TNI Journal of Business Administration and Languages
Vol.5 No.2 July - December 2017

TAM-Based Analysis on ERP Learning of Non-IT Learners

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***Abstract*— Enterprise Resource Planning (ERP) has become a mainstream protocol to integrate the data across an organization. Due to its increasing importance in the business world, many higher educational institutions have organized in-house ERP courses to educate their students including non-IT students (learners) to get ready for future careers. As the objectives of this study, it is interesting to understand how non-IT learners accept to use ERP software and what influences their learning achievement. Here, Technology Acceptance Model (TAM) was applied to analyze the technology acceptance of non-IT learners. The sample data was purposively collected from eighty-eight non-IT undergraduate students enrolled in ERP class at Thai-Nichi Institute of Technology (TNI). Using a path analysis, the influence of two primary TAM factors, perceived usefulness (PU) and perceived ease of use (PEU), was studied. The result shows that both TAM factors have a positive effect on usage intention, indicating the technology acceptance. Regarding the learning achievement by test scores; however, only perceived ease of use has a direct effect whereas perceived usefulness has no direct effect. Perceived usefulness has only the indirect effect on the achievement through the learners' usage intention. Therefore, it is implicative that user-friendly software is required for non-IT learners to initiate the efforts for achieving the learning outcomes of ERP software.**

***Keywords*— Enterprise Resource Planning (ERP), Technology Acceptance Model (TAM), Perceived Usefulness (PU), Perceived Ease of Use (PEU), Learning achievement**

I. INTRODUCTION

Accurate, real-time and updated information is of great importance to the business success of the company. It contributes to effective planning and decision making which requires prompt information to support. Nowadays, Enterprise Resource Planning (ERP) is inevitably mainstream software used to integrate the whole organization data as a single database. The leading companies in different continents throughout the world have adopted ERP to run their business. Among a large number of ERP software vendors, SAP is one of the most used software vendors in the world. According to Forbes [1], SAP was ranked number one in terms of its market share of 25%, as shown in Fig. 1. The total market size was $24.5B with 2.2% growth in 2011.

Due to its increasing importance of ERP software, many higher educational institutions have paid more attention to educate their students to use ERP software. According to the information from SAP University Alliance (UA) [2], fifteen Thai universities including Thai-Nichi Institute of Technology (TNI) have joined SAP UA program and have organized in-house ERP courses. In TNI, SAP taught in ERP courses is aimed at both IT and non-IT students. Hereinafter, 'non-IT students' will also be called as 'non-IT learners' and will be the focus of this study. Note that non-IT learners study ERP software in order to prepare themselves to get ready for future careers as end users in the business, e.g., in sales, production planning, and purchasing functions.

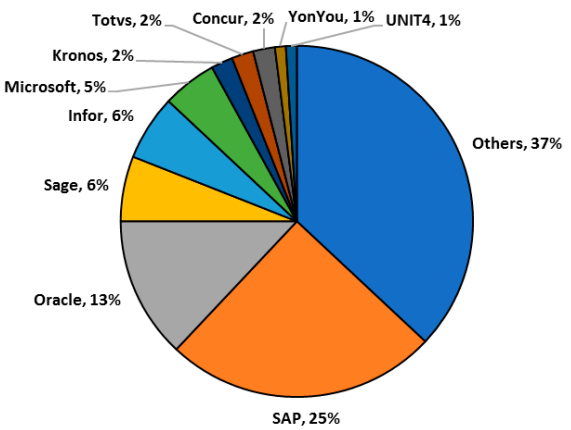

Fig. 1 Worldwide ERP market share in 2012 [1]

Since ERP software is specifically-purposed software used in the business world, it is not generally seen in a daily life like spreadsheet software. First of all, most of non-IT learners may have never seen ERP software prior to their first ERP classes. The features of ERP software such as screen looks, icons and terminology are completely new to them. In addition, the basic core of using ERP is to make use of the business data underlying in the business flow. Therefore, it is essential for non-IT learners to understand such kind of business data simultaneously during the time they are learning how to use the software.

Along with the course of ERP learning, the learning motivation and achievement is expected. However, this software is not just simple due to the difficulties mentioned above. Knowing how non-IT learners think about ERP software should be one of the important approaches for the instructors to organize the ERP courses to be successful. The key conceptual framework here is the user acceptance of technology in order to predict the user behaviour in using the technology. In this study, Technology Acceptance Model (TAM), the most widely cited and influential model in this field [3][4], was proposed to understand the acceptance of technology for non-IT

learners in TNI and also the factors related to the learning achievement.

