The Asian Journal of Technology Management Vol. 11 No. 2 (2018): 94-117

The Evaluation of Digital Readiness Concept: Existing Models and Future Directions

Reza Ashari Nasution*[1], Linda Sendy Lediana Rusnandi[1], Elis Qodariah[1], Devi Arnita[1], and Nila Armelia Windasari[2]

[1]School of Business and Management, Institut Teknologi Bandung, Indonesia
[2]Institute of Service Science, National Tsing Hua University, Taiwan-ROC

Abstract. *The development of digital technology has significantly changed the business landscape. The emergence of new business models provides a greater potential to become more profitable. Therefore, many companies tread the path towards transformation through the adoption and use of digital technologies to catch the opportunities. Unfortunately, many companies fail to understand that the use of digital technologies requires different preparations. One of them is the requirement of an adequate level of digital readiness. The measurement of digital readiness is hindered due to the absence of a reliable, valid and specific model in measuring this construct. As a result, in order to measure the digital readiness of their employees, many companies are applying the existing technology readiness models which can be found in the current literature. This paper aims to provide a viewpoint of the adequacy of existing models for digital readiness measurement with a conception that digital readiness is not only a perception of a digital as an independent object but also as an integrated object.*

Keywords: *Digital technology, digital transformation, digital readiness, readiness model*

1. Introduction

In the last decade, the digital economy has developed and become increasingly intertwined with countless aspects of the world economy, having a massive impact on various sectors/business activities. The digital economy allows digital innovation to not only reshape and transform conventional businesses but also creates enormous business opportunities and leads to more profitable business. The United States and China, for instance, are the major global forces in developing world digital economy through e-commerce.[1] According to The United States Department of Commerce, the total e-commerce sale for 2017 could reach $453.5 billion.[2] Furthermore, The US has been successfully building the digital ecosystem in Silicon Valley, which delivered several outstanding companies to date such as Google, Facebook, e-Bay, etc.[3] On the other hand, China is racing ahead to become the top leader in the digital economy as it accounts for 42% of global e-commerce[4] with capitalization at US$470 billion in 2017.[5] China today is also backed up by many giant digital companies strengthened by their worldwide reputations, such as Baidu, Alibaba, and Tencent.[6]

[1]https://trellis.co/blog/top-10-ecommerce-markets-by-country/

[2]https://www.commerce.gov/
[3]https://www.raconteur.net/culture/living-in-the-future-today
[4]https://www.weforum.org/agenda/2018/04/42-of-global-e-commerce-is-happening-in-china-heres-why/
[5]https://www.businessinsider.sg/china-retail-e-commerce-sales-growth-chart-2017-1/?r=US&IR=T
[6]https://www.mckinsey.com/global-themes/china/chinas-digital-economy-a-leading-global-force

*Corresponding author. Email: reza@sbm-itb.ac.id
Received:May 7th, 2018; Revised: September 12th, 2018; Accepted: September 27th, 2018
Doi: http://dx.doi.org/10.12695/ajtm.2018.11.2.3
Print ISSN: 1978-6956; Online ISSN: 2089-791X.

The growth in the digital economy enforces companies to move quickly towards digitization path or else they will face a risk falling behind their competitors. However, many companies are slow and even struggle to adopt a digital business model.[7] Although several companies have started equipping themselves with advanced digital capabilities, it is likely to happen that large digital investments only lead to a mere loss as many of them fail to perform the required digital leadership.

This finding is also in line with the study of Westermann, Bonnet, & McAfee (2014) which stated that there are just a small number of Digital Masters, companies that understand the development of digital technology and are able to employ it in creating competitive advantages. Through their research, Westermann, Bonnet, & McAfee (2014) discovered that leaders play a vital role in digital transformation. They are the ones who formulate the digital vision and lead the digital transformation thoroughly in a company. Unfortunately, currently, there are not many business leaders who can be classified as such leaders. However, that does not mean we cannot create those leaders. The key is to recognize the leaders' potential in observing and responding to the development of digital technology for the company's advancement. This remarks the emergence of the concept of digital readiness.

Digital readiness has diverse meanings in literature. It can be interpreted as the readiness of individuals, institutions, industries to countries in adopting and utilizing digital technology to acquire the maximum benefits from those technologies. For instance, Horrigan (2016) used the term digital readiness to measure adult skills in using digital technology in the United States. Quaicoe and Pata (2015) defined digital readiness as the readiness of teachers' skills, knowledge and confidence to adopt digital learning in the elementary school education system in Ghana. Punchihewa (2004) used the term in his study of the readiness of institutions in Sri Lanka in implementing e-government. Hamzah and Mustafa (2014) used digital readiness in their study of the digital readiness of journalists in Malaysia.

Meanwhile, the Queensland Department of Trade and Industry (2016) used the term to refer to the industry's readiness in the state in elaborating the opportunities digital economy provides. And lastly, James (2008) and James (2011) used digital readiness to measure and compare the digital readiness of developing countries with developed countries in the world.Moreover, there are also differences in terminology in addressing digital readiness. Some people address and associate digital readiness with e-readiness, e-business readiness, e-government readiness, digital readiness, mobile readiness, networked readiness and generally as technology readiness.

Differences in terminology pose a challenge in the development of digital readiness constructs which indicates there is no common definition of digital readiness that is likely to be universally accepted. The inconsistency use of digital readiness concepts and models has caused research findings to be incomparable and cannot be used to form a uniform understanding or knowledge of digital readiness. Therefore, there must be an effort to make a uniformity by discovering the fundamental components of all models (Rojas-Méndez, Parasuraman, &

[7]https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/why-digital-strategies-fail

Papadopoulos, 2017; Potnis & Pardo, 2011; Lin, Lin, Yeh, & Wang, 2016).

The authors argue that the different terms that are found in the existing digital readiness concepts and models — be they employees, residents, or consumers have something in common. All of the concepts and models have measurement components of digital readiness which apparently rest on the individual level. In other words, the development of a digital readiness measurement model at the individual level is indeed fundamental or important to be conducted. This is also conducted by Parasuraman (2000) when he developed technology readiness and Lai and Ong (2010) when they developed e-business readiness of employees.

Accordingly, different from those researches, the authors will try to make it more general so that the concept of digital readiness at the individual level can be used in various contexts. Further, the "digital readiness" term is chosen as it is considered to be more generic and in line with the current era. Particularly, in the field of technology, many terms embed the word "digital" in them when referring to a phenomena or concept, i.e. digital disruption and digital business. Thus, the entire digital readiness term in this paper refer to individual levels of digital readiness otherwise stated differently.

