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Roles of Individual Perception in Technology Adoption at Organization Level: Behavioral Model versus TOE Framework

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Abstract. It is generally accepted that two different groups of theories are required in order to explain technology adoption at individual level and at organization level. For individuals, behavioral theories including technology acceptance model (TAM), theory of planned behavior (TPB), unified theory of acceptance and use of technology (UTAUT) are frequently used to predict intention and actual behavior. For organizations, diffusion of innovation (DOI) model and technology-organization-environment (TOE) framework are commonly applied for predicting adoption. While this divide appears to be reasonable, the process of investigating an organization is, inevitably, done through collecting opinions of the people in the organization. This leads to the question how individual's perception affects the application of DOI and TOE for understanding organizational technology adoption. To extend further, what is an "objective" measure of organizational characteristics and who can provide it? In previous studies, researchers obtain feedback primarily only from decision makers when applying TOE. This paper examines if a decision-maker-centered-TOE analysis is consistent with the results obtained by directly applying behavior model to predict individual decision maker's action, and hence further justify TOE framework application. For this exploratory study, high degree of consistency is observed.

Keywords: Technology adoption, theory of reasoned action, theory of planned behavior, technology acceptance model, technology-organization-environment framework.

1. Introduction

Understanding why customers adopt a technological product or service is critical to the supplier. When target customers are individuals, behavioral models such as technology acceptance model (Davis, 1985; Davis, 1989; Davis and Venkatesh, 1996), theory of planned behavior (Ajzen, 1991), unified theory of acceptance and use of technology (Venkatesh, Morris, Davis & Davis, 2003) are frequently used for analyzing the adoption decision (Koul & Eydgahi, 2017). These models are rooted in psychological theories and hence suitable for investigating individual decision, but not directly applicable to organization decision (Ajzen & Fishbein, 1977; Ajzen, 1991; Karahanna & Straub, 1999). Thus, when target customers are organizations, the problem is analyzed by a different category of theory. Common theories for this scenario include diffusion of innovation (Rogers, 1962) and technology-organization-environment framework (Tornatzky and Fleischer, 1990). In these theories, several organization characteristics have to be identified in order to predict technology adoption (Oliveira & Martins, 2011; Hoti, 2015).

While using the two groups of theories to correspondingly analyze individual and organization adoption is a generally accepted practice, there is no serious study, as far as the author aware of, regarding how to fairly obtain the required organization characteristics when the target of analysis is an organization. Inevitably, these characteristics can only be obtained by surveying people in the organization. However, different members in the same organization may have very different assessments. For example, CEO of a company, head of IT, and a programmer may have completely different views on these organization characteristics when evaluating a software. These characteristics can be readiness to adopt, realizable advantages, competitive regime, etc. Surveying different people may produce significantly different predictions. Without a proven methodology to fairly determine these organization characteristics, most researchers choose to survey decision makers who have the power to approve final purchase (Oliveira & Martins, 2010; Kuan & Chau, 2001). This appears to be a reasonable approach, but also leads to a concern about the roles of individual perception in organization level theories. Afterall, the outcome of these theories will be dependent on the view of an individual (or a few individuals) on these organization characteristics. As such, the question is whether these organization level theories are fundamentally different from individual level theories, or they are simply alternative manifestations of individual level theories? Clarifying this issue is not only theoretically important, but also provides vital insights for practical research model design.

This paper explores the question by mapping selected results from a questionnaire-based survey into both behavioral model and TOE framework, and then compares their predictions. The survey was conducted last year, and results had been analyzed using a specific, individual level, behavioral model (Li, 2020). Out of 263 responses obtained, 117 are from decision makers. It has been demonstrated that the model can effectively predict organization adoption of blockchain technology when only responses from decision makers are taken into account. However, predictive power quickly deteriorates when other respondents are included. The observation suggests that, by carefully grouping and using the responses, individual level theories may also be applied for predicting organization level adoption. This study continues with the exploration by analyzing the same survey results under TOE framework and examines if the theory gives a complementary or competing explanation against the behavioral model.

This paper is organized as follow: In section 2, the relevant theories are briefly reviewed. Section 3 summarizes the analysis based on the behavioral model developed by Li (2020). Section 4 remaps the survey results into TOE framework and performs the necessary analyses for comparison. Finally, predictions from the two theories and implications are examined in Section 5.

2. Relevant theories

Relevant theories are briefly reviewed in this section.

2.1. Predicting adoption by individual level theories

Most individual level theories are behavioral models in nature. Starting from the theory of reasoned action (TRA), which is a generic model for predicting behavior, some important derived models had emerged. The theory of planned behavior (TPB) is a refined generic behavioral model evolved from TRA. Another model developed from TRA is technology acceptance model (TAM), which is, as its name has implied, a specialized model for predicting technology adoption. Unified theory of acceptance and use of technology (UTAUT) is a further enhancement of TAM. Each of these models also has some derivatives or refinements. Figure 1 depicts the relationships of the major models.

Developed by Ajzen and Fishbein (1977), TRA (Figure 1(a)) is the first theory systematically illustrated that an individual performing a particular behavior is not only influenced by his/her attitude towards that behavior, but also the subjective norm with respect to this behavior. Subjective norm refers to the individual's belief on how other relevant people think about him/her if he/she performs that behavior. With proper research design, TRA quantifies the influences of attitude and subjective norm, and explains many inconsistent behaviors observed in social science research (Ajzen and Fishbein, 1980).

Ajzen (1991) refined TRA by introducing an additional component known as perceived behavioral control (PBC), leading to the TPB model (Figure 1(b)). PCB refers to the individual's perception on how much control does he/she have to perform a certain behavior. There are two aspects of PBC (Ajzen, 2002; Ajzen and Madden, 1986): whether the individual perceives that he/she can access to the resources to perform the behavior, and whether he/she perceives there are opportunities to perform the behavior. A salient feature of PCB is its direct linkage to actual behavior: if the individual perceives that there is no opportunity to perform the behavior, he/she may actually not perform even though he/she has a positive behavioral intention to do so.

