pISSN: 1906 - 3296 © 2020 AU-GSB e-Journal.
http://www.assumptionjournal.au.edu/index.php/AU-GSB
eISSN: 2773 - 868x © 2020 AU-GSB e-Journal.

Determinants of Intention to Use DevOps in Cambodia's Technology Industry

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Received: May 27, 2021. Revised: June 23, 2021. Accepted July 27, 2021.

Abstract

This research investigates the key determinants that impact the intention of developers to use DevOps practice in technology industry, mainly software development, within Phnom Penh, Cambodia. The study was carried out using a quantitative research method to survey 472 software developers, tech entrepreneurs, DevOps practitioners, software project team members, and IT leaders familiar with DevOps practice. The respondents came from software development, technology startup, telecom, internet service providers, financial service institution, technology consulting, and system integrators. The survey employed non-probability sampling method – judgmental, snowball, and convenience sampling. Online Google form was used in the survey from the period January to June 2021. Also, confirmatory factor analysis and structure equation model were used to validate and identify the relationship and the impact of various factors on the intention to use DevOps. Organizational usefulness, personal awareness, and perceived compatibility have significant direct impacts on the intention to use DevOps software development methodology by developers and practitioners. Also, subjective norm and perceived behavioral control internal have the indirect impact on the Intention through organizational usefulness. Moreover, perceived number of users impacts significantly on the perceived availability of complementary services; both indirectly impact the intention to use DevOps through perceived compatibility. Whereas, perceived cost and perceived pisk are not found to have significant impact on intention to use DevOps by the developers.

Keywords: Development and Operation, DevOps, SDM

JEL Classification Code: M15, O32, O39

1. Introduction

In a typical IT organization, Development (Dev) and Operation (Ops) work in silos. These two teams are usually conflicting due to their defined job description and goals. Dev team aims for speed to market while Ops team targets for system stability. This chronic problem has been blocking the organization from moving faster. Atlassian (2020) described that the reaction to this controversial relationship was a movement and a software development methodology (SDM) called DevOps. It is a simple concept where Dev and Ops teams work together as one team collaboratively. As a result, the end-to-end software development cycle can happen more quickly, continuously, and reliably. Formal adoption of DevOps practice within the organization will be a breakthrough innovation for the organization to get new ideas to market faster with much higher quality and fewer defects. In addition, it helps to reduce the cost of development and operation, improve productivity, and increases employee satisfaction (Accenture Technology, 2015). According to Forsgren et al. (2019), elite performer, those with advanced DevOps practice, outperformed the low performer in both operational metrics: throughput and stability. Elite performer achieved 208 and 106 times more often in code deployment and lead time from the commit to the deployment of code respectively. At the same time, it also proved 2,604 faster in incident recovery and 7 times less in change failure rate. Forsgren et al. (2018) confirmed that DevOps, when appropriately implemented, helped the organization address culture problems, transform itself from troublesome bureaucratic and pathological toward a targeted and ideal "generative" organization. The organizational

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culture would be optimized for information flow, trust, innovation, and risk-sharing was the predictor of software delivery and operational performance (Forsgren et al., 2018).

As in 2013, Cambodia had around 60 percent of its population age between 15 and 54 – a young and capable workforce. According to World Bank (2020), Cambodia achieved a lower-middle-income country in 2015 and aiming to be an upper-middle-income country in 2030. Cambodia's GDP had a substantial growth of 7 to 8 percent, driven by tourism and garment export with zero tax incentives from the US and Europe. Hootsuite Social Report (2019) reported 12.5 million internet users in Cambodia with 8.4 million active social media users. It was ready to take digital transformation at scale with the dilemma of digitize-or-die. With 8 million employments, skilled and productive workers had still been a challenge for Cambodia and they had not been prepared for the massive opportunity of the digital economy (World Bank, 2019). With the evolution of industry 4.0, dependency of low-cost-labor competitive advantage and the foreign grant would be the dead-end for Cambodia. It needed a better innovative system to uplift productivity to help the nation to differentiate and compete (World Bank, 2019). Development and upgrading digital skills and productivities of the workforce, particularly in basic and advanced ICT skills, would be the key drivers of the growth and attracting foreign direct investment to invest in the country. It had been the critical pillars of the Cambodian Government's rectangular strategy phase 4 (Beschorner et al., 2018; Royal Government of Cambodia, 2018). Specifically, in the technology and software development space, it was already proven globally that successful adoption and implementation of the DevOps practice within its core processes would be crucial for the success of the organization (Forsgren et al., 2018, 2019; Forsgren & Humble, 2015; Humble & Molesky, 2011; Kim, 2012). It will be critically important for Cambodia to motivate its technology community to consider and plan to adopt and implement this practice within their organizations. Formal adoption will improve the workforce's productivity and make organizations more agile and competitive in the skilled regional market. It will allow Cambodian organizations to be at par and at the forefront of local and regional competition. Adopting DevOps practice will be one of the game-changers amongst many initiatives to help improve the productivity and efficiency of its workforce in the digital and ICT domain.

The DevOps practice is relatively new in the developing world, specifically within Cambodia. Therefore, at the early stage of behavioral study, it is crucial to understand the factors that would drive the intention of developers and practitioners to use DevOps. Moreover, it will provide crucial input for various development programs at the community and the country level. Hence, this study aimed to identify the critical determinants that impact the intention to use DevOps within the technology industry within Phnom Penh, Cambodia.

