An exploratory study of digital workforce competency in Thailand

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A R T I C L E   I N F O

A B S T R A C T

Industry 4.0 and the digital age have dramatically influenced both information technology (IT) job characteristics and IT labor demand. Leaders in higher education must keep up with the situation and accelerate plans to produce graduates with the quality and preparation required to meet industry needs. But based on the existing demand gap, universities are eager to first know which skills the IT-related industries expect from new digital workers. This study, conducted in Thailand, explores the competency of the digital workforce, an issue that was identified as vital to the 2017–2021 national agenda. The research project was divided into two steps. Phase one was to study and identify essential competencies for the digital workforce by first reviewing the literature, then verifying these results through qualitative methodology. Thirty IT experts in IT and related industries were invited to interview sessions. Eventually, after content analysis, 24 competencies were presented. Phase two was to survey the competency expectations of IT experts by using the initial questions generated by Phase One's outcome. 260 questionnaires were analyzed. Exploratory factor analysis (EFA) was selected to cluster the digital workforce competencies that were found. Three significant categories were selected based on Eigenvalue, and the average results of demand were explained. Industries had most expected competencies in the Professional skills and IT knowledge category, followed by the IT technical category and IT management and support category. The top five competencies desired were lifelong learning, personal attitude, teamwork, dependability, and IT foundations. However, there were some slightly different requirements between the IT industry and IT in non-IT industries. The results presented a new perspective that is very useful to Thailand. The academic sector can use these results to shape IT curriculum in order to effectively respond to real demand. In addition, recent graduates or graduating students can study these conclusions and better prepare themselves for future jobs.

1. Introduction

Our world is now in a fourth industrial revolution, and knowledge has increased in worth and become easier to access (Baller et al., 2016). The changes in consumer consumption and the rapid growth of technology have influenced the evolution of business (Buhalis and Amaranggana, 2013; Labrecque et al., 2013; Ritzer and Jurgenson, 2010). We can see new business models in various sectors. For example, in the travel and tourism industry, Airbnb[1] uses a concept of sharing accommodations to provide income to owners and increased choices to customers, and Grab[2] has entered the transportation business with its idea of ride sharing. New business evolutions have made jobs more flexible. These changes directly affect the career characteristics of IT workforces (Gretzel et al., 2015; Leahy and Wilson, 2014).

For workers to be competitive and desired by employers in this job market (Batra, 2010; Lin et al., 2012), the ability to deal with new situations or changing circumstances is required (Brookshire et al., 2007). But nowadays, recent graduates in particular are frequently not qualified. There are numerous studies discussing which skills, other than academic knowledge, make one ready for employment (Barrie, 2004; Breivik, 2005; Callanan and Benzing, 2004; Finch et al., 2013; Gault et al., 2010; Jane and Higson, 2008; Laker and Powell, 2011; Lievens and Sackett, 2012; Md Saad et al., 2013; Redish and Smith, 2008).

To be competitive, new graduates who do not have employment experience have to increase their skills and abilities. It is their responsibility to develop their competence. Nowadays, anyone can easily find many resources to help them improve themselves (López-Bassols, 2002). But it cannot be denied that academia is also responsible for

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educating and training students to get them ready for employment (Brennan et al., 2004; Raymond et al., 1993).

Understanding this, Thailand universities are keenly aware of the changes occurring in the digital age, and try to meet their core function of producing quality workers for industry. Recently, the country has announced national policies regarding the digital economy, and plans are accelerating (Pooparadai, 2016; MICT, 2016). Similar to other countries, Thailand needs a quality digital workforce to support business growth and innovation (Asliturk et al., 2016; Song and Tang, 2016; Ziemann, 2017). The term 'digital workforce' is not clearly defined. However, the studies of Atkinson and McKay (2007) and Lamsfus et al. (2015) interpret 'digital workforce' as people who have a set of IT competencies. In particular, these include understanding and integrating digital knowledge, skills, and technology to do critical tasks and achieve the organizational goals within a digital economy environment. Obviously, digital workforce skills need to be very modern and adaptable to the digital age; preparing students after graduation may be too late.

Empirical studies of competency gaps in IT students in Thailand found a continued mismatch between industry demands and the abilities of the graduates (Siddoo et al., 2017). A survey conducted by the Thailand National Statistical Office[3] from 2014 to 2016 shows the number of IT graduates, and the number of IT jobs that industries need to fill. The country had a total of 130,723 IT graduates in 2014, 108,444 in 2015, and 149,369 in 2016. However, there is still a huge demand for IT labor. In 2014, 16,837 new IT staff were still required, followed by 13,169 in 2015 and 17,674 in 2016. This labor shortage was caused by such factors as changes in the workplace or in higher level education. However, the main concern noted in the report was its finding that new graduates' skills are insufficient for employment. Therefore, the question of which competencies industries need, and how to produce digital workers who match these industry requirements, is still unanswered and becoming increasingly important in Thailand (Song and Tang, 2016).

This research focuses on the contributions of research on digital workforce competency, and how their findings reflect the employability of IT students within related industries in Thailand. An exploratory study of which competencies are required was constructed. Noted the term IT in IT industry covers any organizations who employ IT jobs such as software house companies or hardware and network companies, and the term IT in non-IT industry covers other types of companies such as financial companies or construction companies who employ IT positions. The research questions included:

RQ1: What are the individual competencies needed by the digital workforce for employability?

RQ2: Can digital workforce competencies be clustered into categories?

RQ3: What are the perceptions of the demand for digital workforce competencies?

The research methodology contains two phases. Phase 1 is a study of competencies based on the literature review, and confirms previous findings through qualitative analysis. These results were used as a conceptual framework in the second phase to survey the perceptions held by IT related industries about which competencies are required for a digital workforce. Exploratory Factor Analysis (EFA) is used to categorize the individual competencies. The research contributions are presented. Research questions, limitations, and future potential research directions are discussed.

2. Theory

The objective of higher education is for students to learn, and be able to apply their knowledge to self-development and to work (Brennan et al., 2004). Therefore, getting a job can be seen as one proof of educational success. In general, the employability of new IT graduates

depends on their skills – including both academic knowledge and other more practical skills required for work (Vyver, 2009). As mentioned above, the digital workforce is required to have many skills to achieve success in their careers. 'Employability' is the popular term referring to the capacity of a person to get a job.

Employability is mentioned and defined in various ways. For example, the Cambridge dictionary defines employability as "the skills and abilities that allow you to be employed" (www.dictionary.cambridge.org). Hillage and Pollard (1998) define and discuss employability competency as the ability to gain employment, maintain employment, and get new employment. Forrier and Sels (2003) describe employability as "an individual's chance of a job in the internal and/or external labor market". Yorke (2004) clarified the definition of employability as skills, understandings, and personal characteristics that are beneficial to oneself, one's organization, community and economy, and sets of competencies that will help graduates to gain job opportunities and to succeed.