Both TRA and TPB are generic in nature and not specifically designed for particular situations. These theories have been extensively used to understand individual behavior in health-related issues, work-related issues, investment, product preference, eating habit, travelling and, of course, technology adoption. In order to apply these theories, researchers have to identify the appropriate variables for their study topics. In contrast, TAM (Figure 1(c)) uses two pre-determined constructs, perceived usefulness (PU) and perceived ease of use (PEOU), to predict adoption. The model shown is the original version of TAM, which was developed based on investigating adoption of word-processing software (Davis, 1985). In light of experiences gained from more applications, the inventor had revised the model a few times (Davis, 1989; Davis and Venkatesh, 1996). These revisions remain using PU and PEOU as the only two constructs for predicting adoption. Final version of TAM is shown in Figure 2 (Davis and Venkatesh, 1996). In addition, there are two expanded versions of TAM, namely TAM2 and TAM3, that include more constructs such as subjective norm, computer anxiety, etc. Details are provided in Venkatesh & Davis (2000) and Venkatesh & Bala (2008).

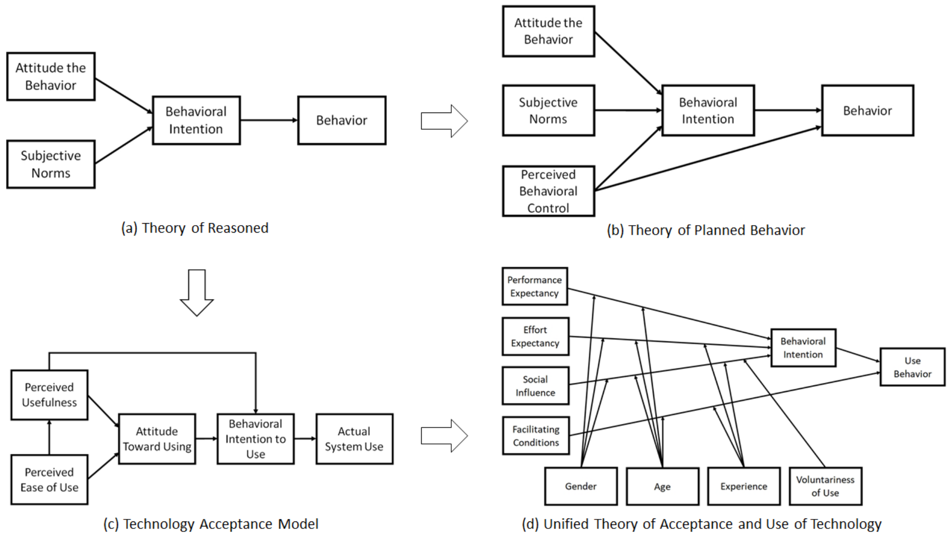


Fig. 1: Individual level models.

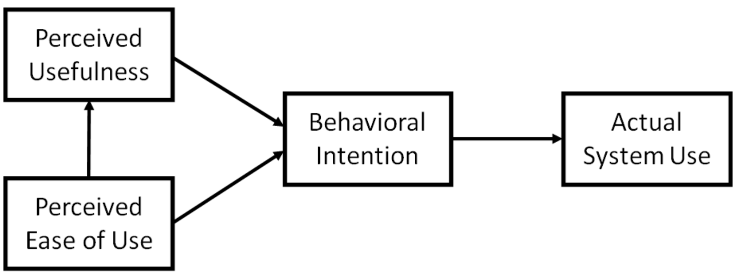


Fig. 2: Final version of technology acceptance model.

While TAM is the most frequently used model for analyzing information technology adoption, the model has been frequently refined, expanded and modified since its deployment. This is not surprising because the model was originated from studying word-processing software acceptance in office environment in 1980s, which is relatively simple compared to the subsequent technology adoption problems down the timeline. Having examined TAM applications under different scenarios, researchers (Venkatesh & Davis, 2000; Bagozzi, 2007; Venkatesh & Bala, 2008) suggested that the model has left out important variables and processes for effective analysis for some cases. Another concern is appropriateness of the two constructs, PU and PEOU, under different applications. Researchers (Legris, Ingham & Collerette, 2003; Ma & Liu 2004; King & He, 2006; Yousafzai, Foxall & Pallister, 2007) conducted numerous meta-analyses covering TAM applications for various technologies, geographies, and participants. These studies indicated that PU remains as a significant predictor of behavioral intention in most cases, but the relative importance and significance of PEOU could be less concrete. This is consistent with Gefen and Straub's (2000) interpretation that PEOU is a dynamic construct and its influence is highly dependent on the nature of the problem under investigation, the technology, and the survey targets.

To address these difficulties, UTAUT (Figure 1(d)) is introduced as an enhancement (Venkatesh, Morris, Davis & Davis, 2003). The model utilizes more generalized constructs and moderators to cater for wider range of applications, and explained about 70% of the variance in behavioral intention and 50% of the variance of actual usage in longitudinal field studies of employee technology acceptance. To further improve explanation of variance, an extended model, UTAUT2, had been proposed (Venkatesh, Thong & Xu, 2012; 2016). Despite the apparent advantages, however, Bagozzi (2007) criticized the large number of variables used in UTAUT has led the study of technology adoption to a stage of chaos. van Raaij and Schepers (2008) challenged the grouping of many variables to represent a single psychometric construct, and pointed out that the high R^2 is only achieved by excessive use of moderators. Li (2020) commented that conducting a lengthy survey with many variables is impractical under most real-life business settings.