2. Literature Review and Research Framework

2.1. Literature Review

The conceptual framework that was presented in this research was developed based on the well-known core technology acceptance theories such as the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), Network Externality Economics Theory (NE), and the Information System Development and Acceptance Model (ISDAM).

2.1.1. Theory of Reasoned Action

The theory of reasoned action (TRA) was anticipated by Ajzen and Fishbein (1980). It was used explicitly in the technology and information system environment. TRA proved the relationship between the user's attitude and their behavioral intention to act. It explained the motivation and the reason why humans acted. According to Ajzen and Fishbein (1980), the human's intention toward particular action was the key predictor of their actual behavior. TRA proposed two factors that influenced humans to perform a specific action. One of them was an "attitude" toward performing behavior; it was the belief that performing a particular action would generate a satisfactory result for oneself. Another factor was subjective norms (SN) or social influence, which related to performing the behavior.

2.1.2. Theory of Planned Behavior

The theory of planned behavior (TPB) was an extension of TRA. It was proposed by Ajzen (1991) to address the limitation in TRA, where the individual had less decision power on the behavior. Ajzen (1991) included the perceived behavior control (PBC) variable to the TRA in TPB as a third predictor of the two limited variables (attitude and subjective norm). TPB had been commissioned to understand the individual acceptance and behavior of many different systems and platforms in various settings (Harrison et al., 1997; Mathieson, 1991; Taylor & Todd, 1995).

2.1.3. Information System Development Acceptance Model

The information system development acceptance model (ISDAM) was proposed by Hardgrave and Johnson (2003) to assess information system development (ISD) acceptance. ISDAM combined TPB, TAM, and the theory of goal setting (Hollenbeck & Klein, 1987) to form another

model. It was proposed to explain the acceptance of ISD processes by the developers in the ISD setting (Masombuka & Mnkandla, 2018). It borrowed the concept from TPB, where attitude, subjective norms, and perceived behavioral control were the critical drivers of behavioral intention toward the IS. In addition, it was derived from TAM, where the subjective norm, perceived usefulness, and perceived ease of use were the critical antecedents of behavioral intention. Hardgrave and Johnson (2003) also adapted the concept from the goal-setting theory, where personal and situational factors were acquired. According to them, the intention to use the information system had three core determinants: subjective norm (SN), organizational usefulness (OU), and perceived behavior control internal (PBCI).

2.1.4. Network Externality Theory

Network externality (NE) was the economic theory that was originated from Leibenstein (1950) notion of the bandwagon effect. It was described as a change in the advantage that an agent derived from a product when there were changes in the number of other agents using the same product type (Liebowitz & Margolis, 1994). The users bought the products to be part of the network, where the network referred to the base of users of innovations. There were two types of network externality: direct NE and indirect NE. Direct NE was the perception of how big the community of the users was, who were using the products or services (perceived number of user). Moreover, Katz and Shapiro (1986) stated that indirect NE was the perception of availability of complementary services (PACS). The early research of NE was concentrated on the corporate environment (Kauffman et al., 2000).

2.2. Research Framework

2.2.1. Intention to Use

The intention was generally used as a predictor of the approval phase of adoption. It became the standard measure for determining the approval of information system. It had demonstrated continuously to be a significant driver of future usage continuity (Agarwal, 2000). The intention was a core factor and generally used as the primary variable in several theories such as TRA, TAM, UTAUT. Moreover, intention was defined as the likelihood of users to perform a particular behavioral action (Ajzen, 1991; Ajzen & Fishbein, 1980).

2.2.2. Subjective Norms

Subjective norm (SN) was introduced in TRA by Ajzen and Fishbein (1980). One's behavior was influenced by people surrounding them (social beliefs). It was the thought of an individual that people, who influenced them, think they should undergo the subjected behavior (Ajzen & Fishbein, 1980). In another research in the DevOps context, Masombuka and Mnkandla (2018) mentioned that SN was the social influence of essential people on a developer's acceptance of SDM. The influences happened in two ways: directly from colleagues and managers and indirectly from the perception of usefulness to the firm, imperatives, and guidelines. According to Hardgrave and Johnson (2003), SN was the perceived effect that people within the developer network (such as supervisors, colleagues, and mentors) had on their use of ISD process. Ajzen (1988) suggested in his research on TPB that SN was the perception of the social push to implement the behavior and influenced a person's intention. In the ISD setting, Hardgrave and Johnson (2003) stated that supervisors and colleagues might impact the acceptance of SDM on a developer directly or indirectly through usefulness. Venkatesh and Davis (2000) claimed a strong connection between SN and usefulness; this was particularly useful in the mandatory or organizational context. Hence, the following hypothesis was suggested.

H1: *Subjective Norm has a significant impact on Organizational Usefulness.*

2.2.3. Perceived Behavioral Control Internal

Perceived Behavioral Control (PBC) could be regarded as the simplicity or inconvenience of executing a specific behavioral action seen by the individual with the intent (Ajzen, 1991). Moreover, Armitage et al. (1999) defined PBC internal (PBCI) as one's internal perception that one owned control over personal resources, such as required competency, knowledge, confidence, sufficient planning, and the capability to perform the behavior. PBCI was identical to perceived ease of use (PEOU) in TAM (Davis et al., 1989). It was also supported by Mathieson (1991), where he claimed that PBCI was the perception that using the technology was effortless. Hardgrave and Johnson (2003) also stated that PBCI significantly influenced the developer's perception to believe that ISD was helpful for themselves personally and the organization. Thus, although PBCI did not directly impact the intention to use a process, it had a sizable effect on the organizational usefulness. Hence, the following hypothesis was suggested.

