THE STUDY OF REQUIRED COMPETENCE FOR ICT WORKFORCE IN THE DIGITAL TRANSFORMATION: THE CASE OF NORTHERN INDUSTRY, THAILAND

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ABSTRACT - Over the last decade, humanity has inevitably adopted Information and Communication Technology (ICT) and be transformed into digital and mobility life. ICT skill becomes to required competence for the new generation workforce. Moreover, it is a challenge for human resource development to motivate the current workers for learning digital and automation technology. To define the ICT skill qualification, the capability of personas should be analyzed circumspectly corresponding with the regions' industrial context. This paper proposes a factor structure model as an analysis methodology design for examining the ICT competence gap. Categories of skill-sets were formed to the assumption model. The structure model of required ICT competence was confirmed through the survey inquiring for the self-evaluation comparing to the result of an ICT proficiency test from the program participants. The study focuses on the case in the northern industry of Thailand, where is in the early stage of digital transformation; still, there is high demand for digital ICT competence improvement. The results reveal trends and required ICT competence that specifies the right workforce development points that align with industrial demands and expectations in the sample context.

Keywords: ICT competence; ICT workforce; Skill gap analysis; Competency trends

1. INTRODUCTION

In the transition period of industrial digitization, ICT competency constitutes an essential qualification of manpower. In the same way, digital technology has been realized as a common feature for businesses applying in several knowledge fields. Not only for organization evolution themselves, but it is also for coping with the technology disruption to the profession. This is an elaborate obligation to human resource development both in new recruitments and in-house training. The most complicated proposition is characterizing the precise and relevant skill-sets of capabilities in modern technology combined with existing organizational knowledge. Competence gap analysis and foreseeable technical trends are imperative actions.

ICT competency assessments seem to be simple under organizational control; because it is a part of education programs in academic institutions. Nevertheless, it is still an enormous variety of plenty curriculums. The efficient assessment should be designed underlying the particular expertise specification corresponding with the industry requirements. Many firms seek out a proper certificate to define the right skills qualification of employment. Recently, various ICT proficiency tests are emerging in academia and related ICT affairs. Most of them outline broad contents which cover the overview of ICT competence. Some assessments have been imposed on national ICT examinations, which are used for required ICT competence determination and workforce qualifications in the ICT industry and business services. However, the affirmation of required skill-sets, which are best suited to a specific area of the business subject, is matter for well-fit evaluation that leads to setting up a productive training course for workforce development.

The subject of the ICT context in the region of northern industry, Thailand, where several ICT examinations are utilized for occupational standards, has been chosen as a case study. Regarding government support, Thailand has adopted the foreign test schemes as a global standard examination. These tests could be an excellent option for the Thai ICT workforce to evaluate their capability in the ICT career; however, it is always questionable of the contents, which one is the most suitable for Thai's industry. The distinctions of each exam are elaborately written according to the ICT technology and software market trends in the region of the source. Even the test was well-created and well-organized, though the variety of practical issues in the contents through the domestic examinee's perspective appears.

This study proposes the analysis model for the competence gap examination. The competence is compared well-matched contents between categories of skill-sets, which are framed from the assumption model, within the confirmation of skill-sets expectation survey from the sample group and the results of ICT competency assessment through the volunteers participating in an ICT proficiency test named the Test of Practical Competency in IT (TOPCIT). The sample has covered the people in the expert field of ICT, academic personnel, and university students.

This paper has organized the structure composing the study background, literature reviews, methodology, analysis and results, discussion, and conclusion, respectively. The methodology is classified into two parts: the design of the analysis model according to assumptions and data collections for pre-test and post-test.

2. LITERATURE REVIEW

2.1. ICT competence

Digital transformation is a part of a national plan for driving the Thailand 4.0 industry. It has been in national trends and ongoing forward. Since there is increasing investment in ICT development in the private sector continuously, it has indicated the growth of positive contribution in IT digital to national gross domestic production (GDP); yet, ICT capability significantly accelerates competitiveness and productivity to firms. Individual ability in ICT is critically required in the transitional concept of the knowledge-based economy [1]. Digital IT competency is a key for human resource development in this period. Organizations have to moderate themselves getting ready for changes. ICT and digital technology are core knowledge of young generation workers; however, the scope of ICT profession demands is vary depending on the areas of business and industry sector [2]. Additionally, ICT competence is discussed widely in several aspects, such as organizational policy and plans for manpower development. c

Competency is defined in several terms; nevertheless, competence has a compliable semantic in the same way, a skill-set of individual possession. Competence proficiency is an imperative criterion for maintaining individual performance [3]. In the competency framework [4], competence is determined as a combination of skills, knowledge, behaviors, and attitudes of individuals that empowers them to effectively take actions on a task within a specific context [5]. ICT competency has an explicit explanation in academia. Teachers should fulfill with skills in both hardware and software, especially for communication, presentation, and class management [6]. Moreover, ICT competency means comprehensive skills to solve problems with a well-understanding ICT principle suitable with existing environments [7].