2.2. Predicting adoption by organization level theories

Technology adoption in an organization is a two-folded problem. In one case, the research problem is to predict whether a company will purchase a certain technology. This is obviously a critical question for the supplier of that technology. In the other case, the company is aware about a technology and want to understand if most employees will adopt it over a period of time so as to consider purchasing. While these two problems are related, they are not the two sides of the same coin because the purchasing decision will not be made solely based on employee's acceptance of the technology. Other factors including the organization's business strategies, operation goals, vendor relationship, competitive environment, regulations, etc. must also be considered. It is worth pointing out that the second problem (i.e. employee adoption over a period of time) is essentially a collection of individual technology adoption problems under organizational constraints. For easy reference, the first problem (i.e. organization making purchase decision) is referred as Type I problem, and the second problem (i.e. employee adoption over a period of time) is referred as Type II problem.

Compared to individual level technology adoption, organizational level adoption is a less researched area. Two major models, diffusion on innovation (DOI, also known as innovation diffusion theory, IDT) model and technology-organization-environment (TOE) framework, have been used for investigation. These models assume some specific characteristics of an organization are known or quite concretely determinable, and use them to infer technology adoption.

Originally a theory about social change, DOI model (Rogers, 1962) has a successful history of explaining social adoption of innovations. The theory examines adoption on a voluntary base, and describes the process as an information seeking and processing for an individual to reduce uncertainty about the advantages and disadvantages of an innovation (Figure 3). Furthermore, the theory outlines five attributes that promote adoption: (a) showing relative advantages over the existing approach; (b) compatible with existing values and practices; (c) simple and ease of use; (d) can be tried on a limited bias in order to reduce uncertainty; and (e) results are easily observable.

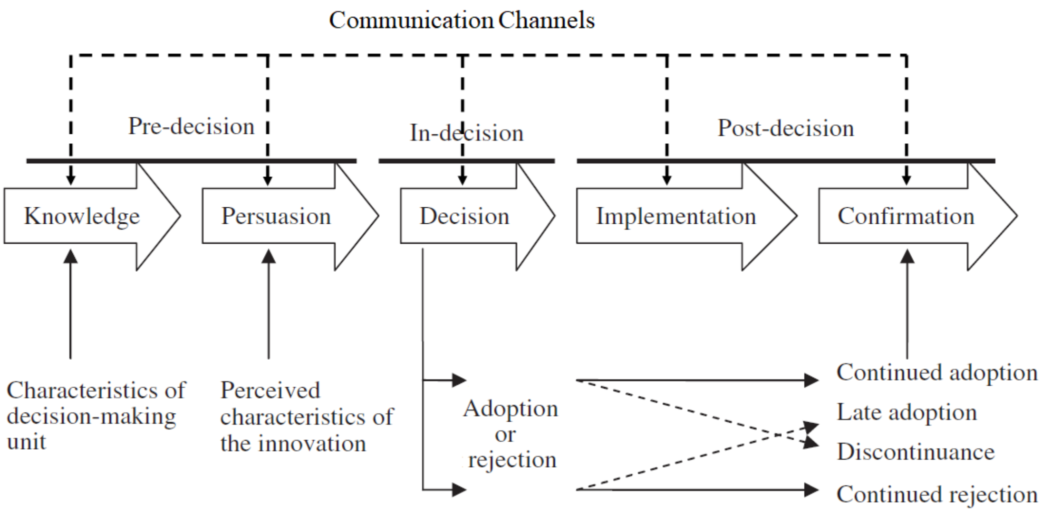


Fig. 3: Information seeking and processing in DOI model.

Unlike the behavioral models discussed in Section 2.1, this information seeking and processing exercise does not stop at the decision stage when an adopt or reject decision has been made. Instead, communication channels will drive the process to continue and decisions can change down the road. This indeed reflects the reality of changing individual technology acceptance decision in organization: some individual will adopt (or abandon) a technology faster than others, and the others may change their mind through the continuous information seeking and processing exercise. Thus, DOI model projects that the overall adoption in an organization will display a pattern as shown in Figure 4.

It should be clear that while both DOI model and the behavioral models in Section 2.1 are focusing on individual adoption, DOI model provides a continuous view on how technology adoption changes in an organization over a period. The behavioral models, on the other hand, are focusing on predicting individual decision at a specific timeslot. Thus, applying DOI model to Type II problem is more appropriate. However, DOI model is high level in nature and therefore researchers usually use the model in conjunction with TAM or other behavioral models in order to develop practically verifiable hypotheses for organization adoption (Dibra, 2015; Yu & Tao, 2009; Zhou Y, 2008).

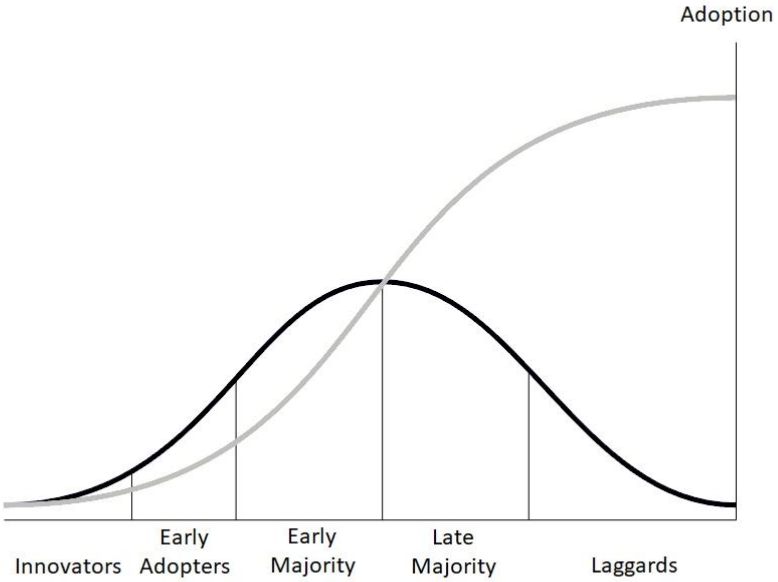


Fig. 4: Innovation adoption pattern in DOI.