Although there are some differences between the definitions of 'employability', there is agreement on the essence of the word, the abilities that one needs to be employed and work effectively. The competencies essential for new IT graduates to acquire have been presented in many forms, such as the IT competency models (ETA, 2016; ITPA, 2015; SFIA Foundation, 2015; Tippins and Sohi, 2003), and the set of employability skills (Barrie, 2004; DEST et al, 2002; Finch et al., 2013; G. K. Singh and Singh, 2008; Md Saad et al., 2013; Radermacher and Walia, 2013).

2.1. IT competency models

Tippins and Sohi (2003) have examined various business factors, including market situations, policies and strategies, information technology and trends. They constructed an IT competency concept that is composed of three categories. The objective of this model was to show how IT could help businesses to succeed. The model components included *IT knowledge*, *IT operations*, and *IT objects*. *IT knowledge* relates to cognition from experience, including the whole working process, especially technical knowledge. Technical knowledge is the knowledge and ability to use IT with various techniques to solve problems and achieve goals, for example, learning and using computer systems. *IT operation* includes the competencies needed to apply IT knowledge for successful applications and the completion of company strategies. *IT object* describes the tools or techniques of particular hardware or software that help run a business properly. In addition, IT object includes the IT support staff who assisted with the system.

SFIA Foundation (2015) proposed an IT framework called the 'Skills Framework for The Information Age' (SFIA). SFIA was constructed with the cooperation of many IT-related people and working groups. The objective of this framework was to present the skills required for an IT career by using clearly communicated language. They stated that IT capability consisted of behavioral skills, knowledge, and professional skills. The six main skill groups included *Strategy and Architecture*, *Change and Transformation*, *Development and Implementation*, *Delivery and Operation*, *Skills and Quality*, and *Relationships and Engagement*.

The group of *Strategy and Architecture* included information, business, and technical strategies, such as the ability to consult and recommend a team by thinking about information and business risk management. *Change and Transformation* paid attention to business change implementation and management. The skills of portfolio, project and change management were considered important, along with business analysis and requirement creation. *Development and Implementation* of technical skills, such as system development, was mentioned. In addition, the concept of good design, with consideration of user's requirements, was key to implementation. As part of the system installation and integration, an understanding of the existing platform and proper implementation were considered as key abilities. *Delivery and Operation* associated service design, service transition and service operations. These group competencies were concerned with how to deliver

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[3] Thailand National Statistical Office (www.nso.go.th).

the product, how to configure production work and how to achieve the target. Skills in standard delivery processes and troubleshooting were also part of this group. *Skills and Quality* concerned the skills of personal learning that result in the working goal. Managing self-development, assessing learning qualities, designing and developing media for learning or support and doing systematic presentations for the team or customers were all considered to be in this group. The model recommended that IT professionals should also identify appropriate learning resources for development. *Relationship and Engagement* dealt with stakeholder management and sales skills. Customer management, digital marketing techniques and approaches to dealing with and supporting customers were also covered.

The Information Technology Promotion Agency: IPA (2015) promoted a skills framework called the 'i Competence Dictionary' (iCD). The iCD was created to support organizational recruitment and career development. The framework consisted of a task dictionary and a skills dictionary. Using this model, organizations or individuals had to apply their skills to completion of the working tasks. Skills were categorized into five groups: *Technology, Methodology, Related Knowledge, IT Human Skills* and *Specific Skills. Technology* skills included the various IT-related techniques used to complete IT-related tasks. Technology skills were comprised of basic IT knowledge, and familiarity with computer and technology systems, development management, maintenance and operations, embedded measurements and control, and non-functional regulations. *Methodology* skills focused on management activity for IT processes. Methods included strategies, planning, implementation, utilization, and support. *Related Knowledge* referred to the knowledge of business and industry. Skills in this group included knowledge of business industry, corporate activities, regulation bases and standards. *IT Human Skills* was the ability to create, implement and communicate with organizations or teams to achieve goals such as creativity, execution and practice, and communication. *Specific Skills* were dependent upon the task being done or the career.

Employment and Training Administration: ETA (2016) published the Information Technology Competency Model with the objective of career development. The model was drawn in three main layer competencies: foundations, specific, and upper-tier or occupation. The foundations competency combined *Personal Effectiveness, Academic,* and *Workplace.* Specific categories contained *Industry-Wide Technical* and *Industry-Sector Technical.* Upper-tier competencies were skills, knowledge and abilities related to specific IT occupations. *Personal Effectiveness* was the set of life skills, including soft skills. It included the person's capabilities to work as part of a team. Skills included interpersonal, which was a positive outlook and compatibility with others. Additional features of effectiveness within groups included being professional and creative, being able to cope with change, and being responsible, trustworthy and diligent. *Academic* derived from curriculum outcomes and education. The competencies included knowledge of subjects such English language abilities including reading and writing, mathematical and science skills, and basic IT skills. Communication and critical thinking were also mentioned. *Workplace* was the set of skills that an IT professional should have in order to get started and work with colleagues in the real world. The group consisted of six competencies: teamwork, planning and organizing, innovative thinking, problem solving, working with technology tools, and knowledge of business. The model proposed that IT professionals should integrate tools and technology with business knowledge to work with teams to solve problems. *Industry-Wide* related to the technical competencies that IT people used to solve problems within a daily working routine. These competencies were described as essential for IT work. The components combined general IT, database, networks, software development, customer support, digital presentations, compliance, and risk management. Industry-Sector and Specific skills focused on in-depth competencies that dealt with a specific industry, with the details still under construction.

2.2. Employability skills

The Australian Department of Education, Science and Training, the Australian Chamber of Commerce and Industry and the Business Council of Australia announced employability skills for their citizens (DEST et al., 2002). The set of these competencies can be applied to various occupations within particular IT industries. There were a total of twenty-one skills within two main groups: key skills and personal attributes. Barrie (2004) mentioned a generic graduate in his study. The components combined broad key competencies in five groups: research and inquiry abilities, information literacy knowledge, personal autonomy, ethical behavior, social and professional behavior, and communication skills. G. K. Singh and Singh (2008) proposed critical competencies for new graduates, including skills in communication, the English language, ICT proficiency, interpersonal abilities, teamwork, leadership, problem solving, adaptability, risk management, creativity and personal planning and time management. Graduate employability skills were again discussed as a set of essential skills, not including academic knowledge, by Finch et al. (2013). This study explored employer requirements, and proposed new graduate employability skills that combined seventeen competencies within five categories. The categories were soft skills, problem solving skills, functional skills, pre-graduate experience, and academic performance. Similarly, a study by Md Saad et al. (2013) argued that academic knowledge was not enough for a new graduate to work in the industry. They finally presented thirteen employability skills with the idea that organizations also considered non-technical skills such as communication or management when they hired new employees. Knowledge deficiencies had also been mentioned by Radermacher and Walia (2013). They explored sixteen deficiencies in the knowledge that the industry required from graduate IT students. These skills, knowledge and abilities included soft-skills, for example, teamwork, critical thinking and technical skills such as programming, database proficiency, and the ability to apply software tools.