H2: *Perceived Behavioral Control Internal has a significant impact on Organizational Usefulness.*

2.2.4. Perceived Number of User

Perceived number of user (PNU) or direct network effect was the perception that the utility a person gained from a innovation increased with the growth in number of users (Katz & Shapiro, 1985). PNU existed when the growth of the network of users directly affected the perceived value of

the innovation (Ewe et al., 2015; Katz & Shapiro, 1986). The "network" signified to the user base or the size of the community of users of innovation. When the number of users increased, the perceived value of technology also increased, and it gravitated other users into the network (Katz & Shapiro, 1985; Song et al., 2009). It was a snowball effect, just like a network marketing and social network. The more users were using the services, the stronger gravity would pull other users into the platform (Rogers, 2014). Ewe et al. (2015) found that PNU has a tremendously positive effect on the perceived availability of complementary services; it also indirectly impacts the intention of the technology. Moreover, Brynjolfsson and Kemerer (1996) also proclaimed that PNU significantly drives user adoption when network externalities characterized the industry. Hence, the following hypothesis was suggested.

H3: *Perceived Number of Users has a significant impact on Perceived Availability of Complementary Services.*

2.2.5. Perceived Availability of Complimentary Services

Perceived availability of complementary services (PACS) existed when the utility of innovation increased because of the existence of various supplementary products or services (Katz & Shapiro, 1985). Zhou (2015) described PACS as reflecting users' associated value when the user number increased. For example, the Windows operating system owned many users. It, in turn, promoted software companies to offer more application software and services to users. Similarly, in the context of social network, Lin and Bhattacherjee (2008) described PACS as a reflection of a user's perceptions of the availability of supplementary innovation. When the number of users inclines, service providers will develop more functions and applications to enrich their services. PACS could significantly drive user intention and adoption when network externalities characterized the industry (Brynjolfsson & Kemerer, 1996; Katz & Shapiro, 1986). Furthermore, when the prospective perceived that they had variety of complementary products and tools to support the innovation, they might also see that the innovation matched their existing standard, past knowledges and demands (Moore & Benbasat, 1991). This was the perception of compatibility. Moreover, it is helpful in the DevOps setting as the availability of technology tools and resources would allow practitioners to get their job done faster and effortlessly. Hence, the following hypothesis was suggested.

H4: *Perceived Availability of Complementary Services has a significant impact on Perceived Compatibility.*

H10: *Perceived Availability of Complementary Services has a significant impact on the Intention to Use DevOps.*

2.2.6. Organizational Usefulness

According to Hardgrave and Johnson (2003), organizational usefulness (OU) was the developers' belief that using ISD would be beneficial to their organization. Moreover, Davis (1989) and Hardgrave and Johnson (2003) also suggested that OU could be referred to as perceived usefulness which directly influences the developer's intention and acceptance of the ISD process. It was how individuals perceived that using ISD would improve their work efficiency and benefit the organization. This statement was also supported by Masombuka and Mnkandla (2018) in their study of the DevOps collaboration model. In the goal-setting theory, Hollenbeck and Klein (1987) suggested that both situational (organizational) and personal (individual) factors of usefulness influenced goals or intentions to use the system. When the developers perceived that the innovation is useful for their organization, they would intend and consider using it within their organization. Hence, the following hypothesis was suggested.

H5: *Organizational Usefulness has a significant impact on the Intention to Use DevOps.*

2.2.7. Perceived Cost

Perceived cost (PCOST) was explained as an extent to which a prospective believed that information system (IS) was expensive (Rahman & Sloan, 2017). In the training context, PCOST was the cost of ongoing technology adoption – planning, organizing, and implementation (Machogu & Okiko, 2012). Rahman and Sloan (2017) studied behavioral intention in Bangladesh and found out that PCOST had a moderate negative impact on the user's intention to use technology. This statement was also supported by many empirical research in developing countries such as Bangladesh (Islam et al., 2011), Zimbabwe (Chitungo & Munongo, 2013), Malaysia (Wei et al., 2009), Thailand (Sripalawat et al., 2011), China (Wu & Wang, 2005) that PCOST undesirably affected the user's intent on IS. Hence, the following hypothesis was suggested

H6: *Perceived Cost has a significant impact on the Intention to Use DevOps.*

2.2.8. Perceived Risk

Perceived risk (PRISK) was defined as the thought that using the technology was risky from the security perspective (Chen, 2008). It could also be referred to as the individual's subjective belief about potential negative consequences from their decision (Samadi & Yaghoob-Nejadi, 2009). In DevOps, PRISK refers to the practitioners' belief that the solution was unsafe and might have a problem when they started using it. It could be a concern for hacking and other

cybersecurity threats. Hence, Chen (2008) found that PRISK severely affected the approval of users on technical services. Various studies also supported the statement that it was the critical determinant that drove intention to use the technology and the adoption program (Chen, 2013; Chitungo & Munongo, 2013). Hence, the following hypothesis was suggested

H7: *Perceived Risk has a significant impact on the Intention to Use DevOps.*

2.2.9. Personal Awareness

Personal awareness (PA) was the level of knowledge of people about the innovation (Verdegem & Verleye, 2009; Mahatanankoon & Vila-Ruiz, 2008). Lacking awareness was a significant barrier to many new technologies and innovation adoption projects (Rahman & Sloan, 2017; Amin et al., 2008; Suoranta, 2003; Verdegem & Verleye, 2009). Without proper awareness of innovation, developers would not intent to use the technology nor would they perceive it useful for their organization. The statement was supported by many other studies (Howard & Moore, 1982; Pikkarainen et al., 2004; Sathye et al., 2018). Hence, the following hypothesis was suggested.

