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Determinants of Thai information and communication technology organization performance: A structural equation model analysis

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Abstract

Thailand 4.0 has awoken many to the information and communication technology (ICT) human resource needs in academic institutions, in research facilities, and industry. To support this, the government has targeted USD 1 billion to train 12,290 research PhDs to serve in 10 key industrial sectors over the next 20 years. The Thai ICT sector that is required to support these goals however has been constantly identified as significantly lacking the skills, knowledge, and expertise to meet the needs of a 21st century, knowledge-based economy. This study, therefore, set out to identify the key variables required to support an ICT organization's performance. By use of a structural equation model and the PLS Graph software, analysis was performed on the interrelationships of the identified latent variables consisting of knowledge management, human resource management systems, employee competency, and ICT organization performance. The results from the analysis indicated that the human resource management system in an organization is the most important factor, with knowledge management and employee competency of secondary importance to ICT organization performance.

Introduction

Thailand is quickly taking steps to embrace a sustainable, value-based economy under what has become known as *Thailand 4.0* (Tortermvasana, 2016). Building digital communities, creating digital innovative start-up networks, and establishing digital parks for small and medium-sized enterprises (SMEs) has become a Thai government priority. This is easy to understand knowing there are 2.7 million Thai SMEs which account for 98% of all business units in Thailand, which also account for 37% of GDP, providing 10 million jobs in 2014 (Thailand Investment Review, 2015). Information and communication technology (ICT) therefore, is one of key drivers of national development, particularly for achieving a transition to a knowledge-based economy.

Research from Tan (2016) indicated that a 20% investment in ICT contributes 1% to gross domestic production (GDP), a 2.1% increase in competitiveness, a 2.2% increase in innovation, and a 2.3% gain in productivity. The effective use of ICT can also improve life quality, reduce educational gaps, and raise efficiency in industrial production and government service provisioning (Thailand Science Technology and Innovation Profile, 2014).

However, shortages of industry-ready skilled workers present one of the biggest challenges for the five core

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member countries of the Association of Southeast Asian Nations, ASEAN-5, as they strive to realize their economic visions (Tan & Tang, 2016). Disruptive technologies also threaten to render jobs obsolete in many industries, including those in ICT.

To offset these problems and professionally staff the environments and educational institutions necessary for sustainable growth, and as part of the Thailand 4.0 initiative to support 10 key economic sectors, the Thai government has also announced plans to budget USD 1 billion for 12,290 doctoral researchers to serve the country's industrial development and human resource development needs over the next 20 years. To put this goal in perspective, only 1,295 individuals were enrolled in science and technology PhD programs in 2013, compared to 2,138 doctoral candidates in Thai university social sciences and humanities programs (Thailand Science Technology and Innovation Profile, 2014).

The Thailand 4.0 PhD sponsorship campaign is part of the Royal Golden Jubilee (RGJ) PhD Programme, which since 1996 has been under the auspices of the Thailand Research Fund (TRF). In 2014, Thailand had 9.5 doctoral researchers per 10,000 people, which the present government wishes to increase to 80 researchers per 10,000 people by 2036 (Anonymous, 2016). Also, according to a 50-nation digital economy study from Huawei Technologies, Thailand only has one IT (information technology) worker per capita, compared to the study average of 3.18 workers (Tan, 2016). This is consistent with a World Bank study which reported that leading countries in innovation and IT had up to 8,000 highly qualified people working in research and development per million of population, whereas the current ratio is 1,000 per million in Thailand (Lathapipat & Sondergaard, 2015). It seems both Thai academic and ICT professional human resource development need serious improvement in the upcoming years.

In Thailand, the National Economic and Social Development Plan (NESDP) serves as the roadmap for economic development with the 12th Plan (2017–2021) aiming to transform, upgrade, and increase the R&D focus of key domestic industries, including the automotive, agriculture, food manufacturing, tourism, and hospitality sectors (Kumpa, 2016; Tan & Tang, 2016). The ICT and the education sectors will be instrumental in providing the physical and digital infrastructure, as well as the human capital needed to support the transformation. This is consistent with Numprasertchai and Igel (2005) which concluded that ICT communication, collaboration, and storage technologies, are essential tools for collaboration within Thai university research environments.