This paper consists of four parts. The first section presents an introduction. After the introduction section, there is a section of literature study that explains the concept of readiness, digital and digital readiness. In this section, there is also a literature study of models related to what we then understand as digital readiness. Furthermore, we then discussed the findings in the discussion section which was summarized in the conclusions and suggestions for further research in the last section.

2. Literature Study

Readiness

Merriam-Webster dictionary defines readiness as the quality or state of being ready. The state is not just meant to refer to a person's condition, but rather various matters related to the readiness to do something. Therefore, Merriam-Webster adds an explanation that readiness is related to preparation (process), willingness (state) and facility (context). Meanwhile, Dictionary.com prefers to define readiness from the point of view of people, i.e. as a developmental stage that shows the tendency, willingness, and readiness of someone to do an action. The definition of Dictionary.com will be used to define the concept of readiness as its point of view is in accordance with our purpose in making the concept of readiness as something dynamic.

Digital

In this paper, digital is related to digital technology and digitalization. Dictionary.com defines digital as any form of digital device/application and its use. Meanwhile, Pullen (2009) refers digital technology as any device that uses microprocessors, which includes computers and their applications as well as digital devices (i.e. video cameras) and mobile devices (i.e. cell phones).

Experts agree that the proficiency in utilizing technology is far more important than just its technological device. Accenture claimed that viewing digital from the technological standpoint is inappropriate and limiting its potential impacts. Digital will be meaningful if it is utilized to redefine work patterns and business models in order to enhance the better experience for everyone.[8]

[8]https://www.accenture.com/us-en/blogs/blogs-digital-what-is-digital-strategy

McKinsey & Company support Accenture's statement. They argued that digital should be seen more as a pathway to do something than only seen as a physical thing. Users of digital technology must be able to utilize it in order to create value in the new boundaries of the business world, creating a competitive advantage that would bring customer experience to a higher level, and also creating fundamental competencies that bolster the whole structure, such as digital mindset, system, and data architecture.

World Economic Forum conveys that being a digital venture needs more changes deeply than merely spend more money to buy the latest digital tools. Companies need to seek new business models, essentially rethink their performing models, transform how they attract and maintain digital aptitude, and consider again how they predict the success of their business.[9]

In line with the industry, researchers also recognize the importance of technology utilization as an indicator of readiness for technology adoption. In the study of Beuningen, Ruyter, Wetzels and Streukens (2009), they state that the readiness of an individual in using self-service technology is a relevant variable to examine individual's inclination in using that technology. Ariff, Yeow, Zakuan, Jusof, and Bahari (2012) also support this statement. They studied the internet banking systems adoption and found a significant influence on the individual's ability to use the computer toward readiness for internet banking systems adoption.

From the above description, there are two perspectives toward understanding digital. The first perspective views digital as technological devices and the second one discusses digital from its broad applications. The digital concept in this paper possesses a meaning that is in accordance with this scope. This concept will then affect the concept of digital readiness that will be explained in the next section.

Digital Readiness

In the previous two sections, the author sets the definition of readiness and digital. Readiness is a developmental stage that describes inclination, willingness, and preparedness to perform an action. Meanwhile, digital is defined as the device and application of digital technology. However, the applications in question supposed to be revolutionary. It must be able to transform business work patterns and current industrial structures to create never imagined opportunities.

Thus, digital readiness is defined as inclination and willingness to switch to and adopt digital technology and the readiness to create new innovative opportunities by using this technology in order to bring an individual, organization, industry, and country to achieve their goals faster and with greater results. Westermann, Bonnet, & McAfee (2014) prove the success of companies that have good digital readiness in creating much higher revenue and profitability than companies with a lower level of digital readiness.

The definition of digital readiness which adopted in this paper indicates the existence of two basic components of digital readiness, namely attitude towards digital technology and attitude towards interaction with digital technology. For the first component, digital technology is seen as a separate object that is freely perceived by anyone (independent object). Yet for the latter component,

[9]http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/digital-enterprise-narrative-final-january-2016.pdf

people who perceive digital technology should expect the possibility of interaction with digital technology (integrated object). In these two components of digital readiness, the important thing to note is the implications of emotional reactions that emerge with the existence of digital technology and the possibility of changes in activity or work processes as an impact of interaction with digital technology. Therefore, the perception of digital technology as an independent object and its implications is referred to as attitudinal readiness, while the perception of digital technology as an integrated object and its implications that appear is then referred to as action readiness.

This separation is in accordance with the concept of digital readiness released by the World Economic Forum (WEF) as seen in Figure 1. In the framework, WEF separates attitude and action in two different dimensions. Attitude is classified in Culture dimension, while the action is classified in Skill dimension. In addition, this concept can also be discovered in the Technology Acceptance Model (TAM). Perceived Usefulness in TAM can be seen as a perception of technology as an independent object, while Perceived Ease of Use can be seen as a perception of technology as an object that interacts and integrates within one's work system (Davis, 1989).

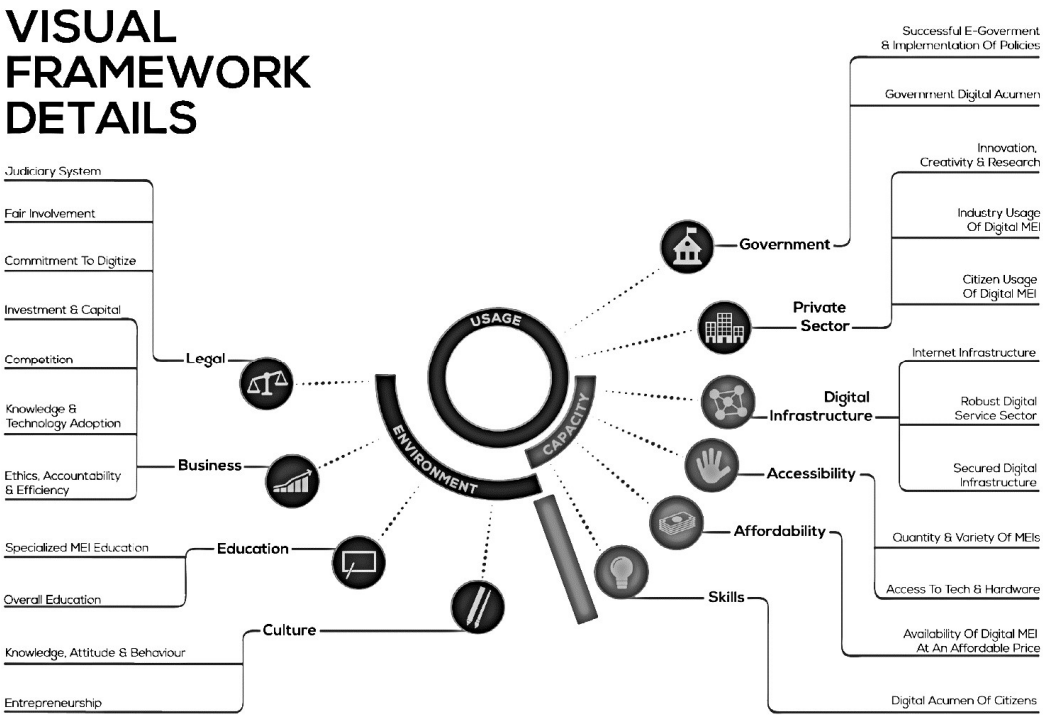

Figure 1.
Separation of Attitude and Action Readiness in the Digital Readiness Media Framework of the World Economic Forum.
Source: World Economic Forum