3. Methodology

3.1. Phase 1 - Initializing a conceptual framework

The objective of Phase 1 was to answer the research question "*What are the individual competencies needed by the digital workforce for employability?*" A list of competencies was drawn from existing IT competencies, employability skills and various discussions related to digital workers, then redundant and similar terms were deleted. Twenty-four competencies were identified. Subsequently, qualitative analysis was used to verify and confirm the competency list.

3.1.1. Population and sample

The population was organizations in Thailand who employ IT-related specialists. Research used a formal list of companies from the cooperation of IT organizations with three universities. There were 289 organizations who work with universities. The sampling process was done within two stages. Samples were first selected from formal lists of organizations in the Thailand Work Integrated Learning Units, focusing on organizations who employ IT-related specialists and are still in operation. Secondly, the samples were required to be IT experts with more than five years' employment, and experience in training new IT staff or students. Follow Malterud et al. (2016) and Mason (2010) suggestions, the 30 sample size was suitable for conducting the interview. Convenient sample selection method was used. All samples were IT experts with both technical and management skills. Therefore, the qualitative results were assured to reflect a wide range of competency recommendations. Table 1 shows the IT experts' profiles.

3.1.2. Instrument and reliability

As the goal is to explore the competencies essential for a digital workforce, the research questions focus on the trends of digital worker

Table 1
List of interviewees.

Participant	Position	Industry type	IT experience	Mentoring experience with (New staff/IT student)
Participant 1	IT Manager	IT	17	Y/N
Participant 2	Senior System Administrator	IT	17	Y/N
Participant 3	Senior IT Staff	Non-IT	20	Y/Y
Participant 4	Senior System Analyst	IT	10	Y/Y
Participant 5	IT Manager/Founder	IT	15	Y/Y
Participant 6	IT Manager	IT	20	Y/Y
Participant 7	System Engineer	IT	10	Y/Y
Participant 8	Senior Programmer	IT	10	Y/Y
Participant 9	Senior System Administrator	Non-IT	17	Y/N
Participant 10	Senior Programmer	Non-IT	10	N/Y
Participant 11	Assistant Vice President	Non-IT	20	Y/N
Participant 12	IT Specialist	IT	18	Y/N
Participant 13	IT Specialist	IT	18	Y/N
Participant 14	IT Project Manager	IT	20	Y/Y
Participant 15	Senior Graphic Designer	IT	12	Y/Y
Participant 16	Project Manager	IT	12	Y/Y
Participant 17	Computer Technical Officer(expertise)	Non-IT	20	Y/Y
Participant 18	Chief of Board of Directors Section	Non-IT	20	Y/Y
Participant 19	Senior System Analyst	IT	20	Y/Y
Participant 20	IT manager	IT	8	Y/Y
Participant 21	Software Engineer	Non-IT	15	Y/N
Participant 22	Senior System Analyst	Non-IT	18	Y/Y
Participant 23	Senior System Analyst	Non-IT	17	Y/N
Participant 24	Senior System Analyst	Non-IT	17	Y/Y
Participant 25	IT Technical and Sale Engineer	IT	17	Y/N
Participant 26	IT Manager	Non-IT	17	Y/Y
Participant 27	Founder	IT	20	Y/Y
Participant 28	IT manager	Non-IT	21	Y/Y
Participant 29	Senior Tester	Non-IT	17	Y/N
Participant 30	Sale Manager	IT	15	Y/N

competency demands and the skills needed from IT experts' opinion. The brief questions covered the following:

1. What are the characteristics of the IT labor force in the digital age?
2. Is the competencies list appropriate based on the previous studies of IT competency?

The construct and content validity of the questions were judged by three IT academics and three IT experts (Denscombe, 2010). The questions and the structure of the interview were both suitable. However, since the questions were open-ended, experts recommended that researchers carefully control the interview process and make sure that respondents' answers were complete. The pilot test showed that the use of IT technical terms improved the understanding of IT experts because they helped avoid ambiguity. Overall, the results were exceptional and were consistent with question objectives.

3.1.3. Data collection and analysis

The emails asking for collaboration and detailing the interview questions' guidelines were sent in advance. After getting subject authorizations, the interview process was started. The semi-structured interviews were individually arranged, and lasted between one and two hours. Both face-to-face and telephone interviews were used. Each interview script was recorded and transcribed. To avoid misunderstandings, researchers sent the meeting transcripts to each participant so they could confirm the details.

Content analysis was used to identify themes and categories (Hsieh and Shannon, 2005). Two researchers were involved in coding and analyzing the interview scripts to prevent misunderstandings. With clear interview questions and an understanding of the research purpose, the results of the two researcher's analyses are similar. The identification of themes and the coding of categories were done manually because of the small number of participants and the limited budget for content analysis software. However, the results are credible based on the researchers '

knowledge and their experience in working with the industry.

3.1.4. Results

Although interviewees represented various industries with different company sizes and positions, they had similar IT-related jobs and experience, and their perceptions of digital workforce competency was almost the same. Their expert opinions can be divided into two categories: *the practical implementation of IT competency* and *competencies for a digital workforce*. In the first category, expert comments related to details of the competencies which may be difficult for new graduates to acquire. Overall digital workforce competencies must not be complicated, and must be easy to understand by Thai organizations which have just started to develop their digital policy plans. By expert view the core competencies were sufficient for IT jobs. The skills should not be too subdivided because it was difficult to implement. The second category included the details of the competencies. The researchers compared the themes to 24 competencies mentioned in the literature. Many of the viewpoints expressed by IT experts were very useful. For example, they stated that mobile-related competencies should be separated from software application competencies, because in this digital era, the development of mobile applications and software applications relies on different methods and techniques. Moreover, actual job advertisements for software and mobile positions require different qualifications, knowledge and abilities. The competencies needed for general communication and for digital communication may differ depending on meaning. As a result, these two competencies were separated, listed with different names and purposes. Management skills such as planning, organizing, and other project control tasks were grouped under project management competencies; this will be clearer for new graduates. As a result, the individual competencies discussed by the experts were described and analyzed. The competencies mentioned in the qualitative interview results are compared with literature review showing in Table 2. The competency details are described in Table 3.

Table 2

A comparison of digital workforce competency between qualitative study and literature review.