H8: *Personal Awareness has a significant impact on the Intention to Use DevOps.*

2.2.10. Perceived Compatibility

Perceived compatibility (PCOM) was the extent that innovation was believed to be in line with the current standards, past knowledge, and the expectation of the intended person (Moore & Benbasat, 1991; Rogers, 2003). Venkatesh et al. (2003) mentioned that compatibility fits the individual's work style and the organization's use. Users, employees, and customers were more willing to follow an innovation when they felt compatible with them and their lifestyle. Agarwal and Prasad (1997) explained that PCOM had a direct impact on the use of IS. Many empirical research also confirmed that the effect of PCOM on behavioral intention in different IS. Moreover, the analysis by Tornatzky and Klein (1982) advised that three innovation features (relative advantage, complexity, and compatibility) had the highest and stable association with intention to use. In line with the study, Moore and Benbasat (1991) also found that the three also had a consistent impact on the continuous usage decision. Hence, the following hypothesis was suggested.

H9: *Perceived Compatibility has a significant impact on the Intention to Use DevOps.*

3. Research Methodology

3.1. Conceptual Framework

Figure 1 portrays the conceptual framework of this research. The studied constructs include subjective norm (SN), perceived behavioral control internal (PBCI), organizational usefulness (OU), perceived cost (PCOST), perceived risk (PRISK), personal awareness (PA), perceived number of user (PNU), perceived availability of complementary service (PACS), perceived compatibility (PCOM), and intention to use DevOps (IU). Hence, there are ten hypotheses proposed for this research to determine factors impacting the intention to use DevOps in the technology industry in Phnom Penh, Cambodia.

3.2. Research Design

This research used quantitative analysis of related constructs that impact the intention to use DevOps practice amongst the developers and practitioners. The survey was conducted with ISD practitioners, technology leaders, and entrepreneurs to gather the required information. Due to the restriction during COVID19, the survey was done using an online Google form. The questionnaire had three parts, screening questions, a five-point Likert scale with ten latent variables and 35 observed items, and respondents' demographic profile. A five-point Likert scale was employed to assess hypotheses ranging from strongly agree (5) to strongly disagree (1). First, confirmatory factor analysis (CFA) was used to test for validity and convergence of the factors. Then, the structural equation model (SEM) was used to define the effect and relationship of constructs.

3.3. Population and Sample Size

According to Clark-Carter (2018), the target population referred to the group of audience who shared their common behavior toward a specific element. Cooper et al. (2006) claimed that the sampling unit was a selection of specific elements of a population that represent the entire population. Therefore, this study's target population was those working in the software development areas and had the proper understanding of software development methodologies such as DevOps, Agile, Scrum, and SDLC in Phnom Penh, Cambodia. The researcher aimed to study in software development, technology startup, telecom, internet service providers, financial service institution, technology consulting, and system integrators within Phnom Penh, Cambodia.

The actual population was unknown as of December 2020. However, according to Startup Kingdom (2019), it estimated that around 50,000 tech talents were working in

large companies such as banks, retailers, and industrials, while the rest were in software development. In addition, more than 300 active startups were working in various domains such as fintech, digital media and advertising, e-commerce and logistics, digital marketplace, development services, and other digital disrupters. Kline (2015) stated that the minimum sample size should be 375 for SEM. Moreover, Blunch (2017) and Ainur et al. (2017) also claimed that, in case of complex data in the analysis, the higher number of sample size was needed to improve goodness of fit. A generally acceptable rule of thumb to define the minimum number of sample size was 10 samples per indicator (Nunnally, 1967). In this research, there were 10 latent variables with 35 indicators. Thus, the minimum required sample size would be 350 according to the rule of thumb. Hence, the researcher used 472 samples for this research to improve the goodness of fit index.