Attitude and Action

Both attitudinal and action readiness is important antecedents to predict digital readiness at the individual level because perception and knowledge are not sufficient to measure how ready individual faces innovation in digital technology. We need another important indicator, i.e. action readiness. Action readiness related to individual belief and skills to digital innovation that will complement the measurement of digital readiness.

Measurement of attitude towards technology is substantial, as it indicates that without a positive attitude it will lead to a slow adoption of new technologies. Therefore, there has been a great deal of research on technology adoption that uses attitude as an indicator of a possible adoption of a technology. However, a positive attitude also does not necessarily guarantee a technology adoption because a positive attitude is formed by a perspective on technology as an independent object. People are not forced to answer the question whether they are ready or able to use the technology. When technology is finally adopted, people might not be able to use it, thus slowing down our chances of getting the most out of the technology. Therefore, we argue that there is a gap between attitudes and beliefs in the ability to use technology where if being neglected will eventually reduce the potential of a technology adoption.

As Frijda (1989) points out in his study of action readiness, one's inclination to action is a component that distinguishes emotional experience from one another. This statement is also supported by other empirical studies, such as Davis (1989), Shaver, Schwarts, Kirson, & O'Connor (1987), De Riveral (1977), Scherer (1999), and Solomon (1981) which stated that action tendencies play a significant role in the emotional experience. Meanwhile, Arnold (1960) explains emotions as "felt action tendencies" which is beyond just the ability to distinguish the mere feelings of pleasantness or unpleasantness. This is where we see the difference between attitude and action. The action is referred to as felt tendency and attitude is referred to feelings.

The relationship between attitudinal and action is circular. This means one's belief in his ability to use technology will encourage a more positive attitude and vice versa. The separation between the two becomes less meaningful for a technology that has been routinely used but will be highly relevant for new technologies. In addition, the separation of attitudinal and action will be useful from the viewpoint of establishing a positive attitude toward an organization. If a manager is able to acquire the results of these two dimensions, he then can formulate a strategy to improve his employee's attitude regarding the idea of adopting a technology. By providing additional skills and experience in using technology, they can improve the support for technology adoption. Moreover, they can also make connections between new technologies and technologies that have been used so that employees can discover the form of interaction that will occur if they adopt new technologies. This will increase employees' understanding of the new technology so as to clarify their attitude toward technology adoption.

The concept of action readiness is based on the concept of self-efficacy. The term self-referent of efficacy or self-efficacy was initially introduced in Bandura (1982). In recent developments, Bandura (2007) says that self-efficacy is perceived operative capability – beliefs about what one can do through whatever resources, rather what one has. Self-efficacy concerned with how people judge their

capabilities and how, through their self-perception of efficacy, they affect their motivation and action.

Bandura (1977) defines that self-efficacy carries weight in one's choice of activities and environmental settings which includes effort and persistence. People tend to avoid accomplishing a specific task when they have low self-efficacy; on the contrary, those who judge themselves that they are capable are more likely to undertake the task. He also stated that high self-efficacious have a tendency to expend greater effort and persist longer in facing obstacles than those who are not efficacious.

A strength of efficacy also predicts behavior change. As their perceived efficacy becomes stronger, people tend to give more effort and persist longer when they face difficulties on a task in order to achieve their goals. Conformable with this theory, increasing self-efficacy can be done by using enactive mastery; enactive mastery is the most influential sources of efficacy. Other comparative studies have strengthened this finding, the studies show that enactive mastery transcends persuasive (Biran & Wilson, 1981), emotive (Katz, Stout, Taylor, Home, & Agras, 1981), and vicarious (Feltz, Landers, & Raeder, 1979) influences in producing high self-percepts of efficacy.

Bandura (1982) states that self-efficacy is a strong predictor in predicting individual behavior, where the more positive the effect of self-efficacy the easier behavioral trends can be predicted. In line with the concept of self-efficacy, enactive mastery was mentioned to play a significant role in shaping the self-efficacy of an individual, and this statement is also in accordance with other researchers as presented in this paper.

The previous studies assure us that self-efficacy is useful to predict or assess individual belief of capabilities and will affect to motivation and behavioral intention. Especially in facing innovation, self-efficacy concept can use to predict individual belief and self-confident about using new tools, applications, or services that resulted from innovation both in working or daily activities and is expected to enable to close the gap between perception of knowledge and skill and action.

Level, strength, and generality of one's self-efficacy are believed to be a predictor of individual action in using new product or service and also influence to individual behavior. People who have high self-efficacy tend to show positive emotion and attitude, good response, fearless with risks and have high creativity when facing innovation. They have a high desire and expectation of using new tools and applications. Conversely, people who have low self-efficacy tend to show negative emotion and attitude, bad response, avoid risks and have the low creativity of using new tools or application. They have low desire and expectation; even tend to avoid using it.

3. Methodology

The author collects some commonly used models to measure readiness in terms of technology adoption. Technology Readiness Index (TRI), Digital Readiness, Employee Readiness to embrace Electronic Business (EREB), and Mobile Readiness are the readiness models we found in the literature. These models use robustly developed scales, so they provide suitable and good references. Other models such as E-Readiness and Network Readiness are not discussed because this model is used at industrial and country level (Bromideh, 2012;

Katsouli, 2006). After that, we analyze each item in each model and then group it into the attitudinal and action readiness dimensions. In accordance with what we said in the previous section, the item that questions about the perception of technology as an independent object will then be referred to as attitudinal readiness. Meanwhile, items containing perceptions about digital technology as an integrated object will then be referred as action readiness. We assigned three reviewers to each model. The results of the groupings they produce will be compared to each other. We then discuss the results to find the final conclusions about the attitudinal and action readiness content in each model.