Unfortunately, although ICT expenditure accounted for 7% of Thai GDP in 2015, of the projected annual requirement of 6,000–7,000 Thai ICT professionals, only 10% of the ICT graduates were considered employable according to interviews conducted with Association of Thai ICT Industry members (Tan & Tang, 2016). This is a major reason that the Thai government has singled out human capital development as a key focus of the 12th NESDP 2017–2022, and implemented other plans such as the STEM Masterplan 2015.

Literature Review

Knowledge Management

KPMG (2014) identified nine, interrelated, global megatrends, with the main reason for their interrelations coming from ICT and the fact that over three-quarters of the planet's citizens have cellular phone technology access. Knowledge Management (KM) and ICT are thus transforming societies, with some developing nations 'leap-frogging' technologically older industrial nations. Digitalization is changing business models, customer relationships, and perceptions together with markets and competitive landscapes (Ernst & Young, 2015; KPMG, 2014).

This is consistent from papers presented at a European conference where the role of new ICT was discussed and how it might fit into organizational knowledge management processes. Interesting outcomes from the papers covered topics such as social networking tools, wikis, internal blogging, and smartphones, and the way they are integrated as KM devices or tools (Soto-Acosta & Cegarra-Navarro, 2016). It was suggested that these tools differ from traditional organizational systems in two critical ways. First, they are voluntary and second, they lack activity or process orientation.

King (2009) also discussed KM and organizational learning, and defined KM as the "planning, organizing, motivating, and controlling of people, processes and systems in the organization to ensure that its knowledge-related assets are improved and effectively employed" (King, 2009, p. 4). This was consistent with a meta-analysis study of hospitality organizations conducted by Hallin and Marnburg (2008) which also concluded the importance of KM in sustaining a competitive advantage. This was confirmed in other studies in which KM was confirmed to be especially relevant for building up a competitive advantage (Buhalis, 2003; Hallin & Marnburg, 2008).

Hinton (2003) indicated from research in Australia and New Zealand that KM and data transfer are also critical to the competitiveness of the organization. Benckendorff and Sheldon (2014) also confirmed the importance of IT within the tourism industry, while Kahle (2002) also discussed the importance of ICT in achieving customer satisfaction.

Human Resource Management (HRM) Systems

From a 636-senior executive survey conducted by the Economist Intelligence Unit (2013) concerning present and future human resources (HR) challenges, 50% indicated that people management was their greatest concern due to multi-generational workforces with growing cultural diversity. These same executives also voiced serious concern over the current disconnect between the skills fostered by education, and those actually needed by 21st century workers, and the considerable obstacle this significant problem presents in the coming years (Economist Intelligence Unit, 2013; Reeve, 2016).

Dechawatanapaisal (2005) investigated how Human Resource Management (HRM) practices in 12 large Thai corporations affected the learning capabilities of ICT