II. TECHNOLOGY ACCEPTANCE MODEL (TAM)

Due to the adoption failure of information system (IS), many types of research works in the area of IS adoption, for the past few decades, have been carried out with the aim of understanding the factors affecting the successful adoption. One of the significant attempts is to predict the system usage of the users. Among various theories, Technology Acceptance Model (TAM) is the most leading model that has attracted many researchers' attention. TAM was originally proposed by Davis F.D. in his doctoral dissertation in 1986 [5]. The model was modified from the Theory of Reasoned Action of Ajzen and Fishbein. The main concept of TAM deals with the user motivation in accepting to use the technology. Since the first publication, TAM has been evolved and validated in different research settings such as e-learning [6], e-book [7] and learning management system [8]. Lastly, in 2000, Venkatesh and Davis developed TAM2 as an extended model to original TAM [9]. Holistically, the important variables ever involved in TAM model and their influencing relationships are illustrated as the conceptual framework in Fig. 2. The arrows show the causal relationships between all possible pairs of the variables. According to the previous literature review, the relationships don't always appear to be valid in any pairs. The validity depends on the research settings and the population.

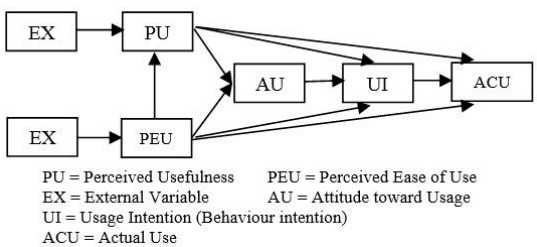

Fig. 2 Holistic conceptual view of TAM model

Perceived Usefulness (PU) and Perceived Ease of Use (PEU) are considered as primary factors originally in the model while External factor (EX) is an extended factor and varied depending on the research scopes. As written in Davis's thesis [5], PU is defined as "*the degree to which an individual believed that using a particular system would enhance his or her performance.*" PEU is defined as "*the degree to which an individual believes that using a particular system would be free of physical and mental effort*." Both of these two primary factors are also found to have an association as shown in the figure above. The external factors, such as subjective norm and job relevance for PU, and self-efficacy and anxiety for PEU, are the antecedents of PU and PEU.

Attitude toward Using (AU), influenced by PU and PEU, was originated from the Theory of Reasoned Action and adopted in the original TAM model. The user attitude was a determinant of the actual use (ACU) of the system. But later in the continuing work of Davis, the additional change was concluded that PU had a directly great influence on the user intention, namely Usage Intention (UI) or Behaviour intention, and on the actual use without forming the attitude [10]. However, the consideration of the attitude into the research framework seems to be optional. Some other TAM-focusing researchers still include the attitude in their research frameworks, but some don't.

Actual Use (ACU) is the actual response from the users after motivated. TAM model was developed to predict whether or not the users would actually use the system. In the meantime, ACU is somewhat the limitation of TAM study since the actual measurement of ACU cannot be directly done. Therefore, self-reporting from the users is normally adopted to collect the data of actual use.

Despite the modification of TAM model and numerous findings from the research works related to TAM validation, TAM model is still a popular model. From the Academic Search Complete of EBSCO database, there are totally 1025 TAM-related academic articles published in 1994-2017 (that is only 45 articles yearly published in average in 23 years) versus 154 articles published in 2016-2017. This high number in the recent years shows the TAM's ongoing popularity.

III. OBJECTIVES

The objectives of the study are as follows.

1. To analyze the technology acceptance of non-IT learners in using ERP software based on the concept of TAM model
2. To understand the factors influencing on ERP learning

IV. RESEARCH FRAMEWORK AND METHODOLOGY

A. Research framework

There were two analysis frameworks in this study. The first one was to understand the relationship with demographic data. The second one was to understand the influence of TAM factors. Two theoretical frameworks are illustrated respectively in Fig. 3 and 4.

In the first framework, the demographic data of non-IT learners in the ERP class consists of gender, cumulative grade point average (GPAX), the grade obtained in the previous computer class in which the students were enrolled in their second year, the number of hours spent per day on computer usage and SAP software installation for home practices.