The assessment of skill readiness level is necessary for educational preparation [8]. Due to the diversity in educational institutions and ensuring the quality of employed workers, test-based competence proficiency measurements designed and applied as international standards are becoming pervasive as a

trustable reference to a personal level of proficiency. For instance, ICTC-Test (Information Communication Technology Competency Test) is adopted to assess the ICT competency among postgraduate students in the Higher Learning Institutions (HLI). This test has been used to validate interactions between cognitive skills and technical skills in the ICT field [9]. Another well-known examination is named Information Technology Professionals Examination (ITPE). This examination originated in Japan; later, it widely applies in several ally countries under the Information Technology Professionals Examination Council (ITPEC), such as Bangladesh, Philippines, Vietnam, Myanmar, Mongolia, and Thailand. ITPE was framed to be the standard criteria of expertise level for IT engineers [10]. The late arrival ICT competence evaluation is the Test of Practical Competency in IT (TOPCIT) supported by the Korean government. TOPCIT was created for driving policy implications regards to ICT skill development on a global scale. Inside the examination contents, it specified for people in the software area coupled with the evaluation system of the ICT proficiency level [11]. Both ITPE and TOPCIT are recognized in the Thailand ICT workforce market.

Nevertheless, the contents of ITPE test figure more in-depth specificity, whereas TOPCIT illustrates more ICT skill combination within the business context. That makes TOPCIT seems to be more generalized in practices for industry sectors. Therefore, in this research, the description of categories and skill items from TOPCIT was implied and composed in the analysis model.

2.2. Competency gap analysis

2.2.1. ICT requisite competence

The competence of qualified Chief Information Officers (CIOs) was proposed by Shalamanov et al., (2020)[12]. Being ICT professional and abilities regarding to foresee and manage ICT infrastructures and resources are required. Also, they emphasized the competence in cybersecurity should be concerned in priority. Siddoo et al., (2019)[13] defined proficient skills for the digital workforce in Thailand's Industry 4.0 context. The associated categories between professional skills, IT technical, IT management, and support were principled clarified; however, the skill-sets for ICT specialists were slightly explanation. The requisite skills from the literature are listed in Table 1.

Table 1. The ICT requisite skills

Category	ICT Skills
IT technical	Computer Network
	Cybersecurity
	Database design and development
	Software convergence application
IT management and support	Business concept
	Project Management
Personal skill	English for technical communication

Note: ICT skills are taken from Siddoo et al., (2019)[13] and Lee and Seo, (2018)[14].

2.2.2. ICT Competency gap analysis methods

The competence gap analysis was initiated from a factor structure model. In two-factors construction, coefficients examination is a suitable analysis method [15]. This method was applied to measure preservice teachers' ICT competencies. The factor model investigated the correlation between ICT competencies in two aspects which are 1) competencies for supporting in-class pupils and 2) competencies for instructional design. The results could confirm the impact of the factors from a structure coefficients model, which were formed by the ICT competence items.

Alternatively, the ICT competency gap is able to examine by levels of proficiency. Gastelú et al. (2015)[16] reported the analysis in university students, Hungary and Mexico. ANOVA was operated mainly for the analysis methodology. In addition, they classified ICT competencies into three sections according to the sample study, which are the core competencies of 1) digital literacy, 2) implementation, and 3) ethics.

From the reviews, we found that each method was considered from the characteristics of the case study and proposition corresponding to demands in different aspects. In this study, we focus more on ICT technical profession skill-set items that have effects on ICT competency level for the future workforce corresponding with the relationship on the practical ICT competence proficiency test, TOPCIT. The investigation is conducted by PLS-SEM and basic statistical analysis.