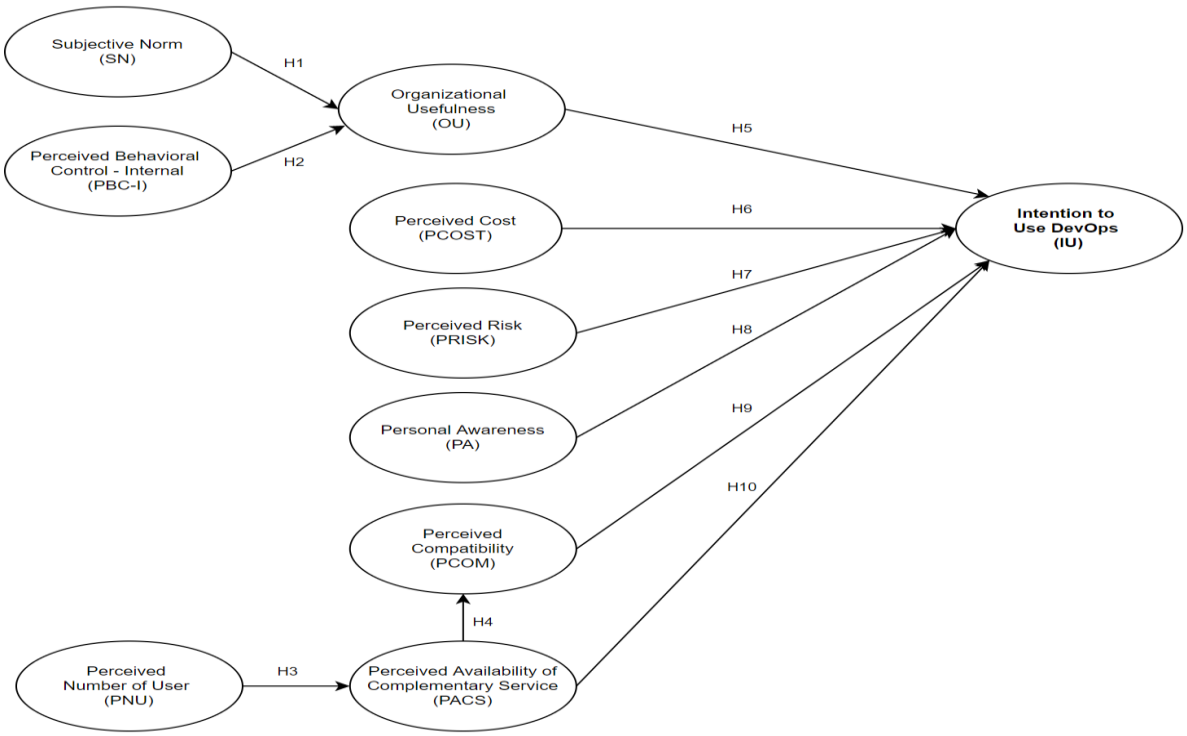


Figure 1: The Conceptual Framework

3.4. Sampling Technique

Because population size was unknown, non-probability sampling was employed as a sampling method to find the relevant sampling units. The researcher uses the three-stage approach to reach the targeted respondents. First, the judgmental sample technique. Gray (2019) claimed that the judgment sampling technique allowed the researcher to select the elements that generated the best phenomenon of the study's interest. The researcher selected the early adopters and DevOps practitioners who influence the community of developers and practitioners in the survey. Second, by using selective early seed, the researcher requested those respondents to recommend and refer the online questionnaire to their peers and network in the form of snowball. According to Browne (2005), snowball sampling was helpful in the situation where the target population is hidden or unknown, or very limited. Lastly, the researcher used a convenience sampling technique to distribute the online questionnaires to an online community within LinkedIn, Facebook, and technological events within Phnom Penh, Cambodia. This convenience sampling was endorsed by Gray (2019) to be the most prevalent sampling technique.

4. Results and Discussion

4.1. Demographic Factors

The respondents of this survey were male dominated at 92.4% versus 7.6% Females. Most of them were less than

41 years old – 38.1% between 34 to 41, 35.2% between 26 to 33, and 23.7% between 16 to 25 years old. 65.5% of them owned bachelor's degrees, where 31.4% held master's degrees. More than half of participants (53.6%) have 1 to 5 years of work experience, while 23.3%, 13.8%, 9.3% had 6 to 10 years, more than ten years, and less than one year of work experience consecutively. 40.3%, 25.6%, 19.7%, and 5.1% worked in software development, telecom, banking and financial institutions, and tech startups, respectively. Finally, most of them are software developers (45.1%), IT leaders (19.3%), project manager (10%), and the rest were operation engineer, QA engineer, tech entrepreneur, and other.

4.2. Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was used to prove the convergent and discriminant validity of all constructs. Byrne (2013) stated that CFA was applied to test the measurement model to see if the observed variables were associated with the underlying latent variables. According to Fornell and Larcker (1981), the composite reliability (CR) should be greater than 0.70 while average variance extracted (AVE) should be higher than 0.50 to be acceptable. However, in case AVE is between 0.4 and 0.5 but CR was more than 0.6, the convergent validity of constructs was still adequate and acceptable (Fornell & Larcker, 1981). Table 1 depicted the result of CFA for all the constructs in the study. All factors loading of all items were greater than 0.50 and significant to demonstrate convergent of measurement (Comrey & Lee, 2013).

Table 1: Confirmatory Factor Analysis (CFA), Composite Reliability (CR), and Average Variance Extracted (AVE) Results

Variables	Source of Questionnaire	Items	Cronbach's Alpha	Factors Loading	CR	AVE
Subjective Norm (SN)	Riemenschneider et al. (2002)	3	0.711	0.630 – 0.670	0.718	0.460
Perceived Behavioral Control Internal (PBCI)	Hardgrave & Johnson (2003)	3	0.701	0.640 – 0.710	0.706	0.445
Organization Usefulness (OU)	Hardgrave & Johnson (2003)	3	0.767	0.610 – 0.810	0.777	0.540
Perceived Cost (PCOST)	Naicker & Van Der Merwe (2018)	3	0.831	0.730 – 0.840	0.834	0.626
Perceived Risk (PRISK)	Rahman & Sloan (2017)	3	0.795	0.690 – 0.810	0.798	0.570
Personal Awareness (PA)	Rahman & Sloan (2017)	6	0.867	0.630 – 0.830	0.869	0.528
Perceived Number of User (PNU)	Ewe et al. (2015)	3	0.767	0.670 – 0.820	0.775	0.537
Perceived Availability of Complementary Service (PACS)	Ewe et al. (2015)	3	0.735	0.680 – 0.720	0.739	0.486
Perceived Compatibility (PCOM)	Ewe et al. (2015)	5	0.842	0.660 – 0.750	0.844	0.519
Intention to Use DevOps (IU)	Hardgrave & Johnson (2003)	3	0.811	0.740 – 0.810	0.814	0.594

Note: CR = Composite Reliability, AVE = Average Variance Extracted, *=p-value<0.05

Additionally, the assessment of discriminant validity was done by calculating the square root of each AVE (Fornell & Larcker, 1981). Based on Table 2, the value of discriminant validity is more significant than all inter-construct correlations. Hence, the discriminant validity is confirmed.