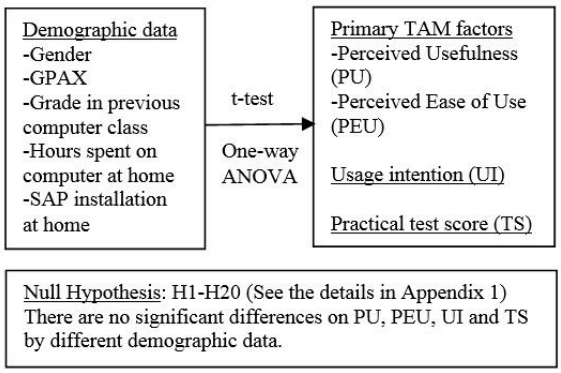

Fig. 3 Research framework for demographic relationship

In the second framework, the external factors, the attitude toward using, and the actual use were eliminated from the proposed model. Instead of measuring the actual use, the learning achievement by practical test scores (TS) was measured as its measurement was straightforward. For two primary TAM factors, PU was presented as an independent variable whereas PEU was a dependent variable because PEU has an effect on PU. The variables, UI and TS, were also presented as dependent variables. The variable UI was the measure of the technology acceptance whereas the variable TS was the measure of learning achievement.

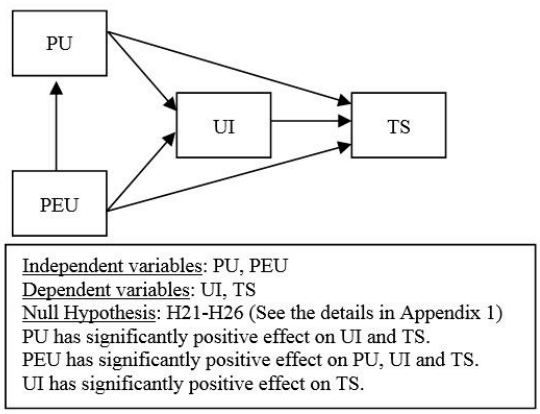

Fig. 4 Path analysis framework for originally proposed model between TAM factors and ERP learning

The variables, PU, PEU and UI, were the psychometric rating data. The variable TS was the ranking data from actual practical test scores in ERP class. The average rating of the items in each variable was calculated and used in the data analysis

B. Research methodology

The method used in the study was questionnaire-based in 5-point rating scale from '(1) Very slightly agreed or Very low score rank' to '(5) Very strongly agreed or Very high score rank', respectively. The population was non-IT undergraduate students from Faculty of Business Administration of TNI who were first enrolled in ERP class. The only class of ERP software taught for non-IT students in TNI was the class conducted in the subject code IMA-314 (Practical Production Planning and Control) where SAP was taught weekly. The purposive sampling was taken from this class in the 10th week of the semester. Those students (88 students in total) were the 3rd year students in the 1st semester of Academic year 2016. Note that the re-enrolled students were not the target of this study.

The questions for psychometric variables were modified from the previous TAM-related research works. They were composed of 5 measurement items for PU, 5 measurement items for PEU and 3 measurement items for UI. See the details in Appendix 2. The questionnaires were distributed to the students and collected in the class. For the framework in Fig. 3, independent t-test and one-way ANOVA by SPSS software was used to analyze the demographic data. A Post-hoc pairwise comparison test was done when necessary.

For the framework in Fig. 4, TAM factors were analyzed to understand their effects on the usage intention and the achievement of ERP learning by Path Analysis using Lisrel software. Moreover, an in-depth interview was conducted with four groups of selected students (three persons in each group) to reaffirm the findings from the proposed model. The interview was conducted with each individual student.

Mean rating score of each psychometric variable and test score ranking is meaningfully expressed as below.

1.00 - 1.80 Very slightly agreed/Very low score rank
1.81 - 2.60 Slightly agreed/Low score rank
2.61 - 3.40 Moderately agreed/Middle score rank
3.41 - 4.20 Strongly agreed/High score rank
4.21 - 5.00 Very strongly agreed/Very high score rank

V. RESULTS

A. Demographic data

The frequency results are shown in Table 1. The mean and standard deviation of TAM factors are demonstrated in Table 2.