3. METHODS

The methodology was structured into three major actions, which are:

1) ICT competence skill-sets Model Formation
2) Pre-test questionnaires
3) Post-test questionnaires

Initially, the ICT competence skill-sets model was created from the test categories of TOPCIT and literature reviews that define the explicit description of each illustrates in Figure 1. Then, the questionnaires surveying the confirmation skill-sets requirements were conducted for pre- and post-taking the test. PLS-SEM was used as an analysis tool. The ICT competence Model is composed ICT Competency as a latent variable that has indicators for skill-sets clarification such as Software Programming, Software Design and Analysis, Database Design and Programming, Network and Security, IT Business Concepts and Technology Trends, Software Project Management, Application Convergence, English for Technical Communication, Software Testing, UX CX and Service Design, and FinTech. The effect of ICT competency subjects on the perception of a well-fit competency test, TOPCIT, is ascribed in the model.

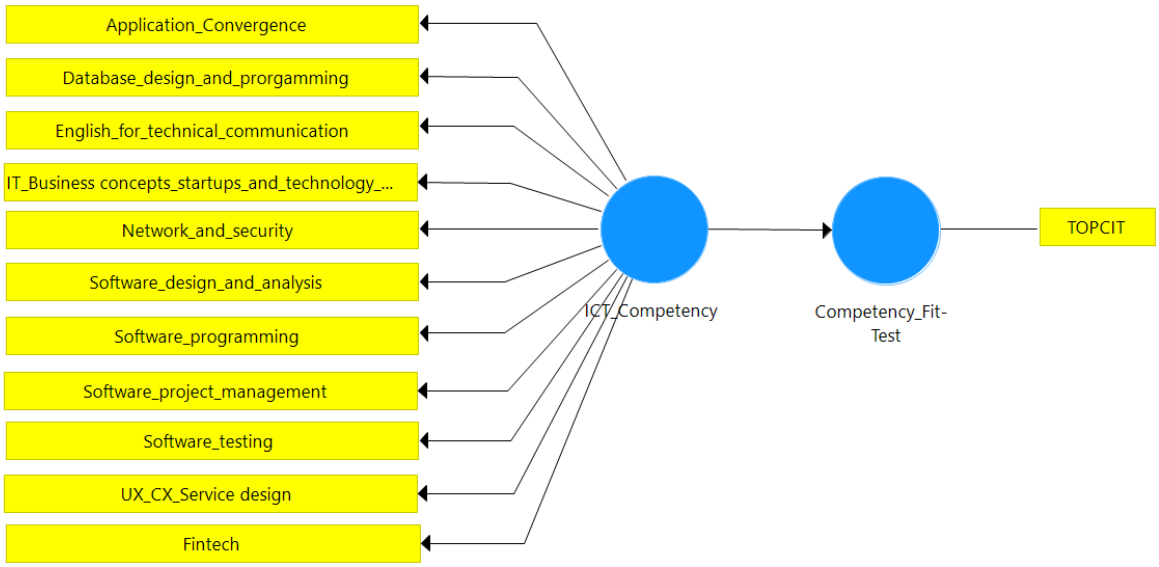

Figure 1. ICT competence skill-sets model

4. DATA

The data was collected from the workforce in ICT fields that have different levels of competence. Twenty-seven participants living in Northern Thailand were recruited to respond to the questionnaires before and after taking the ICT proficiency exam. About 30% of examinees represent workers currently working in the companies, and the rest is the sample of the future workforce.

Table 2. Data Profile

	ATTRIBUTES	n=27
1	**Workforce type:**	
	Future workforce (Students and individuals without working experience)	62.96%
	Current workers	37.04%
2	**Age range (years old)**	
	< 20	43%
	20-29	39%
	30-39	9%
	40-49	9%
3	**Education level**	
	Bachelor	88%
	Master	9%
	Doctoral	3%
4	**Work experience (years)**	
	No experience	55%
	<1	12%
	1-5	18%
	6-10	6%
	>10	9%
4	**Major business operation**	
	Software development	46%
	ICT Services	6%
	Electronic parts manufacturer	3%
	Education	39%
	None	6%

5. RESULTS

From the results, as shown in Figure 2 of the competency survey, we evaluated before and after the test. 33 and 21 respondents gave us feedback; before and after the trial, respectively. Most participants interested in the project live in Chiang Mai (88%) and only a few in nearby provinces such as Tak, Lamphun, and Lampang. 55% of participants are studying in the university without work experience; whereas, 18% of people are working in a company with experience from 1-5 years, 12% with less than one-year experience, 9% and 6% for senior expertise over 10 years and 5-10 years respectively. All of them are personal in the ICT profession.