4. Findings and Discussion

A. Technology Readiness Index

Technology Readiness Index (TRI) was developed by Parasuraman (2000). Technology readiness defines as people's propensity to embrace and use new technology to accomplish goals in home life and at work. There is plenty of empirical evidence to support the TRI's influence on perceptions of technology and the desire to use technology for life. Some of these are written in Table 1. Naturally, TRI has no direct relationship with digital readiness because of its general stance in defining technology. Nevertheless, TRI offers some perspectives that will be useful in developing digital readiness constructs as follows:

1. TRI is a multidimensional construct with two opposite dimensions: enablers and inhibitors. Accordingly, readiness is an overall state of mind that will be determined by two opposing psychological conditions. Simply said, inclination toward technology adoption will be higher when the enablers are stronger than the inhibitors.
2. TRI is designated as an individual-specific attitudinal scale by the developers (Parasuraman, 2000; Lin et al, 2007; Rojas-Méndez, Parasuraman, & Papadopoulos, 2017). Our elaboration of the scale, however, identifies the existence of action-related items (non-attitudinal item). Take INN3 for example. The item statement is: "I can usually figure out new high-tech products and services without help from others". The statement basically measures the respondent's skill in using technology. As such, this can be considered as an action-related item or part of action readiness.

Table 1.
Researches on the Effects of Technology Readiness

Author(s)	**Domain studied**	**Independent variable**	**Dependent variable**	**Findings**
Lin & Hsieh (2007)	Self-Service Technology (SSTs)	Technology Readiness (TR)	Behavioural intentions toward SSTs	TR has a positive and significant impact on SSTs satisfaction and behavioural intentions. Additionally, SSTs satisfaction was a driver of behavioural intentions.
Lin et al. (2007)	Online stock trading	TR	Use Intention	Based on the integrating model of TR and TAM (TRAM), the online community users' perception of TR affects their beliefs such as perceived usefulness and perceived ease of use, which in turn influence intention to use online trading system.
Walczuch et al. (2007)	Software application	TR	Perceived ease of use, perceived usefulness	Positive and negative TR dimensions respectively influenced perceived ease of use positively and negatively. Additionally, optimism and insecurity respectively influenced perceived usefulness positively and negatively. The result confirmed a strong positive relationship between perceived ease of use and usefulness.
Lin & Chang (2011)	Self-Service Technology	TR	Behavioural Intentions	Technology Readiness affects perceived usefulness, perceived ease of use, attitude toward technology and behavioural intention. Additionally, the study found a negative moderating effect of TR on the relationship between perceived ease of use and attitude.
Oh, Yoon, & Chung (2014).	Mobile Internet service	Positive TR, Negative TR	Intention	Positive and negative TR affected intention toward using mobile Internet through perceived usefulness and ease of use in South Korea. However, in the China group, positive TR had a positive effect on the perceived ease of use, and negative TR had a negative effect on perceived usefulness.

Table 1. (Continued)
Researches on the Effects of Technology Readiness

Author(s)	Domain studied	Independent variable	Dependent variable	Findings
Chung, Han, & Joun (2015)	Augmented Reality (AR) Service	Personal Factor (Technology Readiness), Stimulus Factor (Visual Appeal), Situational Factor (Facilitating Conditions)	AR Usage Intention, Destination Visit Intention	TR was a predictor of perceived usefulness. In addition, visual appeal and facilitating conditions affected perceived ease of use. Perceived ease of use affected perceived usefulness. Finally, perceived usefulness and ease of use affected intention to use AR and to visit a destination via AR attitude.

3. Following our argument above, we classified every item in TRI into attitudinal and action readiness. We obtained 9 items in the first group and 2 items in the second group (see Table 2). Using this result, we argue that TRI is both attitudinal and action scale at the same time. Even though TRI is more inclined to measure attitudinal rather than action, the findings support our argument that technology should be seen as independent and integrated object simultaneously.
4. Four items cannot be categorized as attitudinal or action as follows:
   a. Other people come to me for advice on new technology (INN1)
   b. In general, I am among the first in my circle of friends to acquire new technology when it appears (INN2)
   c. I keep up with the latest technological developments in my areas of interest (INN4)
   d. I do not feel confident doing business with a place that can only be reached online (INS4)
   e. When I get technical support from a provider of a high-tech product or services, I sometimes feel as if I am being
   f. taken advantage of by someone who knows more than I do (DIS1)

Those items fall into different categories. The first three items measure personal innovativeness, whereas the last two are emotional responses toward technology. Personal innovativeness plays an important role in TRI because Parasuraman (2000) used it as the main reference when constructing TRI. Personal innovativeness is a personality trait that reflects a tendency to find new information, stimuli, or experiences that tend to be stable from time to time (Midgley and Dowling, 1978; Hirschman, 1980; Agarwal and Prasad, 1998).

In addition to personal innovativeness, TRI measures different emotional responses, which are optimism, insecurity, and discomfort toward technology. The responses rise after the evaluation of attitudinal and action readiness toward technology. It is the emotional response that eventually determines the final result, i.e. the inclination to adopt technology in life. Following this line of argument, we draw a schematic diagram that represents the

entire items in TRI as can be seen in Figure 1. Personal innovativeness is the basic trait that influences attitudinal and action readiness towards technology. The readiness creates emotional responses that will influence individual predisposition toward technology adoption. Emotional response is also defined as both positive and negative feelings which are triggered by the exposure to technology (Parasuraman, 2000).

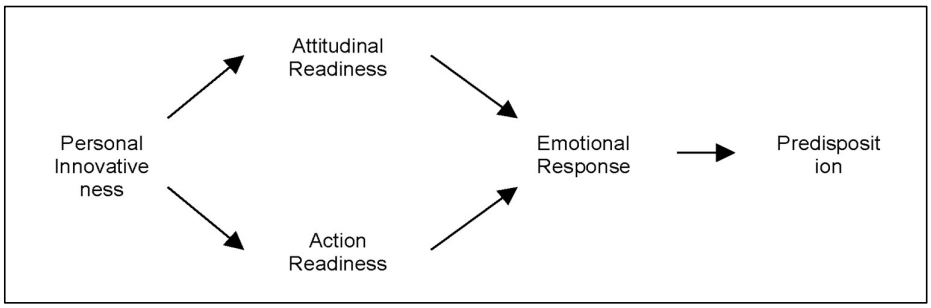

Figure 2.
A Schematic Diagram of Group of Items in TRI

Table 2.
The Technology Readiness Index Categorization to Personal Innovativeness, Attitudinal Readiness, Action Readiness, and Emotional Response