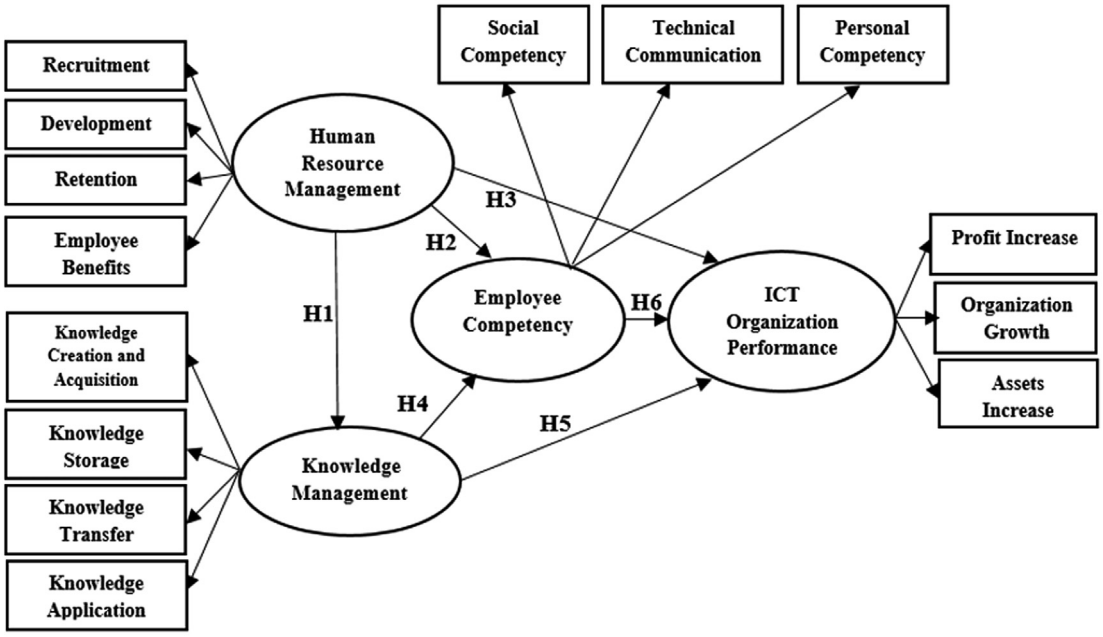

Figure 1 Conceptual model

professionals. From the 524 questionnaires used, it was determined that staffing, training, and development as well as performance appraisal and pay are strong enabling drivers that enhance people's learning behavior and promote a climate of organizational learning.

In Malaysia, it was also concluded that in ICT small-medium enterprises (SMEs), HRM practices had significant and positive impacts on innovation and internal process, as well as an ICT firm's employee learning and growth (Mansouri & Goher, 2016). Another study from the USA indicated that the most significant factor affecting retention rates was job advancement opportunities (Oladapo, 2014). In Greece, Katou (2012) studied 197 small firms and found that HRM policies, being contingent on business strategies (cost, innovation, quality), had a positive effect on organizational performance through employee attitudes and employee behaviors.

ICT Organization Performance

Salim and Sulaiman (2011) studied 115 Malaysian ICT SMEs and confirmed that organizational innovation has a significant influence on enterprise performance, with research from Taiwo and Edwin (2016) also confirming the significant positive relationship between ICT and organizational performance.

Employee Competency

Ismail and Abidin (2010) evaluated 1,136 Malaysian professionals involved in education, health, and ICT, with their results showing the significant connection between workers' competence, human capital, and workers' characteristics on workers' performance.

In Thailand however, many ICT firms are hesitant or unable to provide worker training due to the widespread practice of poaching by other companies. This in turn affects the employees' incentives to stay in the ICT SMEs, contributing to a vicious cycle of having high turnover rates and underqualified staff (Tan & Tang, 2016).

After a review of the literature and based on development from the above concepts, the following six research hypotheses were created (Figure 1):

H1. Human Resource Management (HRM) systems in ICT organizations affect Knowledge Management (KM).

H2. Human Resource Management (HRM) systems in ICT organizations affect Employee Competency (COMP).

H3. Human Resource Management (HRM) systems in ICT organizations affect ICT Organization Performance (PERF).

H4. Knowledge Management (KM) in ICT organizations affects Employee Competency (COMP).

H5. Knowledge Management (KM) in ICT organizations affects ICT Organization Performance (PERF).

H6. Employee Competency (COMP) in ICT organizations affects ICT Organization Performance (PERF).

Methods

Sampling and Data Collection

The population of this study was ICT professionals who were members of Thailand's Association of Thai ICT Industry (ATCI) whose membership represents 80% of all computer hardware and software manufacturers, distributors, and ICT service providers (ATCI, 2017). With such strong representation, ATCI plays a significant role in the

development of National ICT policy and the Thai government's ICT Master Plan.