TOE framework (Tornatzky & Fleischer, 1990) responses to Type I problem by investigating organization technology adoption decision bases on organization characteristics. As the name of the framework implies, these characteristics are categorized as (a) technological; (b) organizational; and (c) environmental (Figure 5).

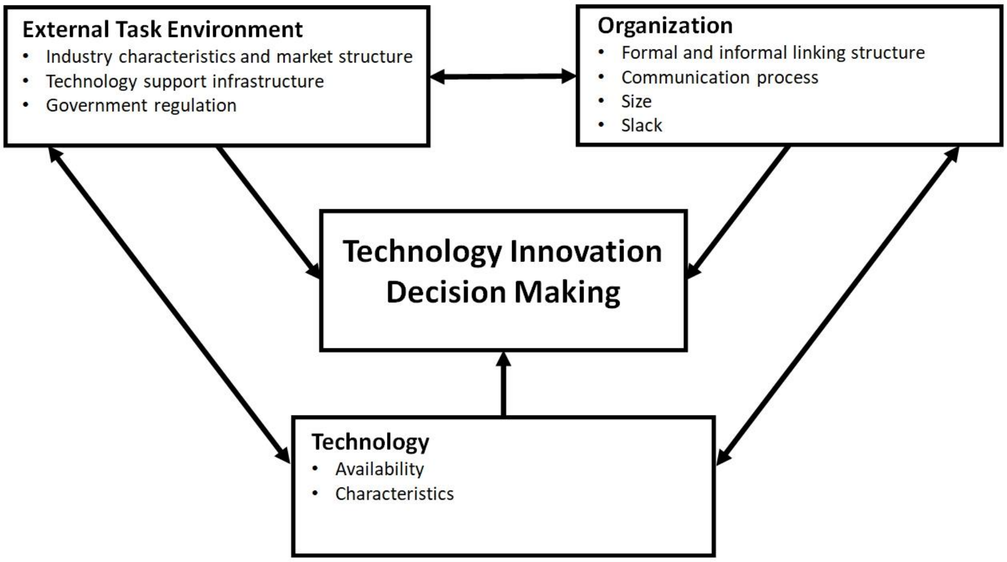


Fig. 5: TOE framework.

While the framework appears to be straightforward, determining these characteristics could be challenging because they can only be understood by collecting opinions from the members of the organization. It is obvious that members of the same organization can have different, or even contradicting, views about these characteristics. Averaging the opinions would not be helpful because purchasing a technology (and hence adopting that technology from the organization's viewpoint) is usually not based on average opinion but the consent of a small group or even the opinion of a single decision maker. To avoid such ambiguity, most TOE-framework-based researches would only rely on input from decision makers (Awa, Ukoha & Igwe, 2017; Yeh, Lee & Pai, 2016; Hoti, 2015; Oliveira & Martins, 2011; Oliveira & Martins, 2010; Kuan & Chau, 2001).

With this limitation, a question of choosing research model naturally arises: For Type I problem (i.e. organization purchasing a technology), is using TOE framework to predict an organization's decision practically equivalent to applying behavioral models to predict the behavior of the organization's decision maker? That is, will these two approaches lead to the same conclusion? As an exploratory analysis, this study developed a TRA model and a TOE model based on the same survey instrument and compared their predictions. The TRA model had been published in an earlier paper (Li, 2020) and the results are summarized in Section 3. Development and validation of the TOE model are illustrated in Section 4.

3. TRA model for blockchain technology adoption: a summary

A survey about blockchain technology adoption among small-to-medium size enterprises (SME) in Hong Kong was conducted from February to July of 2019. Anonymous questionnaires were distributed to audiences of a number of information technology seminars for SMEs. Surveys were administrated during the break. Numerous research studies (Gibson & Bowling, 2020; Yan, Conrad, Tourangeau & Couper, 2011; Galesic & Bosnjak, 2009) had shown that length of questionnaire would adversely affect response rate and also induce careless responding. This is paticularly true in business environment. To ensure relevancy of responses, the questionnaire was brief and should take less then 10 minutes to answer.

Since this study intended to compare the outcome of behavioral model and TOE model, the questionnaire was designed to fit into both frameworks. Given the 10 minutes time constraint for answering the questionnaire, complex behavioral models such as TAM2, TAM3, UTAUT or UTAUT2 are impractical because too many variables and hence too many questions would be required. On the other hand, TAM, although simple, might not be a good choice because of the restriction of using only PU and PEOU as input constructs (Section 2.1). Considering simplicity as well as the flexibility to include additional constructs, TRA had been chosen as the behavioral model for this study.

The questionnaire designed for this research had only 23 questions: 3 brief background questions about the respondent (Table 1), and 20 research questions for model construction (Table 2).

Table 1: Background information

Which of the followings best describe your business nature? __ Manufacturing __ Trading __ Services __ Retail __ Others
You company's annual revenue is: __ Under USD 5M __ USD 5 - 25M __ USD 25-50M __ Over USD 50M
Concerning about evaluating and /or investing in blockchain technologies, you are: __ the final decision maker __ taking major responsibilities __ regularly involved __ occasionally involved __ not involved

