems, as well as being able to apply math and science concepts to problem solving.

In research from Rugarcia, Felder, Woods, and Stice (2000), concerning their vision for engineering education, it was strongly suggested that traditional instructional methods will probably not be adequate to equip engineering graduates with the knowledge, skills, and attitudes they will need in coming decades, although alternative methods (e.g., team based and discovery learning) have good prospects to do so.

Need

Jeffryes and Lafferty (2012) investigated the needs of engineering co-op students and determined that all respondents indicated having to find some sort of information during their work placement, with industry standards and books having a particularly high usage. This is consistent with NASA's Technology Readiness Level (TRL) (Fedkin, 2015; Mankins, 2002), which requires a high level of professional capability to search out the most recent information from a multitude of sources concerning the characteristics of new systems, prototypes, and competition, as well as understanding and justifying the economic viability of the project. Davis et al. (2006) further confirmed the study's results by concluding that engineers in their careers required information retrieval and evaluation skills.

Need was thus strongly confirmed as a direct and positive influence (0.47) on gap (H3), which was supported by yet a larger survey of 606 US organizations (Barrington et al., 2006), from which seven career readiness competencies were identified as absolutely essential (Table 13). At the top of the list was "professionalism/work ethic" with an overwhelming 97.5%, indicating this was a key element to readiness.

Additionally, the study's results were supported by NACE (2015), which indicated that 80% considered leadership skills as greatest factor in hiring one candidate over another. NACE's (2015) study indicating "teamwork" was the most important factor (with a score of 75%) also supports the research's findings and further supports hypothesis H3.

Table 13
Essential Career Readiness Competencies

Competency	Percent of Respondents
Professionalism/Work Ethic	97.5 percent
Critical Thinking/Problem Solving	96.3 percent
Oral/Written Communications	91.6 percent
Teamwork/Collaboration	90.0 percent
Information Technology Application	72.0 percent
Leadership	55.9 percent
Career Management	45.0 percent

Source. NACE, 2015

Need also has a direct and positive influence on Readiness (H4) ($p<.001$), which was confirmed by a positive direct effect of 0.77. And once again, NACE's study supports the hypotheses as career management was identified as one of the seven essential prerequisites for career readiness by the 606 survey participants with a score of 45% (NACE, 2016).

Gap

World Bank's (2014) research identified job related technical skills gaps which included cognitive skills, such as problem solving and critical thinking, and core skills such as teamwork and communication. More recently, the Institution of Engineering and Technology's (IET, 2015) annual survey of UK employers of engineering and IT staff indicated that more than half of employers surveyed say that recruits do not reach the expected standard and nearly two thirds think skills gaps are a threat to their business. This research supports the study's conclusion that *gap* has a direct and positive influence on readiness (H5), which is primarily due to gap's two observed variables (management and teamwork), which were found to be key factors on gap's positive and direct influence on readiness.

This was once again supported by the NACE (2016) study in which teamwork/collaboration was identified by 90% of the survey participants as being a key component of career readiness (Table 13). Malaysian managers also ranked as highest (55.7%) in the ability to function effectively as an individual, and in a group with the capacity to be a leader or manager as well as an effective team member as the most important aspect to graduate readiness (Zaharin, 2009).

Readiness

Cheerakarn (2012) verified engineering readiness with innovation, leadership, flexibility, motivation, and building relationships as important components. These talents however are just the beginning of what becomes a long and difficult process to become an engineer qualified to work in a foreign country, as even though a Thai engineer has obtained a university diploma in an engineering discipline, gained on-site, field experience on major projects, and become a licensed ASEAN engineer by the Thai Council of Engineers, that individual is still not "ready" to work outside Thailand within ASEAN.

This is a fact supported by this study in which less that 1% had obtained the required ACPE/APEC license which then leads to becoming a Registered Foreign Professional Engineer (RFPE) in the host country. The RFPE is defined in the MRA on Engineering Services (Art 2.13) as an APEC who has successfully applied to and is authorized by the host country to work. Only after registration as an ACPE/APEC is it possible to be a RFPE (Hamanaka & Jusoh, 2016).

Conclusion

Mobility of service providers within the Southeast Asian region was not part of the original declaration; however, it has become an important aspect of regional economic integration with the adoption of the AFAS and then later with the initiative to conclude an agreement on MNP (Jurje & Lavenex, 2015). Mobility of skilled labor within ASEAN is also promoted through the so-called Mutual Recognition Arrangements (MRAs) of professional services.

This study however identified some glaring inadequacies related to Thai engineer readiness in working within other AEC member countries on engineering projects. One major reason is because the national legal systems (which are not compatible with the mobility policies) discourage skilled worker migration because of barriers such as lack of recognition of qualifications, insufficient information provided for workers, and the nature of the social structure (Pruksacholavit, 2014).

Follow-up study is recommended which explores the specific experience of Thai engineers and if they meet the very specific criteria established by the 2005 MRA (ASEAN, 2005) in which individuals must "be in responsible charge of significant engineering work for engineers" for two years (APEC, 2017). Furthermore, research is needed to establish how much culture (and language) plays a role in ASEAN engineering projects, and to what level Thai engineers have the necessary language skills to manage foreign workers, as it is the managers that the ASEAN MRA is actually written for. Government agencies are also recommended to promote Thai industrial companies to support more training of engineers to increase their competency and needs of engineers (Rugarcia et al., 2000). In addition, industrial companies in Thailand need to reduce the engineers' competency gap by use of collaborative management and teamwork so that their competency and needs can be improved. Co-op programs in which days are spent in learning skills on the job while also studying theory in a university environment is heavily supported by this research and global employer surveys.

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