Table 2: Discriminant Validity

	SN	PBCI	OU	PCOST	PRISK	PA	PNU	PACS	PCOM	IU
SN	**0.68**									
PBCI	0.29	**0.67**								
OU	0.61	0.29	**0.74**							
PCOST	0.09	0.21	-0.09	**0.79**						
PRISK	-0.13	-0.07	-0.41	0.08	**0.75**					
PA	0.05	0.29	0.32	-0.02	-0.54	**0.73**				
PNU	0.21	0.39	0.24	0.15	-0.17	0.17	**0.73**			
PACS	0.21	0.29	0.16	0.19	-0.15	0.17	0.68	**0.70**		
PCOM	0.46	0.40	0.50	0.11	-0.20	0.36	0.23	0.47	**0.72**	
IU	0.40	0.30	0.57	0.06	-0.33	0.45	0.12	0.28	0.62	**0.77**

Note: The diagonally listed value is the AVE square roots of the variables

Moreover, the indices that were used in goodness of fit in CFA testing were: CMIN/df (ratio of the chi-square value to the degree of freedom), GFI (goodness of fit index), AGFI (adjusted goodness of fit index), NFI (normalized fit index), TLI (Tucker-Lewis index), CFI (comparative fit index), RMSEA (root mean square error of approximation), and

RMR (root mean square residual). According to Table 3, these indices were greater than the acceptance values: CMIN/df=2.57, GFI=0.86, AGFI=0.83, NFI=0.82, CFI=0.88, TLI=0.86, RMSEA=0.06, and RMR=0.04. Hence, the convergent and discriminant validity were confirmed.

Table 3: Goodness of Fit for Confirmatory Factor Analysis (CFA)

Index	Acceptable Values	Statistical Values
CMIN/DF	< 3.00 (Hair & Black, 2009)	2.57
GFI	≥ 0.80 (Baumgartner & Homburg, 1996)	0.86
AGFI	≥ 0.80 (Baumgartner & Homburg, 1996)	0.83
NFI	≥ 0.80 (Wu & Wang, 2006)	0.82
CFI	≥ 0.80 (Bentler, 1990)	0.88
TLI	≥ 0.80 (Sharma et al., 2005)	0.86
RMSEA	< 0.08 (Hair & Black, 2009)	0.06
RMR	< 0.08 (Byrne, 2013)	0.04

Note: CMIN/DF = The ratio of the chi-square value to the degree of freedom, GFI = goodness-of-fit index, AGFI = Adjusted goodness-of-fit index, NFI = normalized fit index, TLI = Tucker-Lewis index, CFI = comparative fit index, RMSEA = root mean square error of approximation, and RMR = root mean square residual

4.3. Structural Equation Model

Structural equation model (SEM) was a statistical technique that uses a multivariate model – the combination of factor analysis and regression analysis. The indices that were used for goodness of fit for SEM were GFI, AGFI, NFI, CFI, TLI, RMR, and RMSEA. After the step-by-step process in SEM and the adjustment, the model was in harmony with the research data as demonstrated in Table 4 for the goodness of fit. All the indices fulfil the recommended criteria: CMIN/df=2.57, GFI=0.86, AGFI=0.84, NFI=0.82, CFI=0.88, TLI=0.86, RMSEA=0.06, and RMR=0.06. Hence, the results suggested that each set of items signifies a single underlying factor and presents evidence for discriminant validity and fit.

Table 4: Goodness of Fit for Structure Equation Model (SEM)

Index	Acceptable Values	Statistical Values
CMIN/DF	< 3.00 (Hair & Black, 2009)	2.57
GFI	≥ 0.80 (Baumgartner & Homburg, 1996)	0.86
AGFI	≥ 0.80 (Baumgartner & Homburg, 1996)	0.84
NFI	≥ 0.80 (Wu & Wang, 2006)	0.82
CFI	≥ 0.80 (Bentler, 1990)	0.88
TLI	≥ 0.80 (Sharma et al., 2005)	0.86
RMSEA	< 0.08 (Hair & Black, 2009)	0.06
RMR	< 0.08 (Byrne, 2013)	0.06