Digital workforce competency	Qualitative results	A	B	C	D	E	F	G	H	I	J
Adaptability	x	x			x	x					x
Basic IT for works	x	x	x				x	x	x	x	x
Business foundations	x								x	x	x
Critical thinking	x				x	x	x				x
Database	x							x	x	x	x
Dependability	x	x									x
Digital communication	x				x						
Digital marketing	x								x		
English for IT	x				x	x					
General communication	x	x		x	x	x	x	x	x	x	x
Hardware/Network	x		x						x	x	x
Innovative	x	x			x	x				x	x
IT foundations	x		x	x	x		x		x	x	x
IT Law and ethics	x	x		x				x	x	x	
IT risk management	x				x				x	x	x
IT support	x		x						x	x	x
Lifelong learning	x	x					x				x
Math and science	x						x			x	x
Mobile technology and application	x									x	
Personal attitude	x	x			x	x		x			x
Problem solving	x	x			x	x	x	x		x	x
Project management	x	x			x			x	x	x	
Software application	x		x			x		x	x	x	x
Teamwork	x	x			x		x	x			x

Note: A: DEST et al. (2002); B: Tippins and Sohi (2003); C: Barrie (2004); D: G. K. Singh and Singh (2008); E: Finch et al. (2013); F: Md Saad et al. (2013); G: Radermacher and Walia (2013); H: SFIA (2015); I: ITPA (2015); J: ETA (2016).

3.2. Phase 2 an examination of digital workforce competency demand

Phase 2 uses the perspective of experienced IT experts to understand which digital workforce abilities are needed. The 24 competencies listed, first identified in Phase 1, were used in a survey model to gain real industry perceptions. To answer the research question 2 *"Can individual competencies be clustered into categories?"* an exploratory factor analysis (EFA) was used to examine the relationship between competencies, and to test whether individual competencies can be clustered into groups (Williams et al., 2010). In research question 3 *"What are the perceptions of the demand for digital workforce competencies?"* descriptive statistics (mean and standard deviation) were used to present the IT industry's view.

3.2.1. Population and sample

The population were IT experts who work in IT industries and in non-IT industries. The list of IT experts was from two sources: Thailand work integrated learning units, and Thailand Digital Economy Promotion Agency. There were a total of 389 IT experts found. A purposive sampling method was used. The samples were only those with IT experience who have served as mentors to new IT staff or to IT students. The IT experts were asked about their qualifications before answering the questionnaires.

3.2.2. Instrument and reliability

The research instrument was a questionnaire composed of two main sections. The first was the IT workers' demographic data, and the second addressed competency demand levels. The first section asked about gender, age, graduate qualifications, study major, IT experience, career group and mentor experience. In the second section, a questionnaire including the 24 competencies and five demand levels was created. The items used a 5-point Likert scale, with each competency rated at a level of 1 (low), 2 (basic), 3 (intermediate), 4 (high), or 5 (advanced). The respondents had to specify, based on their professions, what they demanded of new graduates they expected to work with. The construct and content of the questionnaire, and its validity, were analyzed by the same group of experts that had participated in Phase 1 (Denscombe, 2010). No major changes were suggested, the only improvements proposed were modifications to the language and questionnaire objectives.

Subsequently, questionnaires were piloted by organizations included in a list from a previous study (Siddoo et al., 2017). The coefficient alpha statistics were calculated to assess the reliability of the questionnaire set (Cronbach, 1951). Cronbach's α of each question was above 0.9, and the entire test had an alpha of 0.954. This value indicated that it was acceptable to use the research instrument for a survey (Tavakol and Dennick, 2011).

3.2.3. Data collection and analysis

The survey was conducted between 2 January 2018 and 10 February 2018 using offline interviews and online questionnaires through emails. Each IT expert was asked to complete the demographic questions, and using their IT experience, mark their expectations of IT graduates' competency levels. After elimination of incomplete results, the total was 260 respondents

In the analysis process, the research followed the five steps of EFA protocol (Williams et al., 2010). According to Hair et al. (1995), sample sizes should be over 100 for factor analysis. Comrey and Lee's study (1973) supported the conclusion that sample sizes over 200 are acceptable. Therefore, this research sample size was suitable for a factor analysis. The correlation matrix (Tabachnick and Fidell, 2006), Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (Kaiser, 1974) and Bartlett's Test of Sphericity (Bartlett, 1950) were tested for the data relevant to factor analysis.

The correlation coefficient returns a positive value of >0.30 between each competency, and signifies a typical relationship (Hair et al., 1995). The Bartlett's Test of Sphericity was significant ($\chi2 = 4056.47, df = 276, p < .001$), thus the correlation matrix among 24 competencies was not an identity matrix (Hair et al., 1995; Tabachnick and Fidell, 2006). Meanwhile, the KMO index reached a value of 0.945 that shows the suitability of the sample data (Hair et al., 1995; Tabachnick and Fidell, 2006). Three measures indicated that the survey data were appropriate for factor analysis.

On the extraction methodology process, Principal Component Analysis was performed and followed by varimax rotation execution to restructure the uncorrelated factor (Pett et al., 2003). Varimax rotated factor results are presented in Table 4 along with data interpretation. At the end of the results section, the demand perception level by descriptive statistic is shown.

Table 3

Individual competency details.