Items	Personal Innovativeness	Attitudinal Readiness	Action Readiness	Emotional Response
Innovativeness				
INN1 - Other people come to me for advice on new technology	X			
INN2 - In general, I am among the first in my circle of friends to acquire new technology when it appears	X			
INN3 - I can usually figure out new high-tech products and services without help from others			X	
INN4 - I keep up with the latest technological developments in my areas of interest	X			

Table 2. (Continued)
The Technology Readiness Index Categorization to Personal Innovativeness, Attitudinal Readiness, Action Readiness, and Emotional Response

Items	Personal Innovativeness	Attitudinal Readiness	Action Readiness	Emotional Response
Optimism				
OPT1 - New technologies contribute to a better quality of life		X		
OPT2 - Technology gives me more freedom of mobility		X		
OPT3 - Technology gives people more control over their daily lives		X		
OPT4 - Technology makes me more productive in my personal life		X		
Discomfort				
DIS1 - When I get technical support from a provider of a high-tech product or services, I sometimes feel as if I am being taken advantage of by someone who knows more than I do				X
DIS2 - Technical support lines are not helpful because they do not explain things in terms I understand			X	
DIS3 - Sometimes, I think that technology systems are not designed for use by ordinary people		X		
DIS4 - There is no such thing as a manual for a high-tech product or service that is written in plain language		X		
Insecurity				
INS1 - People are too dependent on technology to do things for them		X		
INS2 - Too much technology distracts people to a point that is harmful		X		

Table 2. (Continued)
The Technology Readiness Index Categorization to Personal Innovativeness, Attitudinal Readiness, Action Readiness, and Emotional Response

Items	Personal Innovativeness	Attitudinal Readiness	Action Readiness	Emotional Response
Insecurity (Continued)				
INS3 - Technology lowers the quality of relationships by reducing personal interaction		X		
INS4 - I do not feel confident doing business with a place that can only be reached online				X

This new understanding may explain the inconsistencies of TRI measurement in the field. Several researchers pointed out that the four dimensions of technology readiness suggested by Parasuraman (2000) failed to be confirmed as independent dimensions (Berger, 2009; Liljander, Gillberg, Gummerus, & Riel, 2006; Taylor, Celuch, & Goodwin, 2002). More specifically, similar problems have been reported that inhibitors such as discomfort and insecurity have been proved unstable (Chung, Han, Joun, 2015). Taylor, Celuch, & Goodwin, (2002) identified that the stronger dimensions for technology readiness are optimism and innovativeness. In line with this study, Berger (2009) referred to the technology dimensions as enablers (i.e. optimism and innovativeness) to reflect the inconsistency regarding technology readiness dimensionality.

Furthermore, Liljander et al. (2006) examined the influence of overall technology readiness (four dimensions), enablers of technology readiness (i.e. optimism and innovativeness), and inhibitors of technology readiness (i.e. discomfort and insecurity) on new technologies users' attitudes, adoption, and responses according to Parasuraman (2000). The results showed that inhibitors could not be tested because they do not form the individual dimensions. Therefore, many researchers seeking permission to use the scale were only interested in measuring overall TR, as just one construct in comprehensive multi construct frameworks (Chung, Han, Joun, 2015).

B. Electronic Business Readiness

Lai and Ong (2010) in their study on "assessing and managing employees for embracing change" figured out a multiple-item scale to measure employee readiness for e-business. Lai and Ong (2010), as based on TRI research by Parasuraman (2000), defined employee readiness for e-business as an employee's propensity to embrace e-business. This propensity is dependent on whether employees understand the benefits of e-business which are capable of being able to perform e-business operations or have a strong determination to embrace e-business.

They generated 27 items to form the temporary initial pool. Then, interviews with professors, doctoral students, and practitioners were undertaken to modify, eliminate, and refine these items. In this stage some items were deleted, modified, and added because of repetition or lack of clarity. Consequently, a 29-item list comprised of three dimensions that constituted a complete domain of the initial item pool for EREB measurement was obtained. Factor analysis was then conducted to identify the underlying factors or the dimensional composition of the EREB instrument. Item factorially impure were eliminated to enable greater specificity of hypotheses (Weiss, 1980).

The result confirmed four factors that were then labeled as the benefit, security, collaboration, and certainty based on the meaning of the items. Benefit means that e-business can improve employee job performance; security indicates that employee is not worried that e-business will change their job status; collaboration refers to how employees work with the others and how they share information/knowledge regarding e-business; and certainty implies that employees understand what functions e-business can provide and their belief that the company will implement it successfully.

Based on our understanding of Attitudinal and Action Readiness, we found that the four components of the structure of digital readiness are applied in this model. Below are all the items included on EREB and how it is divided into Personal Innovativeness, Attitudinal Readiness, Action Readiness, and Emotional Responses. The table shows that there are five items that incline toward Attitudinal Readiness and also five items toward Action Readiness.

Table 3.
Items Included on the E-Readiness For E-Business (EREB) Study

Items	Personal Innovativeness	Attitudinal Readiness	Action Readiness	Emotional Response
Benefit				
B1 - e-Business will improve productivity for me		X		
B2 - e-Business will enhance efficiency of my job		X		
B3 - e-Business will be helpful to my job		X		
B4 - I always utilise functions provided by e-business			X	
B5 - e-Business enables me to be more competitive in my job		X		

Table 3. (Continued)
Items Included on the E-Readiness For E-Business (EREB) Study

Items	Personal Innovativeness	Attitudinal Readiness	Action Readiness	Emotional Response
Security				
S1 - I do not worry that e-business will make me lose my job				X
S2 - I do not worry that e-business will result in a job change for me				X
S3 - I do not worry that e-business will affect my influence in the work environment				X
S4 - I do not worry that e-business will affect my power in the work environment				X
Collaboration				
C1 - I am glad to discuss with co-workers through e-mail or digital technologies (e.g. video conference or chat)			X	
C2 - I am glad to share knowledge about e-business with co-workers				X
C3 - I am glad to work with co-workers on a team from anywhere in which everyone can access and give input to a common product or document that is available online			X	
C4 - I am glad to provide advice and help to fellow employees on how to use e-business			X	
Certainty				
T1 - I understand clearly the purposes of e-business	X			
T2 - I understand clearly the functions of e-business	X			
T3 - I am glad to cooperate with activities regarding e-business				X

Table 3. (Continued)
Items Included on the E-Readiness For E-Business (EREB) Study

Items	Personal Innovativeness	Attitudinal Readiness	Action Readiness	Emotional Response
Certainty (Continued)				
T4 - I believe that my company will implement e-business successfully			X	
T5 - e-business is honourable		X		