Table 2: Research questions for TRA model construction

Item	Description	TRA Construct	TRA Variable
1	In our business, some process improvements CANNOT be made without blockchain technologies.	PU	PU_1
2	Adopting blockchain technologies will enable our company to offer new products / services that CANNOT be provided in the past.		PU_2
3	Blockchain technologies can provide a justifiable return on investment in a reasonable period of time.		PU_3
4	In our sector, companies who have implemented blockchain technologies have gained competitive advantages.		PU_4
5	Blockchain technologies are safe and reliable.	PEOU	PEOU_1
6	For our business, there is no major operational barrier for adopting blockchain technologies.		PEOU_2
7	Our employees can quickly cope with changes due to deploying blockchain technologies.		PEOU_3
8	If needed, external implementation consultants are readily available at a reasonable fee.		PEOU_4
9	At a regional / country level, authorities are encouraging companies to adopt blockchain technologies.	PTRD	PTRD_1
10	Adopting blockchain technologies is becoming a trend in many business sectors.		PTRD_2
11	More companies in OUR sector will adopt blockchain technologies in the NEAR future.		PTRD_3
12	Our customers would expect our company to use blockchain technologies.	NOR	NOR_1
13	Our suppliers would expect our company to use blockchain technologies.		NOR_2
14	Our employees would expect our company to use blockchain technologies.		NOR_3
15	Blockchain technologies can improve our operation	ATT	ATT_1
16	In an overall sense, blockchain technologies are good for our company.		ATT_2
17	I believe our company should implement blockchain technologies in NEAR future.	BI	BI_1
18	I am actively cultivating agreement among other relevant members in the company to adopt blockchain technologies.		BI_2
19	We are working out / already have an implementing plan with budget for blockchain technologies.	B	B_1
20	We have spent / scheduled to spend remarkably on implementing blockchain technologies.		B_2

By the end of the survey period, 263 valid responses had been collected. For the purpose of this study, only responses from "final decision makers" and those who claimed to be "taking major responsibilities" (Table 3.1) for technology adoption in their organizations were used for model construction. In the context of this research, these respondents were collectively referred as decision makers. Additionally, since big companies and small companies could have very different resources for technology deployment, responses from companies with annual revenue less than USD 5M or more than USD 50M were excluded (Table 3.1). Under these criteria, 117 responses were considered as vital responses from decision makers. After standard validation and statistical analysis, a TRA model based on these 117 responses was obtained (Figure 6, referred as Model 1). While most hypotheses in the proposed model (Li, 2020) were supported, it is interesting to note that PEOU is not a significant predictor of attitude to adopt (ATT). As discussed in Section 2.1, the same phenomenon had been observed in many previous meta-analyses on TAM applications (Legris, Ingham & Collerette, 2003; Ma & Liu 2004; King & He, 2006; Yousafzai, Foxall & Pallister, 2007). In this study, the observation could possibly be accounted by the fact that decision makers may not be the one who actual use the technology so they may not consider, or even not aware, ease of use as a crucial factor. Alternatively, other factors such as market trend, financial return, etc. could be far more important in the mind of decision makers so PEOU had insignificant effect in the model.

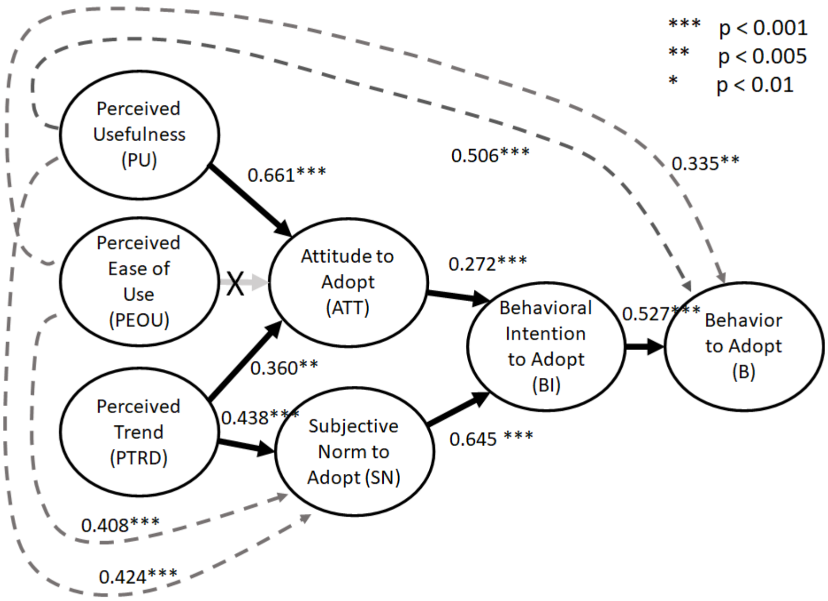


Fig. 6: TRA model based solely on responses from decision makers (Model 1)

As exploratory analyses, two additional trial models utilizing responses from more respondents were computed. In model 2, answers from respondents who claimed to be "regularly involved" (Table 3.1) in technology adoption had been included. In model 3, all responses had been included. Predictive power of the three models were compared (Table 3). Details are provided in Li (2020).

Table 3: Indicative predictive power comparison

R^2	**Model 1 (N=117)**	**Model 2 (N=159)**	**Model 3 (N=263)**
	Decision makers only	Decision makers and those with regular involvement	All respondents
Behavior to adopt (B)	70.2%	29.3%	18.2%
Behavioral intention to adopt (BI)	72.6%	73.0%	65.3%

While all three models can reasonably predict behavioral intention (BI), only Model 1 can meaningfully predict actual adopt (B). Since responses were collected during IT seminars, most participants would have good IT literacy and therefore high R2 for BI should not be surprising. For implementation, however, R2 for B dropped very remarkably when responses from non-decision-makers were included. This could be an indication that behavioral intentions of most non-decision-makers could not be translated into actual adoption (or rejection) due to lack of power to make actual decision.

4. TOE model for blockchain technology adoption

The current scenario of housing affordability situation of middle-income group in Son The questionnaire in Section 3 was designed to fit into both TRA model and TOE model. In this section, the questionnaire is remapped into TOE categories, followed by a preliminary data analysis. A TOE model is then proposed and validated.