Questionnaire

The questionnaire was divided into two parts, with Part 1 consisting of eight items concerning the respondent's general and personal information while Part 2 consisted of four parts and 60 items. These were divided into four parts with ICT organization performance consisting of 14 questions, knowledge management having 16 questions, HRM systems with 17 questions, and employee competency with 13 questions. The questionnaire items related to the constructs were measured using 7-point Likert agreement scale ranging from Strongly disagree (1) to Strongly agree (7).

Furthermore, qualitative research was conducted using in-depth, semi-structured, guided interviews with five experts (two university ICT lecturers, two ATCI ICT members, and one executive from a Thai banking ICT support group) to determine the questionnaire's content validity which covered the four latent variables that were either revised or deleted based upon comments and feedback from each expert. Verification of the content validity was confirmed using the Index of Consistency (IOC). To evaluate the internal consistency of constructs (ICR), Cronbach's alpha was used to test the unidimensionality of the 7-level agreement scale questionnaire items and measure to which extent all the variables are related to each other (Tavakol & Dennick, 2011) from the initial 30-sample test survey. Various scholars have reported on different acceptable values of alpha, ranging from 0.70 to 0.95 (Hair, Jr., Hult, Ringle, & Sarstedt, 2016). The correlation coefficient results were within all recommended acceptable ranges however, being between .796 and .958.

To further determine if the sample size of 280 ICT professionals selected using convenience sampling for the study was adequate, the researchers further confirmed this to be the case from previous researchers (Hair, Jr. et al., 2016) where a ratio of 20 individuals for each observed variable was suggested. As the study had four latent variables with 14 observed variables, 280 questionnaires collected which was deemed as sufficient and reliable. Analysis of ICT organization performance was conducted using descriptive statistics (frequency, percentage, mean, and standard deviation). From the literature review, the latent and observed variables analyzed for this study as well the related theory are show in Table 1.

Table 1
Latent and observed variables as well as associated theory

Latent variable	Observed variable (Figure 2)	Theory and review of the literature
Knowledge Management (KM)	Knowledge Creation and Acquisition (KCA) Knowledge Storage (KMO) Knowledge Transfer (DIK) Knowledge Application (APP)	(Benckendorff & Sheldon, 2014; Buhalis, 2003; Ernst & Young, 2015; Hallin & Marnburg, 2008; Hinton, 2003; Kahle, 2002; King, 2009; KPMG, 2014; Soto-Acosta & Cegarra-Navarro, 2016).
Human Resource Management (HRM) Systems	Employee Benefits (EMB) Retention (RET) Development (DEP) Recruitment (REC)	(Dechawatanapaisal, 2005; Economist Intelligence Unit, 2013; Katou, 2012; Mansouri & Goher, 2016; Oladapo, 2014; Reeve, 2016)
ICT Organization Performance (PERF)	Profit Increase (PRI) Organization Growth (ORG) Assets Increase (ASI)	(Salim & Sulaiman, 2011; Taiwo & Edwin, 2016)
Employee Competency (COMP)	Social Competency (SOC) Technical Communication (TEC) Personal Competency (PEC)	(Ismail & Abidin, 2010; Tan & Tang, 2016).

Results

Sample collection commenced in February 2016 and continued through until April 2016. Convenience sampling was used to target ICT professionals at ATCI-related meetings, seminars, conventions, and association events, where individuals were asked to respond to the 68-item questionnaire.

Partial Least Squares Analysis

Partial least squares (PLS) was chosen as the analysis tool as it is a variance-based or components-based approach, which only examines the explicitly stated covariances in the model and focuses on maximizing the variance of the dependent variables which are explained by the independent ones (Figure 2). Vanneste, Vermeules, and Declercq (2013) indicated that the PLS path modeling approach has minimal demands on sample size, measurement scales, and residual or underlying data distributions, and is the software of choice for most information systems research. Quantitative data analysis and confirmatory factor analysis (CFA) were also conducted using PLS to test manifest variables and latent variables and test the research hypotheses (Gefen & Straub, 2005). In conducting CFA, it is essential to establish convergent and discriminant validity, as well as reliability which can be measured by both composite reliability (CR) and average variance extracted (AVE) (Table 3).