C. Mobile Readiness

Research about mobile readiness has been investigated by Cheon, Lee, Crooks, and Song (2012) which explains how college students' beliefs influence their intention to adopt mobile devices in their coursework, namely mobile learning. Mobile learning is a specific type of learning model using mobile technology (Naismith, Lonsdale, Vavoula, & Sharples, 2004; Yuen & Yuen, 2008). M-learning embraces many features of e-learning such as multimedia contents and communications with other students (Horton, 2006), but it is unique in terms of flexibility of time and location (Peters, 2007). The characteristics of mobile devices are three folds: (a) portability: mobile devices can be taken to different locations, (b) instant connectivity: mobile devices can be used to access a variety of information anytime and anywhere, and (c) context sensitivity: mobile devices can be used to find and gather real or simulated data (BenMoussa, 2003; Churchill & Churchill, 2008; Klopfer, Squire, & Jenkins, 2002; Sharples, 2000).

Indicators in this study refer to the attitudinal construct that adopts from the Theory of Planned Behavior and is also influenced by external factors. In this study, external beliefs are formed based on attitudinal beliefs (perceived ease of use and perceived usefulness), normative beliefs (instructor and student readiness), and control beliefs (perceived self-efficacy and learning autonomy). We found that this study investigates both attitudinal and action readiness. Attitudinal readiness can be reflected through statements: I believe that mobile devices would be easy to use, I believe that mobile devices would be easy to operate, I would like my coursework more if I used m-learning, I think other students in my classes would be willing to adopt a mobile device for learning, and most people who are important to me would be in favor of using a mobile device for university courses. Meanwhile, action readiness is measured through statements such as I am confident about using a mobile device for my courses, using a mobile device for my courses would not challenge me, I have a sufficient extent of knowledge to use m-learning, I would be able to control the pace of learning in my classes with a mobile device, and I would have more opportunities to create knowledge in my coursework with a mobile device.

In addition to Cheon et al. (2012), Lin, et al. (2016) also conducted a study on mobile readiness. They developed a scale to measure mobile readiness. Our evaluation of this scale is explained in the

following table. We also discover that this model contains the four items of digital readiness, namely Personal Innovativeness, Attitudinal Readiness, Action Readiness, and Emotional Responses. Hence, we divide each item based on the four items.

Table 4.
Mobile Readiness Categorization to Attitudinal Readiness and Action Readiness

Items	Personal Innovativeness	Attitudinal Readiness	Action Readiness	Emotional Response
M-learning self-efficacy				
L1 - I feel confident in performing the basic functions of mobile learning systems			X	
L2 - I feel confident in my knowledge and skills of mobile learning systems				X
L3 - I feel confident in using mobile learning systems to effectively communicate with others			X	
L4 - I feel confident in using the internet (Google, Yahoo) to find or gather information for mobile learning			X	
L5 - I feel confident in studying to operate mobile learning systems			X	
L6 - I feel confident in knowing all the special keys and functions contained in a mobile learning system			X	
L7 - I feel confident in knowing how a mobile learning system works			X	
Optimism				
E1 - I like studying via mobile learning systems because I am able to study anytime				X
E2 - Mobile learning systems make me more efficient in my studying		X		

Table 4. (Continued)
Mobile Readiness Categorization to Attitudinal Readiness and Action Readiness

Items	Personal Innovativeness	Attitudinal Readiness	Action Readiness	Emotional Response
Optimism (Continued)				
E3 - I like mobile learning systems that allow me to tailor				X
E4 - I like mobile learning systems				X
E5 - Mobile learning systems give people more control over their studying time		X		
E6 - The newest mobile learning system is much more convenient to use		X		
E7 - Mobile learning systems give me more freedom of studying		X		
Self-directed learning				
S1 - I can direct my own learning progress	X			
S2 - I carry out my own study plan	X			
S3 - In my studies, I set goals and have a high degree of initiative	X			
S4 - I manage time well	X			
S5 - In my learning, studying, or working, I am self-disciplined and find it easy to set aside learning time	X			

Readiness is not only physical maturity but also a combination of emotional and cognitive forces that mediate learning environments and results in the mastery of new operation (Beller, 1972; Gesell, 1928; Lai and Ong, 2010). Theory self-efficacy provides an explanation that the mastery of new operation, which we address as action readiness, will be an important aspect of adopting a technology. The belief to utilize a technology and generate maximum benefits from the technology is the reason why one decides to adopt the technology. Therefore, in measuring the digital readiness we need to analyze the two elements - attitudinal readiness and action readiness.

From the research results, we also discover that there are five key items to measure the digital readiness, namely

personal innovativeness, attitudinal readiness, action readiness, emotional response, and predisposition. Personal innovativeness has an impact on attitudinal and action readiness towards technology. The attitudinal readiness that exists in all three models leads to the measurement of perceptions about the benefits and impacts of technology.

A person who has high attitudinal readiness will see technology as something that is very useful and has a positive impact on someone as well as others. Meanwhile, the action readiness in those models refers to the measurement of an individual's efficacy in using digital technology or readiness to work in a new environment after digital technology adoption. Both of the readiness constructs will form the emotional response which eventually will influence one's predisposition towards the adoption of technology.

Our review results show that the TRI model includes three elements of personal innovativeness, most of the elements of attitudinal readiness, two elements of action readiness and two elements of emotional readiness. As stated before, TRI only has a few elements of action readiness. It is understandable because TRI measures the general perception of a technology so that the measurement of action readiness becomes less relevant.

Action readiness becomes more relevant in the EREB model as it specifically measures readiness in using e-business. Although e-business itself is quite general, questions about the basic skills needed to be able to use them are relevant so that action readiness appears within the EREB scale. EREB model consists of four elements of attitudinal readiness and five elements of action readiness. In addition, EREB model only covers two elements of personal innovativeness and six elements of emotional responses.

Meanwhile, in the third model, the mobile readiness model, it only has five elements of personal innovativeness, four elements of attitudinal actions, six elements of action readiness and four elements of emotional responses. Action readiness was more prevalent in the mobile readiness model we learned from Lin *et a.l*'s (2016) research. This is because they study the application of mobile technology in a specific context, namely mobile learning.

The above argument becomes one of the reasons why research on technology readiness still provides inconsistent findings. This is because there is an imbalance between attitudinal and action readiness in the readiness models that exist in the current literature. Someone may have a positive assessment towards technology, yet he may not be able to utilize the technology as he is not capable of doing so. Therefore the attitudinal component of readiness should be greater if we want to examine a person's attitude towards technology in general like the one in TRI. If the technology is clear enough then we should start using readiness action more balanced with attitudinal readiness.