Competency/Interview support	Description
Adaptability (24/30)	The ability to recognize problems, modify methods for solving problems and demonstrate flexibility (Precision Consultancy, 2006). Adaptability is crucial in the digital age because the rate of change in technology and the environment is accelerating rapidly and directly affects jobs; new graduates who can adapt to any situation will be employable (Bernie Trilling, 2012; Rainsbury et al., 2002).
Basic IT for works (30/30)	The ability to realize and use IT-based tools to seek information, and support the task (Gressgård et al., 2014) and to adopt intimate ICT technical skills to work efficiently and successfully (Md Saad et al., 2013). New graduates who apply IT to help improve company productivity can increase their career path growth (Prabhakar et al., 2005).
Business foundations (13/30)	The ability to understand business processes, accounting, finance, marketing, or economic situations pointed out by employers (Bassellier and Benbasat, 2004; Nord and Nord, 1995) and to apply technical knowledge plus business knowledge to collaborate with customers (Bassellier and Benbasat, 2004). The demand for business skills has increased significantly in the IT professions (Hardin et al., 2002) and they are essential for business negotiations (Liu and Hai, 2005).
Critical thinking (30/30)	The ability to gather skills, knowledge, and tactics that are creative, rational, and effective in addressing problems (Ennis, 1985; Reid and Anderson, 2012). Critical thinking is associated with the ability to apply knowledge in a real situation and analyze problems intelligently (Aizikovitsh-Udi and Cheng, 2015).
Database (24/30)	The ability to effectively use or manage simple and complex data to help increase business strategy competitiveness (ETA, 2016; SFIA, 2015). For example, data scientists need the ability to manage huge amounts of data (Horton et al., 2015). IT workers should understand and apply in-depth database techniques such as the medias analytic technique (Gandomi and Haider, 2015) or the big data technique (Zhou et al, 2016).
Dependability (27/30)	The ability to complete one's assigned duties in a punctual fashion (DEST et al., 2002; ETA, 2016). Reliability is a significant asset in the workplace, and is a qualification sought by employers. Because high-level managers do not have time to closely follow all workers, and need time to do other things that are more beneficial to the organization, they need new graduates that they can trust (Human Resources, 2018).
Digital communication (22/30)	The ability to use digital media and technology such as the Internet, email, and social media (Deursen and Dijk, 2011; Lan, 2000) to communicate, create networks and collaborate with others. New graduates should understand online usage, and should be able to use a variety of tools such as mobile phones, tablets, computers, and online social networks to increase self-capacity and to work with teams (Ala-Mutka, 2011; Ferrari, 2012; Vuorikari et al., 2016). Includes awareness of online social etiquette (Ramsay, 2010; Vuorikari et al., 2016) and issues of information privacy (Brandtzæg et al., 2010).
Digital marketing (10/30)	The ability to deal with customers through both traditional and interactive methods (Deighton and Sorrell, 1996), along with the skills needed to use digital technologies to help increase profits and maintain customer lifecycles (SFIA Foundation, 2015; Smith, 2007). Digital marketing is becoming increasingly important in this digital age because of changing consumer behaviors (Simmons, 2008) and the advancement of technology (Brady et al., 2008). This research has included digital marketing in the digital workforce competency list because most SME companies in this case study need digital marketing knowledge and techniques (Royle and Laing, 2014) to maintain their customers and market share.
English for IT (15/30)	The ability to effectively speak, listen, read and write in English (G. K. Singh and Singh, 2008), particularly knowing the jargon of ICT. English plays an important role in both oral and written communication in Thailand and other developing countries (Wiriyachitra, 2002). Language abilities affect employability, in particular that of non-native English speaking workers (Arkoudis et al., 2009), because employees who cannot communicate in English may face obstacles to their interpersonal communication and their effectiveness (Harzing and Pudelko, 2013). Most IT job advertisements list language proficiency as a required qualification. (JobsDB, 2018; Omar et al., 2012).
General communication (30/30)	The ability to communicate with significant people, using appropriate language in the right contexts, includes being a good listener who can express opinions (ETA, 2016; Radermacher and Walia, 2013). Effective communication can increase individual, team, and organizational success (Vries et al., 2010). Excellent written and oral communication skills will give new graduates confidence and courage (Ganguly, 2017), and enable them to work smoothly with teams in the organization (Gray, 2010).
Hardware/Network (10/30)	A basic knowledge of network systems, computer connection types, various operating systems and how they work and network security (ETA, 2016; ITPA, 2015). This also includes ICT infrastructure building in the digital age (Chourabi et al., 2012), for example, the Internet of things (I. Lee and Lee, 2015). or the concept of resource sharing - such as the cloud computing service (Bhardwaj et al., 2010). It was found that one factor contributing to success within an organization is the right investments in infrastructure and system development (Garrison et al., 2012). Therefore, new graduates should realize the importance of an organization's hardware, network meaning and mechanisms.
Innovative (12/30)	The ability to arrive at innovative solutions (ETA, 2016). Because companies have to provide excellent products or services to their customers (Tushman and Nadler, 1986), innovation within an ever-changing environment is necessary. New employees with creativity are needed by employers (Carnevale et al., 1988) because good ideas can help organizations to enhance business benefits and compete with their rivals in the market (Kilgour and Koslow, 2009).
IT foundations (30/30)	The ability to understand fundamental IT concepts, systems, platforms, tools, and technologies and to manipulate hardware, software, and services - including IT applications in organizations or industries (ETA, 2016; Gorgone et al., 2006). Having a strong IT foundation can influence firms to adopt advances of IT usage, particularly in SME firms (Hashim, 2015).
IT laws and ethics (13/30)	The ability to be honest and have self-respect includes being sincere and truthful with colleagues, customers and competitors (Crane and Matten, 2016). The awareness of IT laws and ethics is a fundamental competency for IT professionals, who need to keep records confidential, and know the other rules and regulations that might affect their companies (Sulmasy, López, Horwitch, & American College of Physicians Ethics, 2017). A lack of ethics could lead to serious business problems (George, 2006).
IT risk management (17/30)	The ability to plan, identify, analyze, respond, monitor and control a project (Morris, 2001). Risk is a variable that affects projects, and may cause plans to fail (Padayachee, 2002). If an organization can effectively manage risk, it will help them to accomplish their particular IT project goals (Alhawari et al., 2012).
IT support (30/30)	The ability to cover the broad range of assistance services provided to customers and/or users (SFIA Foundation, 2015). Support tasks include solving hardware/software problems, software maintenance, preparing documents and manuals, and training users how to use computer systems (ETA, 2016; ITPA, 2015). IT professionals should have technical knowledge which they are able to convey in a way that users can easily understand (Tarafdar, 2016). New graduates who understand and can apply IT standards and management tools will help organizations to increase their business success, providing service level agreements (SLA) for software maintenance (Hassan and Khan, 2017) or using ITIL frameworks (Cater-Stee et al., 2006).
Lifelong learning (30/30)	The ability to establish learning objectives, striving to learn either by self-study or through outside training. This skill involves acquiring new knowledge, and learning approaches to tasks that help increase business efficiency and effectiveness (DEST et al., 2002; ETA, 2016; Md Saad et al., 2013). Life-long learning is a crucial issue for knowledge societies and communities (Klamma et al., 2007). Organizations expect their employees to acquire new knowledge and update their skills whenever possible (Sutherland and Crowther, 2006).
Math and science (10/30)	The ability to understand and use IT-related mathematics, scientific rules and methodology to assist with tasks and solve problems (ETA, 2016; ITPA, 2015; Partnership for 21st Century Skills, 2008). New graduates who have high-level skills in applying math and science to IT jobs are needed by the industry in the digital era (Atkinson, 2013).
Mobile technology and application (14/30)	The ability to understand the technology of mobile communications, mobile data systems, wireless fidelity, mobile operating systems and mobile application development and distribution processes (ETA, 2016; Holzer and Ondrus, 2011). New graduates should have knowledge of mobile platforms and mobile programming languages (Dalmasso et al., 2013) to create or maintain applications, because many organizations in many

(continued on next page)

Table 3 (*continued*)