To remap the questionnaire, five TOE categories are defined. These five constructs are:

(a) Technical advantage (TADV) – this construct accounts for, from technical perspectives, process improvement, new product offering, cost reduction, enhanced reliability, and other advantages that the concerned technology may lead to;

(b) Organization readiness (ORDY) – this construct examines if the organization is ready to adopt the technology base on operation, human resources, and other supporting requirements;

(c) Management support (OMSP) – this construct measures the management's willingness to adopt the technology via general impression, investment justification, actions taken, etc.

(d) General trend (EGEN) – this construct represents the broad impression about the development direction of the technology under examination;

(e) Stakeholder (ESTK) – this construct concerns about stakeholder expectations.

In addition, the construct IMPN measures the implementation of adoption (or rejection) plan. Remapped research questions are listed in Table 4.

Table 4: Research questions for TOE model construction

Item	**Description**	**TOE**	
		Construct	**Variable**
1	In our business, some process improvements CANNOT be made without blockchain technologies.	TADV	TADV_1
2	Adopting blockchain technologies will enable our company to offer new products / services that CANNOT be provided in the past.		TADV_2
4	In our sector, companies who have implemented blockchain technologies have gained competitive advantages.		TADV_3
5	Blockchain technologies are safe and reliable.		TADV_4
15	Blockchain technologies can improve our operation		TADV_5
6	For our business, there is no major operational barrier for adopting blockchain technologies.	ORDY	ORDY_1
7	Our employees can quickly cope with changes due to deploying blockchain technologies.		ORDY_2
8	If needed, external implementation consultants are readily available at a reasonable fee.		ORDY_3
3	Blockchain technologies can provide a justifiable return on investment in a reasonable period of time.	OMSP	OMSP_1
16	In an overall sense, blockchain technologies are good for our company.		OMSP_2
17	I believe our company should implement blockchain technologies in NEAR future.		OMSP_3
18	I am actively cultivating agreement among other relevant members in the company to adopt blockchain technologies.		OMSP_4
9	At a regional / country level, authorities are encouraging companies to adopt blockchain technologies.	EGEN	EGEN_1
10	Adopting blockchain technologies is becoming a trend in many business sectors.		EGEN_2
11	More companies in OUR sector will adopt blockchain technologies in the NEAR future.		EGEN_3
12	Our customers would expect our company to use blockchain technologies.	ESTK	ESTK_1
13	Our suppliers would expect our company to use blockchain technologies.		ESTK_2
14	Our employees would expect our company to use blockchain technologies.		ESTK_3
19	We are working out / already have an implementing plan with budget for blockchain technologies.	IMPN	IMPN_1
20	We have spent / scheduled to spend remarkably on implementing blockchain technologies.		IMPN_2

Based on the 117 responses from decision makers, Cronbach's alpha test (Table 5) and discriminant validity test (Table 6) are performed.

Table 5: Cronbach's alpha test

	No. of variables	No. of data	Cronbach's alpha
TADV	5	117	0.83
ORDY	3	117	0.76
OMSP	4	117	0.90
EGEN	3	117	0.71
ESTK	3	117	0.89
IMPN	2	117	0.92

Cronbach's alpha greater than 0.7 indicates satisfactory internal reliability (Nunnaly, 1978). Thus, numerical average of the variables in a category can properly represent their corresponding construct.

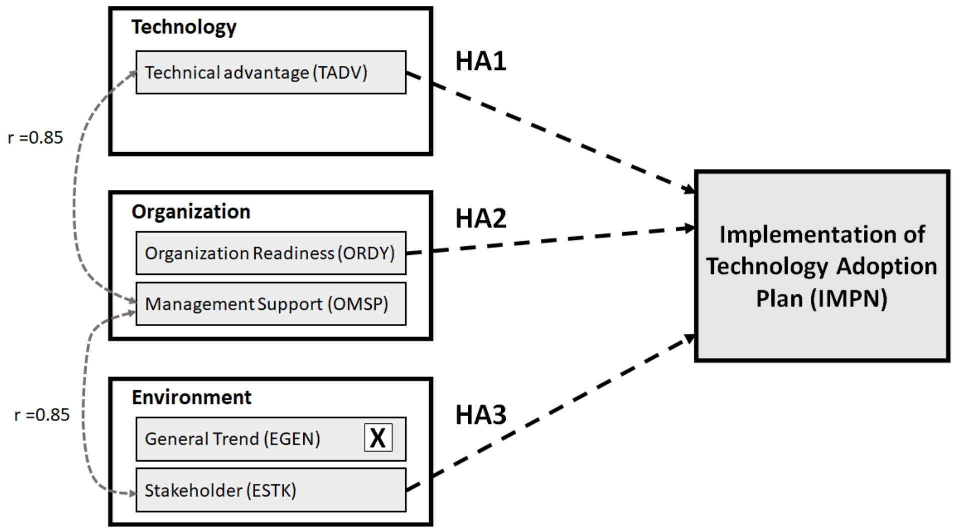
Table 6: Discriminant Validity

	Correlation coefficient (r)	Standard Error (SE)	1 - r - 2*SE
TADV - ORDY	0.41	0.08	0.44
TADV - OMSP	0.85	0.04	0.08
TADV - EGEN	0.77	0.07	0.10
TADV - ESTK	0.75	0.05	0.16
TADV - IMPN	0.75	0.04	0.17
ORDY - OMSP	0.64	0.06	0.24
ORDY - EGEN	0.48	0.10	0.32
ORDY - ESTK	0.61	0.06	0.26
ORDY - IMPN	0.63	0.05	0.27
OMSP - EGEN	0.72	0.10	0.08
OMSP - ESTK	0.89	0.05	0.02
OMSP - IMPN	0.84	0.05	0.07
EGEN - ESTK	0.75	0.04	0.17
EGEN - IMPN	0.55	0.05	0.36
ESTK - IMPN	0.77	0.05	0.13