Furthermore, analysis results for scale validity, reliability, and internal consistency measurement were accomplished using the coefficient alpha (α-coefficient) to calculate the average value which was shown to range between 0.796 and 0.958. Nunnally (1978) indicated that values over 0.70 are acceptable (Table 2).

Reflective model structures were created for this research and tested for convergent validity and discriminant validity. The criteria for convergent validity state that the loading value must be positive, and the indicator loading values must be over 0.707, having a statistical significance of ($| t | \geq 1.96$) for all values (Lauro & Vinzi, 2004).

Table 2
Reflective statistical values indicating convergent validity of the latent variables

Construct/item	Loading	t-value
Human Resource Management Systems (HRM)		
Recruitment (REC)	0.933	68.425
Development (DEP)	0.945	109.278
Retention (RET)	0.941	90.298
Employee Benefits (EMB)	0.927	91.716
Knowledge Management (KM)		
Knowledge Creation and Acquisition (KCA)	0.953	140.622
Knowledge Storage (KMO)	0.918	82.527
Knowledge Transfer (DIK)	0.941	123.852
Knowledge Application (APP)	0.970	252.371
Employee Competency (COMP)		
Social Competency (SOC)	0.962	155.221
Technical Communication (TEC)	0.971	229.475
Personal Competency (PEC)	0.955	133.413
ICT Organization Performance (PERF)		
Profit Increase (PRI)	0.925	107.534
Organization Growth (ORG)	0.962	113.852
Assets Increase (ASI)	0.946	121.030

Establishing discriminant validity in PLS also requires an appropriate average variance extracted (AVE) analysis (Gefen & Straub, 2005). Normally, the square root of the AVE of each construct should be significantly greater than the correlation of the specific construct with any of the other constructs in the model (Chin, 1998) and should be at least .50 (Fornell & Larcker, 1981; Lauro & Vinzi, 2004).

Construct Validity

Construct validity uses both convergent and discriminant validity in combination and must be used together to establish overall validity. Technically, convergent validity can be evaluated by three tests: item reliability, composite reliability and average variance extracted (AVE) (Chau, 1997). The first measure (item reliability) is indicated if items have significant factor loadings of 0.50 or above. The second measure (composite reliability) is assessed based on the criteria that the indicator's estimated pattern coefficient is significant with regard to its underlying factor, which should have a threshold value for construct reliability at 0.70 or higher (Nunnally, 1978). Table 3 shows the composite reliability was higher than 0.60, with all AVE values higher than 0.50, and all R^2 values classified as 'substantial' (Hair, Jr. et al. 2016).

The results from the structural equation model (SEM) hypotheses testing are shown in Figure 2. The statistical significance level was at .05 ($p < .05$). Table 4 and Figure 2 show the results of the final hypotheses testing.

Hypothesis Testing

Table 5 shows the direct effect (DE), indirect effect (IE), and total effect (TE) of each construct on the hypotheses testing. The p value is the 'level of significance' with a $p < .05$ indicating that the probability that the result is observed due to chance being 5%, or a "false positive" result (McDonald, 2014). Hooper, Coughlan, and Mullen (2008) indicated that items with low multiple R^2 values (less than 0.20) should be removed from the analysis as this is an indication of very high levels of error. This was confirmed by Hair, Jr. et al. (2016) who indicated that R^2 values of 0.75 are substantial, 0.50 are moderate, and 0.25 are weak.