The subjects that respondents commented on the topics they want to develop their expertise in descending order: Software Programming, Software Design and Analysis, Database Design and Programming, Network and Security, IT Business Concepts and Technology Trends, Software Project Management, Application Convergence, English for Technical Communication, Software Testing, UX CX and Service Design, and FinTech. After test feedback, the sample group answered positively on the project being organized and corresponded to their intended purpose. More than half of them commented that the project's outcome met their expectations before joining the project. A significant critique

indicates that the TOPCIT exam contents are consistent with the context of the ICT career of respondents highly to 74% of registrars. Specifically, the result from PLS-SEM analysis appeared highest factor-load on the subjects, English for Technical Communication (0.890) and IT Business Concepts and Technology Trends (0.820), which could reflect the perception of the well-fit competency test, TOPCIT, to the sample.

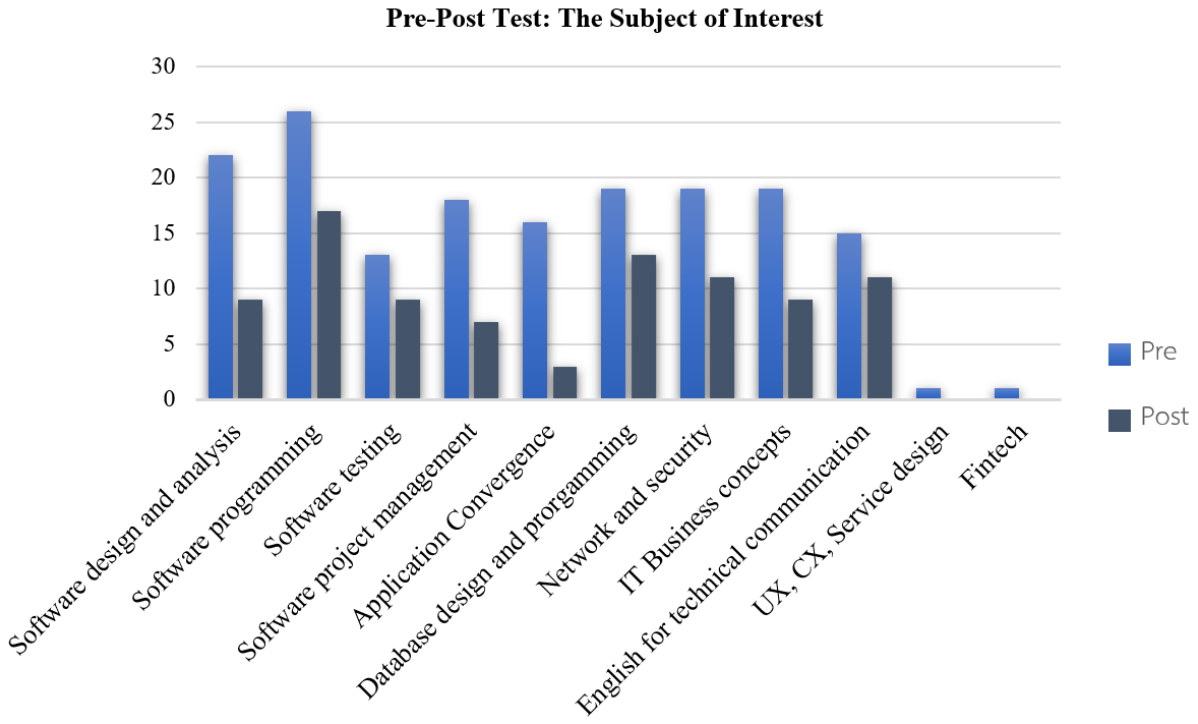

Figure 2. Feedback response to the subjects of interest

6. DISCUSSION AND CONCLUSION

The results projected the noticeable competency gap in skill-sets of participants' self-improvements. It implied that the approximate of the ICT skills requirements had been affected after the test taken. We received high positive responses consistently in the skill-sets of software programming, Database Design and Programming, and English for Technical Communication; whereas, the demand on Software Design and Analysis, Software Project Management, and Application Convergence have been declined significantly. The proficiency could consider being an advanced development skill such as Network and Security and Software Testing. Apparently, the Application Convergence is slightly at the edge of interest; likewise, the IT Business Concepts and Technology Trends knowledge should be maintained but not for intensive focus on the training aspect.

Explicitly, there are demands of skill upgrade in ICT competence towards more in the subject categories of the software developer than business and management [13]. The training program should mainly plan for software programming, Database Design and Programming, and Network and Security. Besides that, the capability in IT Business Concepts and Technology Trends is still needed for future employees; in the same way, English language skill is still a classic weakness for technical communication in the Thai ICT workforce.