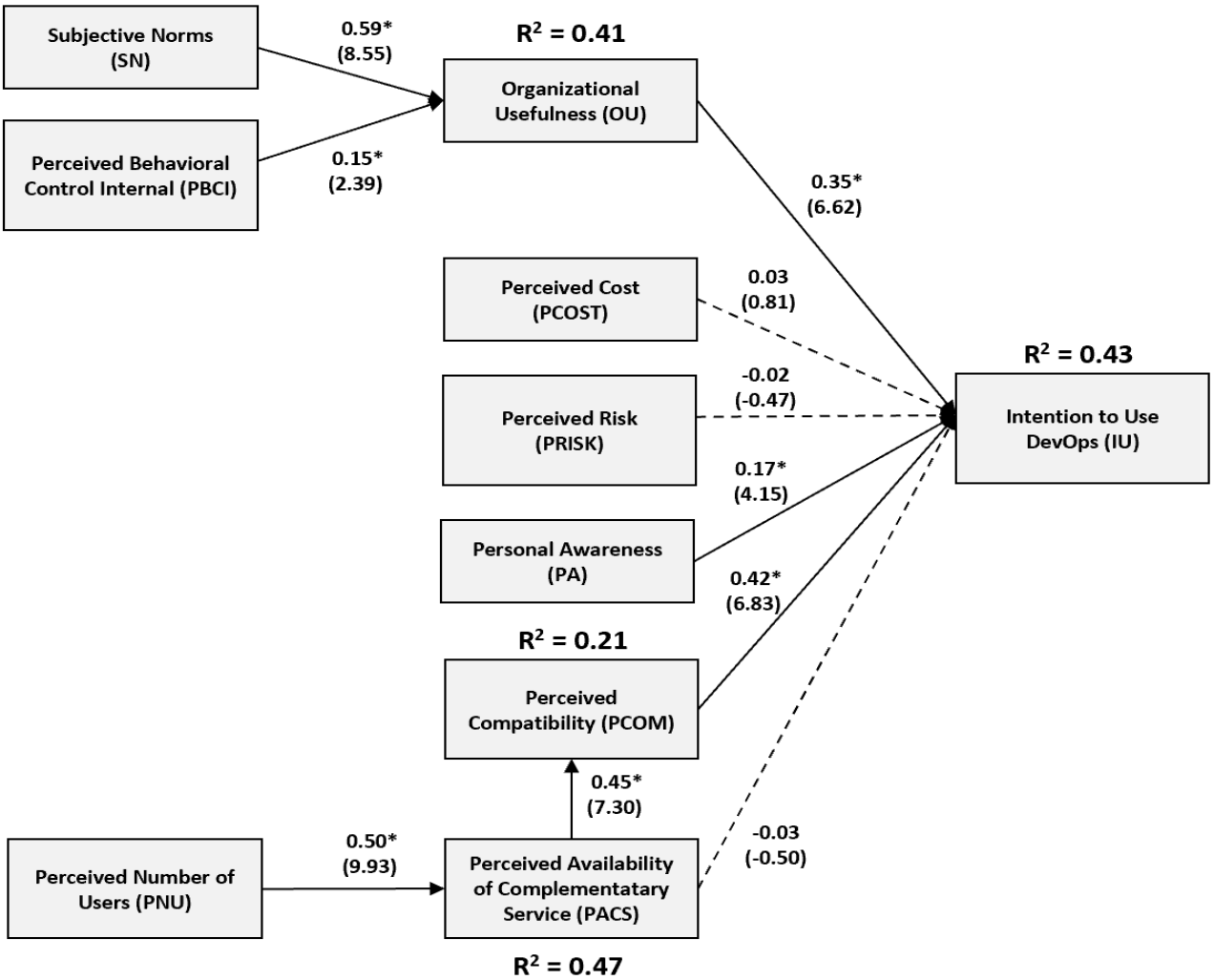
4.4. Research Hypotheses Testing Results

The result of SEM depicted in Table 5 can clearly explain the factor influencing the intention to use DevOps in Phnom Penh, Cambodia, and Figure 2 demonstrates the finding of this study in graphical representation. SN and PBCI significantly impacts OU with standardized path co-efficient (β=0.59, t-value=8.55*) and (β=0.15, t-value=2.39*) respectively. Also, OU significantly impacts IU with standardized path co-efficient (β=0.35, t-value=6.62*). Thus, H1, H2, and H5 are supported. The finding is in line with the previous empirical studies of Hardgrave and Johnson (2003), who proclaimed that OU significantly influencing the intention to use SDM and that SN and PBCI indirectly influencing intention of develop through OU. Furthermore, PNU significantly impacts PACS with standardized path co-efficient (β=0.50, t-value=9.93*). Also, PACS is proven to greatly impact PCOM with path co-efficient (β=0.45, t-value=7.30*). Hence, H3 and H4 are supported. It is aligned with the previous finding by Ewe et al. (2015), who claimed that the increase of number of users drove the development and availability of complementary service. At the same time, when there were variety of complementary choices of innovation, the user would feel that the innovation was compatible with their knowledge, experience, and their way of work. At the same time, PCOM is demonstrating the significant direct impact on IU with β=0.42 and t-value=6.83*. It can be concluded that H9 is supported. It is in line with the previous finding by Ewe et al. (2015) and Tornatzky and Klein (1982). All of them claimed that when innovation was perceived to be compatible with user, the intention would follow. For H8, PA was confirmed to have significant impact on IU with β=0.17 and t-value=4.15*. It could imply that when those, who have less knowledge of DevOps, would most likely have no intention to use the technology. It is synchronous with the previous finding by Rahman and Sloan (2017), Amin et al. (2008), Suoranta (2003), and Verdegem and Verleye (2009) in various contexts of study. Awareness drove intention while lack of it would hinder the adoption of innovation. However, PCOST and PRISK are not the influential factors of IU with corresponding (β=0.03, t-value=0.81) and (β=-0.02, t-value=-0.47) respectively. It signifies that these factors have no significant impacts on the intention and decision of developers to use DevOps. It contradicts the finding of the study by Rahman and Sloan (2017) in the emerging markets. They stated that perception of cost and risks significantly hinder and slow down the innovation project in the price sensitive and low educated market. Moreover, PACS is not found to have significant impact on intention to use DevOps (IU) by Developer with standard co-efficient of (β=-0.03, t-value=-0.50). Thus, the path is not supported by the model. This is in contrast with the finding by Ewe et al. (2015), who claimed that PACS had a significant impact on the intention to use innovation.