Discussion

Based on the results of this study, the HRM systems in ICT is a very important factor as it is the first process in getting employees into the organization, which today has become known as *e-cruiting*. Additionally, strategic human

Table 4
Test results research hypotheses

Hypotheses	Coefficient.	*t*-stat	Result
H1: Human Resource Management (HRM) systems in ICT organizations affects Knowledge Management (KM).	0.873	40.570	Passed
H2: Human Resource Management (HRM) systems in ICT organizations affects Employee Competency (COMP).	0.652	5.172	Passed
H3: Human Resource Management (HRM) systems in ICT organizations affects ICT Organization Performance (PERF)	0.362	3.533	Passed
H4: Knowledge Management (KM) in ICT organizations affects Employee Competency (COMP).	0.221	1.724	Passed
H5: Knowledge Management (KM) in ICT organizations affects ICT Organization Performance (PERF).	0.463	5.635	Passed
H6: Employee Competency (COMP) in ICT organizations affects ICT Organization Performance (PERF).	0.062	0.857	Rejected

Table 3
Cross construct correlation and performance indices

Construct	CR	R^2	AVE	Cross		Construct	
				HRM	KM	COMP	PERF
HRM	0.966	–	0.878	**0.937**			
KM	0.971	0.761	0.895	0.873	**0.946**		
COMP	0.975	0.680	0.982	0.818	0.766	**0.990**	
PERF	0.962	0.762	0.893	0.838	0.849	0.731	**0.994**

Note. Statistical significance level is at the .01 level and the numbers on the diagonal indicate $\sqrt{AVE}$. CR = composite reliability, AVE = average variance extracted, R^2 = square of the correlation

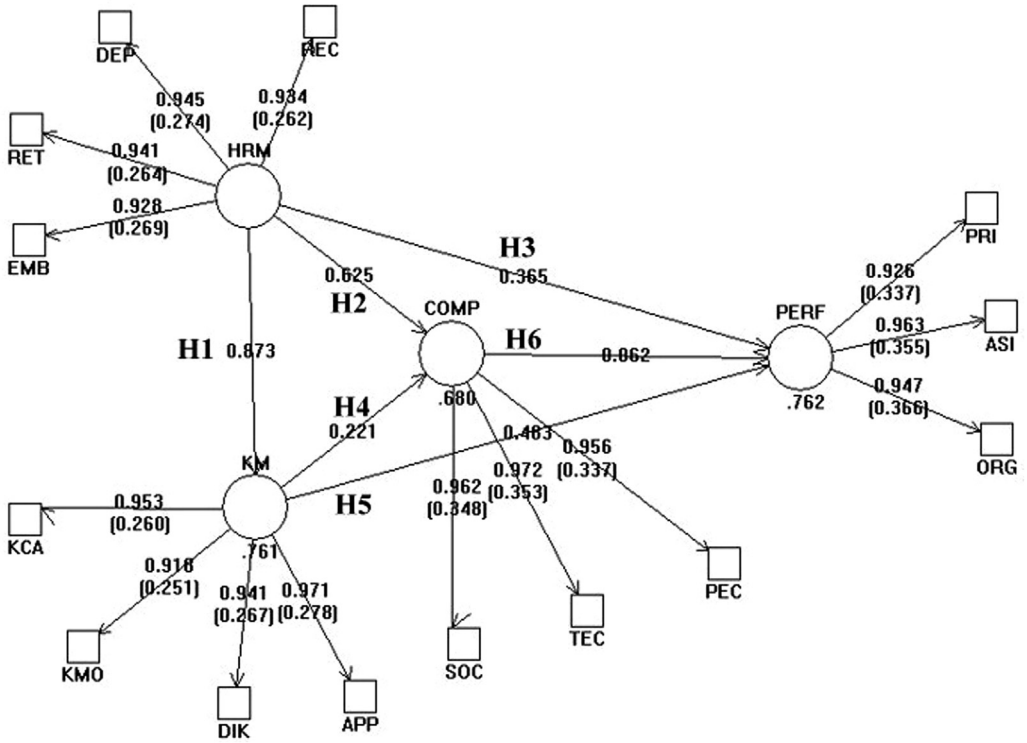

Figure 2 Final Model, where circles represent the latent variables, while boxes represent the manifest or observed variables. Quantities above the numbers in parentheses, are the standardized factor loadings or correlations, while their standard errors are in parentheses. The R^2 values for KM = 0.761, COMP = 0.680, and PERF = 0.762

Table 5
Direct effect, indirect effect, and total effect in path model (N = 280)