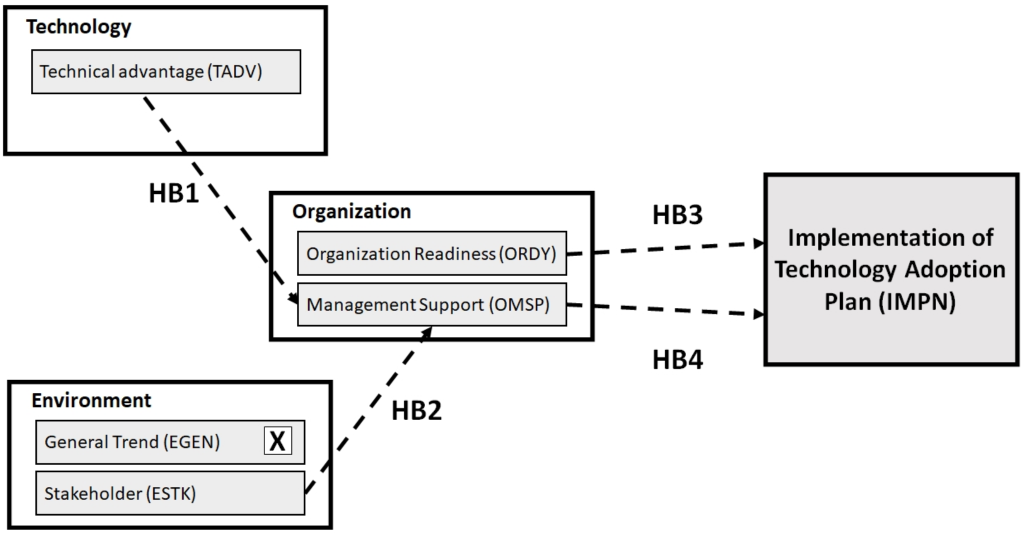
According to Bagozzi and Warshaw (1980), discriminant validity can be claimed if

$$1 - r - SE > 0 \quad (1)$$

where r is the correlation coefficient. SE is the standard error



(a) TOE Model A



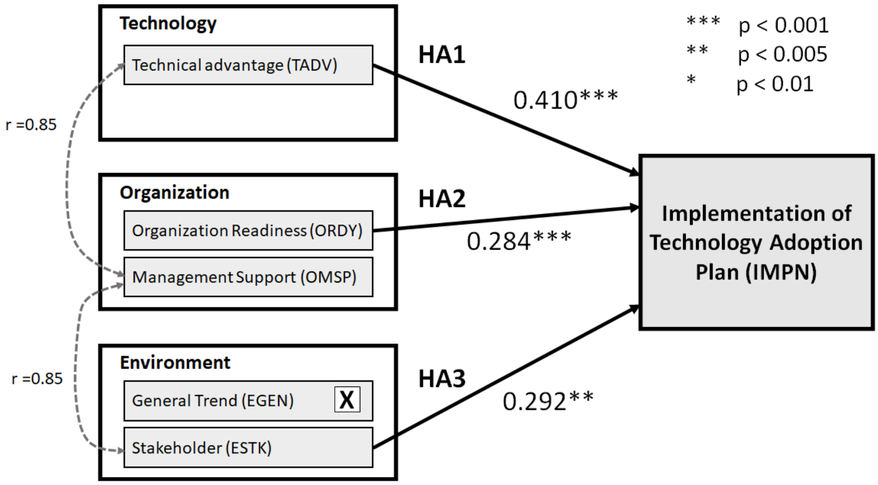
(b) TOE Model B

Fig. 7: Proposed TOE models based solely on responses from decision makers.

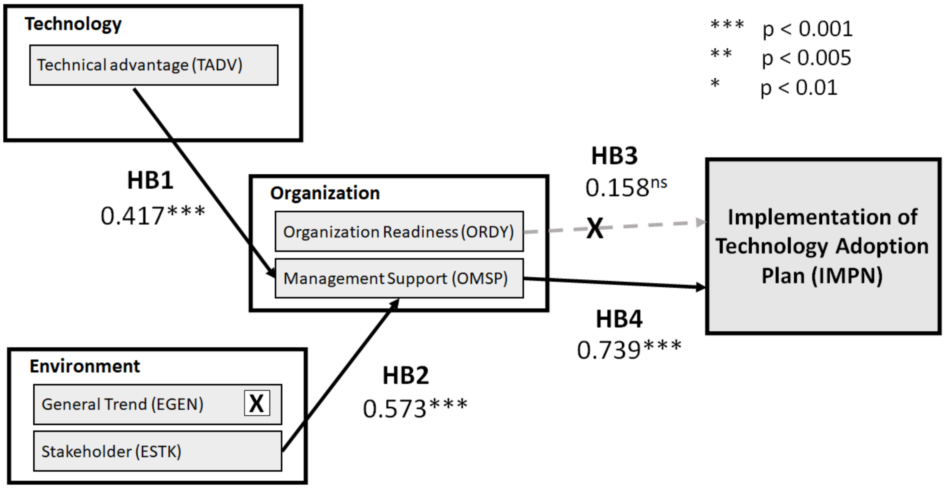
Thus, as shown in Table 4.3, discriminant validity is also satisfied.

To develop a vital TOE model, correlations among the variables are examined. Three important observations are: (i) correlation between input variables OMSP and ESTK is very high; (ii) correlation between input variables TADV and OMSP is very high; and (iii) correlation between input variable EGEN and output variable

IMPN is low.



(a) TOE Model A



(b) TOE Model B

Fig. 8: Validated TOE model based solely on responses from decision makers.

Because of its low relevance, EGEN is excluded in order not to unnecessarily increase standard error. To avoid potential multicollinearity problem, there are some possible choices. For example:

(a) Omit OMSP and link both TADV and ESTK to IMPN; or

(b) Put OMSP as a mediating variable that links TADV and ESTK to IMPN.

Two models are proposed accordingly, with all hypotheses (HA1-3, HB1-4) postulating positive correlations between concerned variables (Figure 7).