Our analysis indicates that attitudinal action is related to how an individual view technology as an independent object. This means technology is associated with its nature, essence, personality, benefit, physical forms, characters, implications, and utilization. Meanwhile, action readiness is related to how an individual view technology as an integrated object. In other words, action readiness denotes that technology is associated with an individual's self-efficacy, how someone can use his/her

abilities in operating a technology, how someone possesses a sound knowledge of technology which enables him/her to teach others, how someone can anticipate the impact of technology adoption in his/her daily work life etc.

For practical assessment, the measurement of these two elements is sufficient. However, to further develop this research, we have to trace into the antecedent. Now, there is only one antecedent that can be found, namely personal innovativeness. Considering that personal innovativeness is a stable trait, it might lead to a difficult further research development. Therefore, the model should be developed towards the seeking of new antecedent or moderating variables which are not a trait. Hence, the development process of the digital readiness is easier to be conducted.

5. Conclusions

Our study discovers that structures in all three models, TRI, EREB, and mobile readiness model, consist of personal innovativeness, attitudinal readiness, action readiness, emotional response, and predisposition. Personal innovativeness is defined as the antecedent of attitudinal and action readiness. It influences both readiness towards technology. Meanwhile, the emotional response is the consequence of these readiness. The emotional response will determine the individual predisposition, i.e. the inclination towards technology adoption in life.

In addition, in all three models, we find elements related to attitudinal readiness as the capabilities, impacts, functions, and implications of technology. This implies that attitudinal readiness is indicated by the perception of technology as a separate object (an independent object), for example, technology gives more freedom of mobility, technology gives more control over daily lives, and technology will improve productivity. Meanwhile, we also found elements related to action readiness that is seen as an individual's efficacy in using digital technology.

Hence, action readiness is then can be viewed as an integrated object. Some examples of elements containing perceptions about digital technology as an integrated object are I can usually figure out new high-tech products and services without help from others, I always utilize functions provided by e-business, and I feel confident in performing the basic functions of mobile learning systems. From the above discussion, the authors gather that when it comes to measuring individual readiness on utilizing technology and digital application usage, the items of the measurement have to be balanced in measuring attitudinal and action readiness. This is because attitude and perception that can form behavior (attitudinal readiness) have to be followed by motivation, knowledge, and skills that in the end will form action readiness. Moreover, action readiness cannot be forgotten as skills and vocational competence in using objects (technology and digital application) will be supported by action readiness (Frijda, 1989; Baartman & Bruijn, 2011).

Further research is needed in order to develop a scale that includes both proportional attitudinal and action readiness aspects. This scale should be tested in a study to acquire empirical evidence to prove that the two aspects are indeed needed in developing digital readiness. In addition, the empirical results are also required to find out which of these two aspects are more important in the formation of digital readiness.

Moreover, we also need to observe whether the development approach is more effective than the mapping/placement approach. The development approach is conducted by developing every individual into their desired or maximum level for every aspect of both dimensions of digital readiness – attitudinal readiness and action readiness. Therefore, it is expected that every individual can act as an individual agent in adopting a technology.

Meanwhile, regarding the mapping/placement method, we ascertain that there is only one antecedent can be found, namely personal innovativeness. This means when we develop people based on their personal innovativeness, it will lead to a dead-end. It is because, as stated before, personal innovativeness is a stable personality trait that is difficult to change over time. Hence, the mapping/placement method is seen as an appropriate method for handling this matter. We need to define our requirements so we can design the best composition of people in encouraging the technology adoption. An individual who has a high level of digital readiness will lead a company; conduct a change management etc., while an individual with a lower level of digital readiness will execute the business operational.

References

Agarwal, R., & Prasad, J. (1998). A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information systems research*, 9(2), 204-215.

Ariff, M.S.M., Yeow, S.M., Zakuan, N., Jusoh, A., & Bahari, A.Z. (2012). The effects of computer self-efficacy and technology acceptance model on behavioral intention in internet banking systems. *Social and Behavioral Sciences,* 57, 448-452

Arnold, M.B. (1960). *Emotion and personality (Vols. 1 and 2).* New York: Columbia University Press.

Baartman, L. K. J., & Bruijn, E. (2011) Integrating knowledge, skills and attitudes: Conceptualising learning process towards vocational competence. *Educational Research Review* (6), 125-134.

Bandura, Albert (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215

Bandura, Albert. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 37(2), 122-147.

Bandura, A. (2007). Much ado over a faulty conception of perceived self–efficacy grounded in faulty experimentation. *Journal of Social and Clinical Psychology*, 26(6), 641-658.

Beller, E. K. (1972). The concept readiness and several applications. *Exploring Human Development: Interdisciplinary readings*. Bernard, H. W. and Huckins, W. C. Boston, Ally and Bacon Inc.: 507-518.

BenMoussa, C. (2003). Workers on the move: New opportunities through mobile commerce. *Stockholm mobility roundtable*, 22-23.

Berger, S. C. (2009). Self-service technology for sales purposes in branch banking: The impact of personality and relationship on customer adoption. *International Journal of Bank Marketing*, 27(7), 488–505.

Beuningen, J.V., Ruyter, K.D., Wetzels, M., & Streukens, S. (2009). Customer self-efficacy in technology-based self-service. *Journal of Service Research*, 11(4), 407-428

Biran, M., & Wilson, G. T. (1981). Treatment of phobic disorders

using cognitive and exposure methods: A self-efficacy analysis. *Journal of Consulting and Clinical Psychology*, 49(6), 886.

Bromideh, A.A. (2012). Factors affecting customer e-readiness to embrace auto e-insurance in Iran. *Journal of Internet Banking and Commerce*, 17(1)

Cheon, J., Lee, S., Crooks, S.M., & Song, J. (2012). An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers & Education*, 1054 - 1064

Chung, N., Han, H., & Joun, Y. (2015) Tourists' intention to visit destination: Role of augmented reality applications for heritage site. *Computers in Human Behavior*.

Churchill, D., & Churchill, N. (2008). Educational affordances of PDAs: A study of a teacher's exploration of this technology. *Computers & Education*, 50(4), 1439-1450.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340

De Riveral, J. (1977). A structural theory of the emotions. New York: International Universities Press.

Feltz, D. L., Landers, D. M., & Raeder, U. (1979). Enhancing self-efficacy in high-avoidance motor tasks: A comparison of modeling techniques. *Journal of Sport Psychology*, 1(2), 112-122.