Dependent variable	R^2	Effect	Independent variable			
			HRM	KM	COMP	PERF
Knowledge Management (KM)	0.761	Direct Effect	0.873	N/A	0.221	0.483
		Indirect Effect	N/A	N/A	N/A	0.013
		Total Effect	**0.873**	**N/A**	**0.221**	**0.496**
Competency (COMP)	0.680	Direct Effect	0.625	0.221	N/A	0.062
		Indirect Effect	0.193	N/A	N/A	N/A
		Total Effect	**0.818**	**0.221**	**N/A**	**0.062**
Organization Performance (PERF)	0.762	Direct Effect	0.365	0.483	0.062	N/A
						0.165
		Indirect Effect	0.472	0.013	N/A	N/A
		Total Effect	**0.837**	**0.496**	**0.062**	**N/A**

N/A = not applicable

resource planning (SHRP) is an important element before the recruitment of new employees can begin.

Given the importance of Thailand 4.0 and Thailand's goal for a digital economy based on knowledge management, planning is paramount to success (Reeve, 2016; Tan & Tang, 2016; Tortermvasana, 2016). This includes online management, digital content, and understanding and implementing the "Internet of Things", as nearly everything in the future is linked to the Internet. Mobile, smartphone technology has become the "elephant in the room", with nearly every conceivable innovation such as the Thai National e-Payment, PromptPay, and Thailand 4.0 based around it. Therefore, organizations need to implement HRM systems, embracing methods which change the way of working.

The boundaries between the private world and the work world are no longer clear, with workers using personal social media at work, with chat programs blurring the lines between home and work, with concepts such as *Work-Life Balance*, *Line-me*, and *Weisure Time* (work/leisure time) becoming common.

Learning through social networking is becoming very important as well, with the 'e' decade (such as e-learning, e-book, e-commerce) morphing into the 's' decade, or an

era of social networking and social media (Mulgan, 2017). As individuals and organizations become more 'social', ICT organizations in the future must be more socially responsible as well, embracing policies that are socially responsible and focused on sustainable development. The New Age is driven by corporate social responsibility (CSR) to creating shared value (CSV) that instills a sense of values in social responsibility, life, environment, and nature, integrating it into the business from the upstream to the downstream. Capitalism in the future world must adapt to *conscious capitalism*, in which HR managers in organizations play a key role (Kowitt, 2015).

Conclusion

The emerging popular idea, that ability to learn and leverage knowledge of people is truly the primary source of a sustainable competitive advantage for organizations, shapes new challenges (Dechawatanapaisal, 2005). The importance of ICT cannot be understated as mobile technology alone generated 5.4% of Asia Pacific's GDP and created 15 million jobs in 2015 (GSSM, 2016). Managing disruptive technologies requires a paradigm shift in the thinking of policy makers, employers, and employees alike, who must find new ways to develop a skilled but flexible workforce, that accepts the need for continuous and lifelong learning (Tan & Tang, 2016). Specifically, this study agrees with other regional research that suggests that education and training institutions at all levels, have not been able to equip graduates adequately with the skills that the growth industries need (American Chamber of Commerce, 2016).

The low competency level in STEM education, and the shortage of workers with sufficient technical and engineering skills (Reeve, 2016), could threaten to derail the ambitious industrial development plans of Thailand (and its neighbors) and their move towards a more technology-intensive and knowledge-intensive economy (Tan & Tang, 2016). Thailand's leaders however recognize these shortcomings and in addition to the vision laid out in Thailand 4.0 documents, has also set out objectives (February 2016) for the 20-year Digital Economy Master Plan with priorities placed on improving rural infrastructure connectivity, promoting internet use for SMEs, and a move to e-government. The International Data Cooperation predicts that the Digital Economy Master Plan, if "done right", will be able to contribute to as much as 30% of Thailand's gross national product (GNP) by 2020. Thailand has the ambition of becoming a technology-intensive and knowledge-intensive production base and a high-income country by 2027. The main obstacle to this journey is the limited supply of technical and vocational workers across all industries.

Conflict of interest

We have no conflict of interest to declare.

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