Multiple regression is used to analyze the hypotheses. Results are summaries in Figure 8.

While all hypotheses in Model A are supported, HB3 (i.e. effect of ORDY) in Model B is not. The apparent inconsistency suggests that effect of ORDY may mediate through OMSP. A mediation test (Baron and Kenny, 1986; Judd and Kenny, 1981) has verified this assumption (Table 7).

Table 7: Mediation test (non-significant when p > 0.01)

Constructs	Correlation Coefficient	p-value	Mediation
ORDY – IMPN	0.633	0.000	Full
ORDY – OMSP	0.642	0.000	
ORDY - IMPN	0.158	0.015	
OMSP - IMPN	0.739	0.000	

Accordingly, Model B has been modified to reflect the mediation relation. The resulting model (Model C, Figure 9) has been satisfactorily validated.

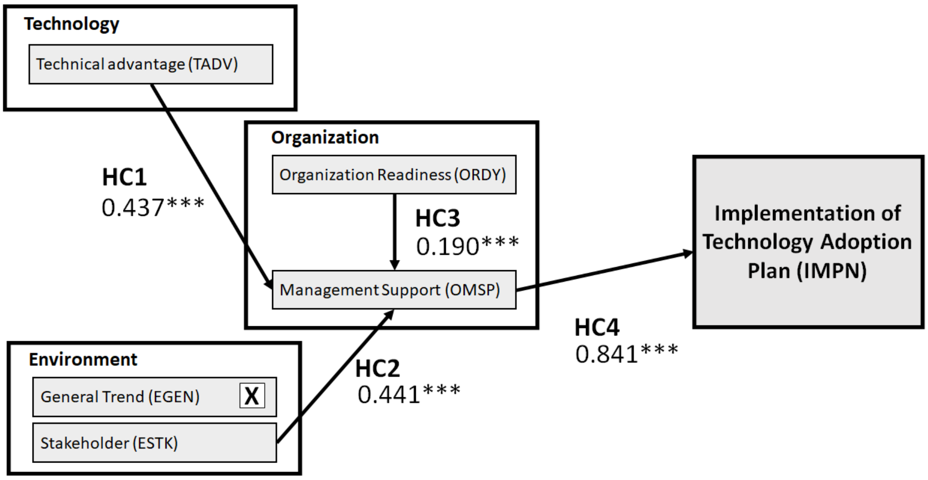


Fig. 9: Validated TOE Model C.

Thus, two vital models, Model A and Model C, are obtained base on the TOE framework.

5. Discussions and Conclusion

Model C resembles, to a good degree, Model 1 in Figure 6 after slight rearrangement (Figure 9). Comparing the two models, TADV's role is similar to PU, ORDY to PEOU, and ESTK to SN. Other mediating variables in Model 1 are replaced by OMSP in Model C. R2 of Model 1 is 70.2% and that of Model C is

71.1%.

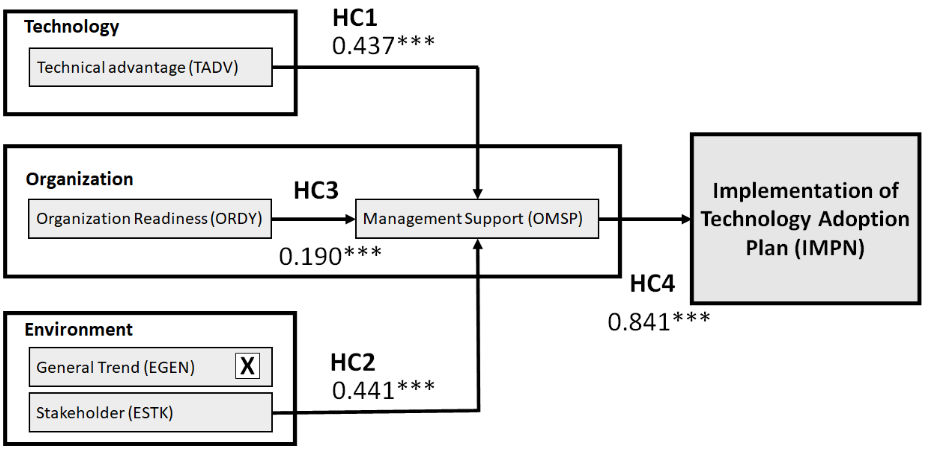


Fig. 10: Model C rearranged.

It should be realized that Model 1 is a behavioral model predicting decision maker's technology adoption action, and Model C is a technology adoption model built on organization characteristics obtained from decision makers. As such, they started from different theoretical bases, and this is an important rationale for most literatures to classify behavioral model and TOE framework as, respectively, individual level theory and organization level theory. However, the resemblance shown in this study suggests the models can offer similar explanation of the adoption action and would practically lead to similar results.

Thus, besides deriving classical TOE model such as Model A, the TOE framework can also generate models compatible to behavioral-theoretic, and hence endorses its applicability. Baker (2012) has remarked that TOE framework is lacking of development because the theory is too generic and offers complementary, instead of competing, explanation to other organization level theories such as DOI. As such, there is no need for theorists to modify the framework. This is probably true from the viewpoint of developing the theory itself. Compared to TAM and other behavioral models, there are in fact much less TOE literatures in both theory and application. For practitioners, however, TOE framework is easy to use in real-life business settings but more justifications are necessary. As an exploratory attempt, this study has examined the equivalence of TOE framework and the well proven behavioral models under the situation where only decision makers' views are considered. The results add to justifications for applying TOE framework in practical business environment.

Regarding limitations, it is obvious that the research was only based on adoption of one specific technology among SMEs in a city. Most survey respondents have relatively high level of IT proficiency, which might make their responses different from a wider range of general IT users. Thus, the findings in this study cannot be over-generalized and further researches covering different range of participants for other products/services and geographies are essential.

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