Competency/Interview support	Description
	sectors use mobile apps to do business, and to sell their products and services (Neuhofer et al., 2015; Scott, 2015; Silva et al., 2015). In this research, this skill was selected because of its demand in daily life (Charland and Leroux, 2011; Goggin, 2012; Wasserman, 2010).
Personal attitude (30/30)	The characteristics of individuals who are confident, enthusiastic and happy with their work (Robles, 2012). Having a positive attitude will give individuals a positive perspective on a negative situation (Burton, 2015). Organizations need new graduates who have the right attitude (Burton, 2015).
Problem solving (30/30)	The ability to process information, think systematically and make correct decisions (ETA, 2016; Kilgour and Koslow, 2009) in both routine and unusual problems in a workplace. Problem-solving often requires critical thinking skills to assess the problem (ETA, 2016), particularly by IT workers who should generate alternative solutions that optimize profit and reduce implementation time.
Project management (16/30)	The ability to manage overall organizational plans, schedules, and performance (ITPA, 2015; Pant and Baroudi, 2008; SFIA Foundation, 2015). Because existing IT projects in the digital age are becoming more complicated, many organizations are paying attention to skill refinement for project managers and project workers (Svetlana Cicmil, 2018) to lower failure rates (Mir and Pinnington, 2014). New graduates who have project management experience (Natalie Ewin, 2017) are required.
Software application (22/30)	The ability to understand the software development life cycle, learn fundamental programming skills, to keep in touch with software tools, software development frameworks and technology and trends (ETA,2016; Finch et al., 2013; Vuorikari et al., 2016). Programmability has been studied as there has been a huge demand for it in many organizations (Geer, 2006; Westlund and Hannon, 2008), therefore new graduates are much more employable if they acquire this skill.
Teamwork (30/30)	The ability to work as part of a team, including helping one's team to achieve targets or goals (DEST et al., 2002; ETA, 2016). Teamwork is defined as group effectiveness (Carnevale et al., 1988) and is considered a skill necessary to organizations (Crebert et al., 2004; Robles, 2012). This skill can help individuals develop themselves by learning from others, and maintaining team learning contributes to organizational development as a whole (Ellis et al., 2005).

Table 4

Demographic details.

Dimension	Total sample (%) n = 260	IT in IT sector (%) n = 158	IT in Non-IT sector (%) n = 102
Gender			
Female	105 (40.38%)	58 (36.71%)	47 (46.08%)
Male	155 (59.62%)	100 (63.29%)	55 (53.92%)
Age (years)			
<25	51 (19.62%)	26 (16.46%)	25 (24.51%)
26–30	88 (33.85%)	53 (33.54%)	35 (34.31%)
31–35	50 (19.23%)	36 (22.78%)	14 (13.73%)
36–40	44 (16.92%)	27 (17.09%)	17 (16.67%)
41–45	11 (4.23%)	8 (5.06%)	3 (2.94%)
>45	16 (6.15%)	8 (5.06%)	8 (7.84%)
Graduate qualification			
High vocational	2 (0.77%)	0 (0%)	2 (1.96%)
Bachelor degree	191 (73.46%)	116 (73.42%)	75 (73.53%)
Master degree	63 (24.23%)	38 (24.05%)	25 (24.51%)
Doctoral degree	4 (1.54%)	4 (2.53%)	0 (0%)
Study major			
Engineer	41 (15.77%)	29 (18.35%)	12 (11.76%)
IT/Computer/SE	152 (58.46%)	98 (62.03%)	54 (52.94%)
Management/ Accounting	35 (13.46%)	15 (9.49%)	20 (19.61%)
Science	18 (6.92%)	9 (5.70%)	9 (8.82%)
Other	14 (5.38%)	7 (4.43%)	7 (6.86%)
IT experience (years)			
<1	17 (6.54%)	7 (4.43%)	10 (9.80%)
1–3	60 (23.08%)	38 (24.05%)	26 (25.49%)
4–6	53 (20.38%)	18 (11.39%)	7 (6.86%)
7–9	41 (15.77%)	32 (20.25%)	28 (27.45%)
10–12	25 (9.62%)	36 (22.78%)	17 (16.67%)
>12	64 (24.62%)	27 (17.09%)	14 (13.73%)
Career groups			
Digital Content/ Internet/SEO/ Marketing	29 (11.15%)	12 (7.59%)	17 (16.67%)
Hardware/Network	24 (9.23%)	15 (9.49%)	9 (8.82%)
IT Auditing/Testing/ QA	13 (5.00%)	11 (6.96%)	2 (1.96%)
MIS	80 (30.77%)	52 (32.91%)	28 (27.45%)
Programming	101 (38.85%)	63 (39.87%)	38 (37.25%)
Web Design/Graphic	13 (5.00%)	5 (3.16%)	8 (7.84%)
Mentor experience with (new staff/IT student)			
Yes/No	120 (46.15%)	74 (46.84%)	46 (45.10%)
Yes/Yes	140 (53.85%)	84 (53.16%)	56 (54.90%)

Note: n = participant numbers.

3.3. Ethics considerations

This research was approved by the program committee of College of Arts, Media and Technology, Chiang Mai University. Information of organizations was granted to be used in the study.

4. Results

4.1. Demographic

The survey shows the frequency and percentage of demographic data from participants. There are a total of 260 usable questionnaires from respondents; of these, 158 were from IT experts from the IT industry and 102 were from Non-IT industries. About 89.62% of respondents were under 40 years of age. Almost all respondents have received at least a Bachelor's degree (99.23%) and over 50% have graduated with an IT-related major (information technology, computer science or software engineering). All questionnaire respondents have IT work experience, with over 50% having over seven years' experience. The respondents have held a variety of IT positions. Two-thirds of the respondents were from programming and management information system job groups. Over half (140) of the respondents have had experience in training IT students.

4.2. Results of factor analysis

The total variance is approximately 61.285%, and three components have an eigenvalue >1. Table 5 presents the factor analysis results and the total variance of the varimax-rotated components that are explained by each factor. The three component interpretations are *Professional skills and IT knowledge, IT management and support, and IT technical*. Competency items with a factor loading of at least 0.40 (Fornell and Larcker, 1981) are included and shown.

4.3. Result of demand perception

For the factor analysis results, the demands of digital workforce competencies were separated and shown under three main categories. Table 6 illustrates the list of competencies, mean values, standard deviations, t-test and p-values and the comparison mean results.

In summary, all IT experts had the strongest expectations of competencies in professional skills and IT knowledge, followed by IT technical, and IT management and support. The highest demand for competency was Lifelong learning at 3.85 followed by Personal attitude, Dependability, and Teamwork at 3.83, 3.79, and 3.79 respectively. The three

Table 5
Digital workforce competency categories by factor loadings.

Category prescription and competency	Factor loading
(1) Professional skills and IT knowledge Eigenvalues = 11.766, Variance = 49.025%	
Personal attitude	0.786
Dependability	0.765
Adaptability	0.754
Critical thinking	0.746
Lifelong learning	0.724
Innovative	0.666
General communication	0.636
Problem solving	0.580
Teamwork	0.571
IT foundations	0.540
Math and science	0.526
IT law and ethics	0.469
(2) IT management and support Eigenvalues = 1.922, Variance = 8.009%	
Digital marketing	0.767
IT risk management	0.741
Digital communication	0.739
IT support	0.690
Project management	0.627
Business foundations	0.619
(3) IT technical Eigenvalues = 1.020, Variance = 4.251%	
Mobile technology and application	0.791
Hardware/Network	0.778
Software application	0.632
Database	0.609
English for IT	0.514
Basic IT for work	0.511

competencies that are least needed are IT risk management, Digital marketing, and Hardware/Network at 3.05, 3.09, and 3.13 respectively.