Table 5: Hypotheses Result of the Structural Model

Hypothesis	Path	Standardized Path Co-Efficient (β)	t-value	Test Result
H1	SN → OU	0.59	8.55*	Supported
H2	PBCI → OU	0.15	2.39*	Supported
H3	PNU → PACS	0.50	9.93*	Supported
H4	PACS → PCOM	0.45	7.30*	Supported
H5	OU → IU	0.35	6.62*	Supported
H6	PCOST → IU	0.03	0.81	Not Supported
H7	PRISK → IU	-0.02	-0.47	Not Supported
H8	PA → IU	0.17	4.15*	Supported
H9	PCOM → IU	0.42	6.83*	Supported
H10	PACS → IU	-0.03	-0.50	Not Supported

Note: *=p-value<0.05



Note: Solid line reports the Standardized Coefficient with * as p<0.05, and t-value in Parentheses; Dash line reports Not Significant

Figure 2: The Result of Structure Model

5. Conclusions and Recommendations

5.1. Conclusions and Recommendation

The comprehensive model of this research was based on the previous empirical studies in software development and internet technologies by Hardgrave and Johnson (2003), Rahman and Sloan (2017), and Ewe et al. (2015). It aims to investigate the factors that significantly impact developers' intention to use DevOps within the technology industry in Phnom Penh, Cambodia. Successful adoption of DevOps within organizations is the breakthrough for them to stay competitive in the digital world and drive employee productivity and satisfaction (Forsgren et al., 2019). Out of ten hypotheses, seven are supported, while three are rejected.

The study reveals that subjective norm (the social influence from colleagues, managers, and friends) and perceived behavioral control internal (the perception of one's competency or ease of use) significantly impact the perception of usefulness of DevOps for their organization (OU). OU has a significant impact on the intention to use DevOps by the developer. Both SN and PBCI indirectly impact the intention of developers to use the DevOps practice through the mediation of OU. The finding is in line with the previous empirical studies of Hardgrave and Johnson (2003), who proclaimed that OU significantly influencing the intention to use SDM and that SN and PBCI indirectly influencing intention of develop through OU. It is also found that the perceived number of users (PNU) or size of the DevOps community significantly impacts the perception of the availability of complementary or supplementary services (PACS) or tools to assist the developer to implement DevOps successfully. PACS significantly leads developers to think that DevOps practices are fully compatible with them and their team. It is aligned with the previous finding by Ewe et al. (2015), who claimed that the increase of number of user drove the development and availability of complementary service. At the same time, when there were variety of complementary choices of innovation, the user would feel that the innovation is compatible with their knowledge, experience, and way of work. Moreover, personal awareness significantly impacting the intention of the developer to use DevOps. Lack of awareness or without adequately addressing the basic knowledge of DevOps for developers or employees at the early stage is expected to have adverse reaction or resistance from the employees. This could hinder the progress of adoption program. It is synchronous with the previous finding by Rahman and Sloan (2017), Amin et al. (2008), Suoranta (2003), and Verdegem and Verleye (2009) in various contexts of study. Similarly, the perceived compatibility (PCOM) significantly impacts the intention of developers and teams to use DevOps. It is in line with the previous finding by Ewe et al. (2015) and Tornatzky and Klein (1982), who claimed that the user would intent to use innovation when they believed that it is compatible with them.

However, it is found that perceived cost (PCOST) and perceived risk (PRISK) do not have impact on the intention to use the DevOps practice. It explains that developers and practitioners within Phnom Penh, Cambodia, with DevOps' experience do not believe that it is expensive nor risky to start using DevOps practice within their team, projects, and organization. This could be because DevOps practice can be done using various open-source tools or affordable cloud subscription. The implementation could be done either on-premises or on the cloud at their preference and under their control. This finding contradicts the finding of the study by Rahman and Sloan (2017) in the emerging markets, who stated that perception of cost and risks significantly hinder and slow down the innovation project in the price sensitive and low educated market. Also, the availability of complementary services (PACS) is not found to have the impact on the intention to use. The developer would not be concerned about the availability of tools, practice, and assistance as the big players (Google, Microsoft, and Amazon AWS) supported the technology and practice. It gives them the comfort to start using the technology. This is in contrast with the finding by Ewe et al. (2015), who claimed that PACS had a significant impact on the intention to use innovation.

From the result of the finding, it is apparent that, just like other digital transformation and adoption initiatives, awareness of DevOps plays a vital role in driving developer's intention to use this practice. It is recommended that the stakeholders (IT leaders, project managers, and technology entrepreneurs) shall make sure their employees have a good foundation of knowledge of DevOps before putting them into the DevOps adoption program. It could be done through the training program and the establishment of an internal community for knowledge sharing. The influence of managers, peer colleagues and the community also catalyze developer's intention toward DevOps practice. It is crucial that the organization's leadership team take a leading role and provide the necessary support to developers and practitioners within their companies and play the role of early adoption and champion of the DevOps program.

5.3. Limitation and Further Research

There are three limitations of the research that future researchers could address. Du-Plessis (2007) stated that de mographic characteristics could segment the market. First, this study only considered general terms of demographic factors but did not investigate the effect of demographic

factors on any constructs. Secondly, the study was conducted with developers and practitioners from a personal angle, and the researcher did not deep dive into the organizational factor to adopt the technology. Furthermore, the research only surveys the early stage of behavioral intention, the intention or consideration to use DevOps. It did not consider the factors that drive the second and third stages – adoption and continuous usage of DevOps.

Future research could address this limitation by further analyzing the demographic factors such as age, gender, working experience, and income of the respondent. Also, the organizational angle of adoption shall be studied in detail on top of developers' perception alone. Finally, it would also be important that the adoption and consistent use of the technology stage be assessed to cover a complete end-to-end of DevOps Adoption.

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