Fridja, N.H., Kuipers, P., & Schure, E.T. (1989). Relations Among Emotion, Appraisal, and Emotional Action Readiness. *Journal of Personality and Social Psychology*, 57(2), 212-228.

Gesell, A. L. (1928). *Infancy and Human Growth*. NY, Macmillan.

Hamzah, A. & Mustafa, S. E. (2014). Digital Readiness of Malaysian Journalists. *Advances in Journalism and Communication*, 2, 58-67.

Hirschman, E. C. (1980). Innovativeness, novelty seeking, and consumer creativity. *Journal of consumer research*, 7(3), 283-295.

Horrigan, J.B. (2016). *Digital Readiness Gaps*. Pew Research Center.

Horton, W. (2006). *E-learning by design*. San Francisco, CA: Pfeiffer

James, J. (2008). Digital Preparedness Versus the Digital Divide: A Confusion of Means and Ends. *Journal of The American Society for Information Science and Technology*, 59(5), 785–791

James, J. (2011). Internet skills in developing countries: how much do we know? *Information Development,* 27(2), 94–99

Katsouli, E. (2006). Investigating the Impact of Technology and Network Readiness on National Competitiveness. *Journal of Information Technology Impact*, 6(3), 153-160.

Katz, R. C., Stout, A. L., Home, M., Taylor, C. B., & Agras, W. S. (1981). *The use of propranolol in the treatment of severe spider phobics*. Unpublished manuscript, Stanford University.

Klopfer, E., Squire, K., & Jenkins, H. (2002). Environmental detectives: PDAs as a window into a virtual simulated world. In *Wireless and Mobile Technologies in Education, 2002. Proceedings. IEEE International Workshop on* (pp. 95-98). IEEE.

Lai, J. & Ong, C. (2010). Assessing and managing employees for embracing change: A multiple-item scale to measure employee readiness for e-business. *Technovation*. 30. 76-85.

Liljander, V., Gillberg, F., Gummerus, J., & Riel, A. (2006) Technology readiness and the evaluation and adoption of self-service technologies. *Journal of Retailing and Consumer Services*. 13. 177-191.

Lin, C. H., Shih, H. Y., & Sher, P. J. (2007). Integrating technology readiness into technology acceptance: The TRAM model. *Psychology & Marketing*, 24(7), 641–657.

Lin, H.H., Lin, S., Yeh, C.H. & Wang, Y.S. (2016). Measuring mobile learning readiness: scale development and validation. *Internet Research*, 26(1), 265 - 287

Lin, J. S. C., & Chang, H. C. (2011). The role of technology readiness in self-service technology acceptance. *Managing Service Quality,* 21(4), 424–444.

Lin, J. S. C., & Hsieh, P. L. (2007). The influence of technology readiness on satisfaction and behavioral intentions toward self-service technologies. *Computers in Human Behavior*, 23(3), 1597–1615.

Midgley, D. F., & Dowling, G. R. (1978). Innovativeness: The concept and its measurement. *Journal of consumer research*, 4(4), 229-242.

Naismith, L., Lonsdale, P., Vavoula, G. N., & Sharples, M. (2004). Mobile technologies and learning.

Oh, J. C., Yoon, S. J., & Chung, N. (2014). The role of technology readiness in consumers' adoption of mobile internet services between South Korea and China. *International Journal of Mobile Communications*, 12(3), 229–248.

Parasuraman, A. (2000) Technology readiness index (tri) a multiple-item scale to measure readiness to embrace new technologies. *Journal of Service Research*, 2, 307-320.

Peters, K. (2007). m-Learning: Positioning educators for a mobile, connected future. *The International Review of Research in Open and Distributed Learning*, 8(2).

Potnis, D.P. & Pardo, T.A. (2011). Mapping the evolution of e-Readiness assessments. *Transforming Government: People, Process and Policy,* 5(4), 345 – 363.

Pullen, D. L. (Ed.). (2009). *Technoliteracy, Discourse, and Social Practice: Frameworks and Applications in the Digital Age: Frameworks and Applications in the Digital Age*. IGI Global.

Punchihewa, D.J. (2004). *The measurement of e-Government readiness in Sri Lanka: survey perspectives.* In the Proceedings of the 2nd International Conference on e-Governance: from policy to reality, 29th November to 4th December 2004, Colombo, Sri Lanka

Quaicoe J.S. & Pata, K. (2015). *Modelling Factors Influencing Digital Readiness: A Case of Teachers in Ghana's Basic School System*. In: Li F., Klamma R., Laanpere M., Zhang J., Manjón B., Lau R. (eds) Advances in Web-Based Learning -- ICWL 2015. *Lecture Notes in Computer Science*, vol 9412. Springer, Cham

Queensland Department of Trade and Industry (2016). *CCIQ Digital Readiness Study* 2016.

Rojas-Méndez, J. I., Parasuraman, A., & Papadopoulos, N. (2017). Demographics, attitudes, and technology readiness: A cross-cultural analysis and model validation. *Marketing Intelligence & Planning*, 35(1), 18-39.

Scherer, K. R. (1999). *Appraisal theory. Handbook of cognition and emotion*, 637-663.

Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers & Education*, 34(3-4), 177-193.

Shaver, P., Schwarts, J., Kirson, D, & O'Connor, C. (1987). Emotion Knowledge: Further exploration of a prototype approach. *Journal of Personality and Social Behavior*. 52, 1061-1086.

Solomon, G. F. (1981). Emotional and personality factors in the onset and course of autoimmune disease, particularly rheumatoid arthritis. *Psychoneuroimmunology*, 159-182.

Taylor, S. A., Celuch, K., & Goodwin, S., (2002). Technology readiness in the e-insurance industry: an exploratory investigation and development of an agent technology e-consumption model. *Journal of Insurance*. 25 (2) 142-165.

Walczuch, R., Lemmink, J., & Streukens, S., (2007) The effect of service employees' technology readiness on technology acceptance. *Information & Management*. 44. 206-215.

Weiss, C. H. (1980) Knowledge creep and decision accretion. *Knowledge: Creation, Diffusion, Utilization.* 1(3), 381-404.

Westerman, G., D. Bonnet, & McAfee, A. (2014). *Leading Digital, Turning Technology into Business Transformation*, Harvard Business Press.

World Economic Forum (2016). *The Digital Media Readiness Framework*. White Paper of Global Agenda Council on the Future of Media, Entertainment & Information.

Yuen, S. C. Y., & Yuen, P. K. (2008). Mobile learning. In *Encyclopedia of information technology curriculum integration* (pp. 580-586). IGI Global.