Considering the average expectations of each IT and Non-IT competency, there were no differences in demand between the two groups. A T-test for the difference in means found that the IT and Non-IT opinions about skills were the same.

The IT sector had the highest expectation of positive attitude skills, and there were equal results for this competency in Non-IT groups ($M_{IT,Non-IT}$ = 3.83). Dependability, lifelong learning, teamwork and general communication were also required in the front line. In the same way, the demand for these skills in the Non-IT sector was relatively

similar to that of the IT sector. The non-IT sector needed the lifelong learning skill at very high level (M_{Non-IT} = 3.94), followed by teamwork, attitude, and dependability.

5. Discussion

The three research questions raised in the introduction section, and the results from Phases 1 and 2 are discussed below.

5.1. RQ1: What are the individual competencies needed by the digital workforce for employability?

Based on the literature review, and confirming the individual competencies of a digital workforce by qualitative methodology, the findings in Tables 2 and 3 illustrate twenty-four competencies and their supporting evidence.

Most explored competencies are consistent with previous studies. General communication is often talked about as being similar to the problem-solving skills mentioned in many IT models. Both an IT foundation and IT for work are featured in the IT profession, and are considered required skills. Software application proficiency is an essential competency; many IT models mention this skill because the ability to program is a fundamental requirement in almost all IT jobs. The competencies less discussed are digital marketing and digital communication, because these skills are new and have not been deeply studied.

What is interesting is there are nine competencies that were discussed by all 30 interviewees: attitude, basic IT for work, critical thinking, general communication, IT foundations, IT support, lifelong learning, problem solving, and teamwork. The interviewees commented that, for the less experienced or younger workers, organizations were expecting them to work properly in a collaborative environment, as well as having the ability to learn. All IT experts are particularly concerned with the fundamental IT knowledge needed to get started on the job, more than the more technical aspects. In addition, trustworthiness in work and flexibility regarding technology and various situations is very important. When looking at in-depth technical skills, it is found that database management skills, software application, and digital communication were mentioned by most IT experts. Experts say that in the IT profession, understanding database systems is a foundation for working. As part of

Table 6
Summarized demand level by competency and industry.

Individual competency	Associated category	All		IT in IT Sector		IT in Non-IT Sector		t	p
		M	SD	M	SD	M	SD		
Lifelong learning	Professional skills ..	3.85	0.90	3.79	0.88	3.94	0.92	−1.377	.170
Personal attitude	Professional skills ..	3.83	0.83	3.83	0.81	3.83	0.87	−.040	.968
Dependability	Professional skills ..	3.79	0.96	3.79	0.95	3.79	0.99	−.024	.981
Teamwork	Professional skills ..	3.79	0.86	3.75	0.87	3.86	0.84	−1.064	.289
IT foundations	Professional skills ..	3.76	0.81	3.78	0.79	3.74	0.86	.418	.677
General comm..	Professional skills ..	3.70	0.86	3.71	0.84	3.70	0.89	.117	.907
Adaptability	Professional skills ..	3.69	0.86	3.63	0.85	3.78	0.87	−1.382	.168
Critical thinking	Professional skills ..	3.67	0.87	3.67	0.84	3.67	0.90	−.019	.985
Innovative	Professional skills ..	3.64	0.90	3.61	0.88	3.70	0.94	−.770	.442
Basic IT for works	IT Technical	3.58	0.85	3.54	0.88	3.64	0.82	−.856	.393
Problem solving	Professional skills ..	3.55	0.85	3.58	0.84	3.49	0.86	.854	.394
IT Law and ethics	Professional skills ..	3.47	0.95	3.43	0.95	3.54	0.95	−.903	.367
Math and science	Professional skills ..	3.41	0.89	3.46	0.85	3.32	0.94	1.177	.240
Database	IT Technical	3.37	0.88	3.39	0.86	3.35	0.92	.294	.769
English for IT	IT Technical	3.34	0.82	3.40	0.80	3.25	0.84	1.487	.138
Software app..	IT Technical	3.30	0.91	3.27	0.91	3.34	0.92	−.529	.597
Project manage..	IT management and ..	3.29	0.94	3.34	0.92	3.22	0.97	1.002	.317
Digital comm..	IT management and ..	3.27	0.97	3.20	0.92	3.38	1.02	−1.469	.143
IT support	IT management and ..	3.19	0.90	3.16	0.86	3.24	0.95	−.677	.499
Mobile tech..	IT Technical	3.19	0.95	3.18	0.95	3.22	0.94	−.319	.750
Business found..	IT management and ..	3.17	0.98	3.19	1.02	3.14	0.92	.422	.673
Hardware/Network	IT Technical	3.13	0.90	3.06	0.93	3.25	0.84	−1.736	.084
Digital Marketing	IT management and ..	3.09	0.97	3.06	0.96	3.14	0.99	−.652	.515
IT risk management	IT management and ..	3.05	0.99	3.01	0.96	3.13	1.04	−.960	.338

Note: M = mean, SD = standard deviation, t = t-test value, p = p-value.

software application and development, it is a skill that the industry expects; new graduates need to know at least one programming language. To get employment, having programming competency is very advantageous. Digital communication is also a competency required by most companies. Workers argue that multiple digital communications make working easier, and in the IT profession, if one can understand and use this channel appropriately, it will help the organization achieve the desired results.

5.2. RQ2: can digital workforce competencies be clustered into categories?

The findings of the factor analysis process suggest that individual competencies can be clustered into three categories: Professional skills and IT knowledge, IT management and support, and IT Technical. Professional skills and IT knowledge accounted for most crucial factor for 49.025% of the overall total variance. Followed by IT management and support which accounted for 8.009% and IT Technical which accounted for 4.251% of total variance. The number of categories and their members are not very different from those included in previous studies in the literature review section. The results show that based on the scope, the grouping of soft skills, academic skills, hard skills, and IT skills are the same as other studies. However, looking further inside the competency details of each group demonstrated interesting results requiring further explanation.

Category 1: Professional skills and IT knowledge category details include soft skills with knowledge of both academic subjects and basic technology. In addition to soft skills, competencies in mathematics, computational ability, scientific principles, and basic IT knowledge, including law and ethics related to IT jobs are clustered into this category. The group context is different from previous research such as the study of Finch et al. (2013) that separated soft skills from foundational knowledge and functional skills, or competencies listed in the SFIA study (2015), ITPA (2015), and ETA (2016) that separately grouped soft skills, academic familiarity and IT knowledge. Phase 1 demonstrates that IT experts in Thailand are from the real industry, and they don't worry much about group meaning - whether soft skills or IT skills. They think about real situations and the way those skills are applied to training new graduates. A digital workforce should have professional soft skills and IT knowledge, and know the rules and laws important for IT work.