In conclusion, this research proposed the method aiming for ICT competence gap analysis. The proposition in this study targets a sample group of the ICT workforce in Northern Thailand. The ICT competence skill-sets were defined and consequently confirmed with demands and requirements of the proficiency development. The research investigation illustrates technology trends that indicate the direction of Thai's ICT industry in the digital transformation stage. This study's findings convey the practical implication for policymakers in education and human resource management to scheme the ICT skill-sets in training, individual competence development, proficiency measurement, and performance manipulation. Additionally, further study has been planned to augment the investigation scope by recruiting more participants in various industry sectors; as well as, the analysis model would be considered to reconstruct the attributes including attitude and necessary contexts such as problem-based constraints and ICT adoption issues.

AUTHOR CONTRIBUTIONS

A.W. conceived of the presented idea and designed the analysis method. A.W. and T.J. collected the data as well as contributed analysis tools and performed the analysis. T.K. contributed to the interpretation of the results. A.W. took the lead in writing the manuscript. All authors discussed the results, provide critical feedback, and contributed to the final manuscript.

REFERENCES

1. Jones, C., & Pimdee, P. (2017). Innovative ideas: Thailand 4.0 and the fourth industrial revolution. *Asian International Journal of Social Sciences, 17*(1), 4-35.
2. Müller, E., & Hopf, H. (2017). Competence center for the digital transformation in small and medium-sized enterprises. *Procedia Manufacturing, 11*, 1495-1500.
3. Sampson, D., & Fytros, D. (2008). Competence models in technology-enhanced competence-based learning. *In Handbook on information technologies for education and training* (pp. 155-177). Berlin, Heidelberg: Springer.
4. UNIDO. (2002). Human Resource Management Framework (HRMF) - Administrative Instruction. Retrieved August 22, 2021, from https://www.unido.org/overview/legal-resources/human-resources-documents
5. Zervas, P., Chatzistavrianos, K., & Sampson, D. G. (2014). Towards modelling teachers' ICT competence profile in Europe. *ICT in Education in Global Context* (pp. 163-181). Berlin, Heidelberg: Springer.
6. UNESCO. (2011). *ICT competency framework for teachers.* United Nations Educational, Scientific and Cultural Oraganization.
7. Cha, S. E., Jun, S. J., Kwon, D. Y., Kim, H. S., Kim, S. B., Kim, J. M., ... & Lee, W. G. (2011). Measuring achievement of ICT competency for students in Korea. *Computers & Education, 56*(4), 990-1002.
8. Puriwat, W., & Tripopsakul, S. (2020). Preparing for Industry 4.0--Will Youths Have Enough Essential Skills?: An Evidence from Thailand. *International Journal of Instruction, 13*(3), 89-104.
9. Ahmad, M., Karim, A. A., Din, R., & Albakri, I. S. M. A. (2013). Assessing ICT competencies among postgraduate students based on the 21st century ICT competency model. *Asian Social Science, 9*(16), 32.
10. *ITPEC*. (2021, July 30). Retrieved from Information Professionals Examination Coucil: https://itpec.org/
11. *TOPCIT*. (2021, July 30). Retrieved from Test of Practical Competency in IT: https://www.topcit.or.kr/

12. Shalamanov, V., Monov, V., Blagoev, I., Matern, S., Vassileva, G., & Blagoev, I. (2020). A Model of ICT Competence Development for Digital Transformation. *Information & Security: An International Journal, 46*, 269-284.
13. Siddoo, V., Sawattawee, J., Janchai, W., & Thinnukool, O. (2019). An exploratory study of digital workforce competency in Thailand. *Heliyon, 5*(5), e01723.
14. Lee, H. S., & Seo, Y. W. (2018). An Analysis of the proliferation Case of TOPCIT (Test of Practical Competency in ICT) and policy implications. *Journal of Digital Convergence, 16*(5), 1-12.
15. Tondeur, J., Aesaert, K., Pynoo, B., van Braak, J., Fraeyman, N., & Erstad, O. (2017). Developing a validated instrument to measure preservice teachers' ICT competencies: Meeting the demands of the 21st century. British Journal of Educational Technology. *48*(2), 462-472.
16. Gastelú, C. A. T., Kiss, G., & Domínguez, A. L. (2015). Level of ICT competencies at the university. *Procedia-Social and Behavioral Sciences, 174*, 137-142.