Category 2: The *IT management and* support category combines details of business, management, and services related to IT. This group shows evidence of IT experts' concern about the management competency of a digital workforce. IT graduates should acquire both IT expertise and management skills to understand customer needs. The details of this competency are consistent with the IT operation category study of Tippins and Sohi (2003), in that it has the same focus on customer service and management and is similar to the Japanese framework (ITPA, 2015). ITPA classifies risk management, IT support, and business in the support category, but puts project management in the implementation group. The difference in this group relates to digital marketing and digital communication competencies; these two items are very new and are not often mentioned in previous studies except for the IT competency model (ETA, 2016) and SFIA framework (SFIA Foundation, 2015).

Category 3: The *IT technical* category emphasizes IT expertise, e.g. IT technique for work, and in-depth IT skills (hardware network, software development, database, mobile related technology). The results are consistent with previous research such as Tippins and Sohi (2013), SFIA (2015), ITPA (2015), and ETA (2016). These studies show that IT specific abilities are always a focus of employers, and graduates who have IT expertise gain more opportunities for employment (Finch et al., 2013; Md Saad et al., 2013; Radermacher and Walia, 2013). One exciting result of doing factor analysis is that English for IT ability, included in this category, was usually placed into the soft skills category by other studies. The demand for language ability in IT can be explained through the qualitative interviews in Phase 1. IT workers in Thailand, where English is not a formal language, still require good language abilities to work in IT

related fields. This is similar to the study findings from Malaysia (G. K. Singh and Singh, 2008). Having English ability for IT purposes means to be able to use the language well, particularly in IT contexts.

5.3. RQ3: What are the perceptions of the demand for digital workforce competencies?

The survey results demonstrate that competencies related to soft skills and foundation knowledge in IT are most required, followed by IT technical ability and IT management capabilities. Industries concerned about a future digital workforce stated they would appreciate new graduates to have proper mindsets and systematic thinking, and be secure in IT skills related to their future careers. Lifelong learning, Personal Attitude and Dependability are competencies expected from almost all IT experts in Thailand. This is because since survey respondents were mostly IT outsourcers, and the nature of their work is so chaotic they don't have time to train new graduates or serve as a classroom teacher. Therefore, a person willing and able to learn, who is reliable in regards to completing assigned work tasks is desirable. This result was consistent with previous studies such as DEST et al. (2002), G. K. Singh and Singh (2008), and Radermacher and Walia (2013). Previous researchers mentioned these skills, e.g., learning skills, honesty and integrity, interpersonal/personal skills and their importance in getting a job.

Regarding the need for knowledge and abilities in IT, demand for an IT foundation and Basic IT for work are top-ranked industry competencies. This can be explained by the fact that organizations do not require advanced IT skills from new graduates. Most respondents in the survey focus initially on strong academic IT knowledge as a foundation for IT career development. In addition, basic IT techniques, and knowledge of various IT tools that make work easier or use tools to solve problems at work are needed. Similar to the opinion of Finch et al. (2013), organizations understand that new graduates have no experience, so it takes time to practice. This is consistent with the result of the Phase 1 research interview, showing that IT work has a learning curve. However, gaining in-depth technical and management skills are still fundamental company goals. This can be demonstrated by survey results; all 24 competencies had a demand scale above the mid-point.

Comparing the views of the IT experts in IT and non-IT industries shows that they have similar demands. Professional skills and IT knowledge are the top-ranked needs. Each competency has average values above the scale mid-point. IT technical competencies, except for database and language, are more required by the non-IT industry. This is because in non-IT organizations, the in-house IT department has less staff but still has to support the entire company. Therefore, the need for a technically skilled person to work without much training is higher than it is in an IT organization that has a lot of skilled staff able to support their customers. This also shows that skills in Lifelong learning, Digital communication and Adaptability are quite important for non-IT industries. By contrast, math and science, language abilities and project management are more required by IT industries than non-IT companies, because developing IT products and delivering services involve strength in computation as well as in project management, while most non-IT industry jobs perform customer supporting tasks that focus on implementation.

6. Conclusion

The digital age has brought about a lot of changes to professions and employment (Atkinson and McKay, 2007), especially to IT jobs within IT-related industries (Vyver, 2009). To achieve the goals of national digital policy in Thailand, to develop a digital workforce capable of meeting national and international economic needs (Pooparadai, 2016), universities should take the responsibility for preparing graduates. But until now, educational agencies were not fully aware of the needs of the industries who will hire the graduates. This research consequently explores digital workforce competencies, and their relation to IT industry

demand. Based on a literature review and supported by findings from 30 IT experts, twenty-four digital workforce competencies were presented. EFA was calculated by using quantitative data from 260 subjects.

In Thailand the competencies are categorized into three factors which are Professional skills and IT knowledge, IT management and support, and IT technical. The top-five required competencies are from Professional skills and IT knowledge. Lifelong learning, personal attitude, dependability, teamwork, and IT foundations are essential in all IT careers. Both IT in the IT sector and IT in the Non-IT sector need IT graduates who can work perfectly under various situations. However, higher education cannot deny IT technical competencies which are the core value of IT professionals in any IT careers. The demands of basic IT for work, database skills, English for IT and software application are needed. IT graduates who have the technical ability will have a lot of work advantages. However, the requirement between IT in the IT sector and the Non-IT sector has some differences in desired competencies. IT sector expected digital workforce should have personal attitude, lifelong learning, and dependability at most while IT in the Non-IT sector expected lifelong learning, teamwork, and personal attitude respectively. The Non-IT sector needed more IT technical capabilities of the digital workforce than the IT sector. At IT management and support factor, project management competency is more highly expected in the IT sector than the Non-IT sector. Digital communication and digital marketing are both important in the Non-IT sector and the IT sector.

The study findings show universities which digital workforce competencies should be focused on. The level of demand from IT experts for those competencies can help academia to design appropriate curriculum and teaching directions. In addition, graduates who plan to work in the IT field will know what the industry needs, and can prepare themselves in advance to compete in the labor market.

Noted that previous studies mentioned in the literature review may be incomplete as they were acquired from an online library with limited access, and may not cover all related digital workforce competency studies. The IT experts involved in both qualitative and quantitative studies are from various IT careers and industries. Thus, the results of the research are general, and cannot be applied to specific IT occupations or industry groups. However, researchers have planned further studies to clarify specific needs. Future research will provide an in-depth exploration of digital workforce competency using two perspectives - industry and career.

Declarations

Author contribution statement

Veeraporn Siddoo: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Jinda Sawattawee: Analyzed and interpreted the data.

Worawit Janchai: Performed the experiments.

Orawit Thinnukul: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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