TABLE I:
DEMOGRAPHIC DATA OF NON-IT LEARNERS

Description	Frequency	Percent
Gender		
Male	35	39.8
Female	53	60.2
Total	88	100.0
GPAX		
3.51-4.00	9	10.2
3.01-3.50	20	22.7
2.51-3.00	27	30.7
2.01-2.50	28	31.8
1.51-2.00	4	4.6
Below 1.50	0	0.0
Total	88	100.0
Grade in previous computer class		
A, B+	30	34.1
B, C+	36	40.9
C, D+	21	23.9
D, F	1	1.1
Never taken, W, I	0	0.0
Total	88	100.0
Hours spent on computer		
More than 6 hours	13	14.8
4-6 hours	26	29.5

Less than 4 hours	49	55.7
Total	88	100.0
SAP software installation at home		
Already installed	39	44.3
Not yet installed	49	55.7
Total	88	100.0

TABLE II:
MEAN AND STANDARD DEVIATION OF VARIABLES

	Mean	**Standard deviation**
PU	3.91	0.66
PEU	3.13	0.67
UI	3.2	0.88
TS	3.42	0.95

The results show that non-IT learners strongly agreed with the usefulness of ERP software rather than thinking that the software was easy to use. In terms of intention to use, they moderately agreed that they would desire to use the software in their future career. Regarding the test score ranking obtained in the class, non-IT learners could accomplish the ERP practical test in high ranking.

Cronbach's alpha was also calculated to test the reliability of the items within each psychometric variable (PU, PEU and UI). The coefficients were in the acceptable range (minimum value of 0.60 is recommended); that was 0.841 for PU, 0.797 for PEU and 0.900 for UI.

B. Analysis of demographic relationship

To understand whether the demographic data has an effect on TAM factors, independent t-test and one-way ANOVA was applied to test the hypothesis H1-H20 at significance level of 0.05. The results are demonstrated in Table 3.

TABLE III:
SUMMARY OF P-VALUE FOR HYPOTHESIS TEST OF DEMOGRAPHIC DATA

	PU	**PEU**	**UI**	**TS**
Gender	0.159	0.497	0.74	0.781
	(H1)	(H6)	(H11)	(H16)
GPAX	0.359	0.486	0.171	0.000*
	(H2)	(H7)	(H12)	(H17)
Grade in computer class	0.111	0.083	0.158	0.000*
	(H3)	(H8)	(H13)	(H18)
Hours spent on computer	0.331	0.3	0.126	0.156
	(H4)	(H9)	(H14)	(H19)
SAP installation	0.252	0.513	0.179	0.929
	(H5)	(H10)	(H15)	(H20)

*Significantly different ($p<0.05$)

From Table 3, there were no statistically significant differences between genders, GPAX, the grade in previous computer class, the hours spent on computer usage and SAP installation, in terms of PU, PEU and UI. But there was significant difference of TS due to GPAX and the grade in the previous computer class. The null hypothesis H1-H16 and H19-H20 were accepted whereas the null hypothesis H17 and H18 were rejected. Then, Post-hoc test (Scheffe test) was done to find out the significant difference of means between pairs in GPAX and the previous grade, as presented in Table 4 and 5 respectively.

From Table 4, it was found that only the pairs between the non-adjacent groups of GPAX had significantly different means of the test scores. The groups with much higher GPAX obtained significantly higher test scores than the groups with much lower GPAX. But the groups with closer GPAX did not have significantly different test scores.

From Table 5, it was found that only the group with excellent grade (A, B+) had significantly higher test scores than the other groups. The other two groups with lower grade had indifferent test scores between groups.

TABLE IV:
MEAN DIFFERENCE FOR MULTIPLE COMPARISON IN GPAX (H17)

GPAX	**3.51-4.00**	**3.01-3.50**	**2.51-3.00**	**2.01-2.50**	**1.51-2.00**
3.51-4.00	-	-	-	-	-
3.00-3.50	0.538	-	-	-	-
2.51-3.00	0.852	0.313	-	-	-
2.01-2.50	1.550*	1.011*	0.698	-	-
1.50-2.00	2.014*	1.475*	1.162	0.434	-

*Significantly different ($p<0.05$)

TABLE V:
MEAN DIFFERENCE FOR MULTIPLE COMPARISON IN GRADE (H18)

GRADE	A, B+	B, C+	C, D+
A, B+	-	-	-
B, C+	0.597*	-	-
C, D+	1.008*	0.41	-

*Significantly different ($p<0.05$)

Furthermore, the unexpected finding from Table 3 was that regardless of SAP installation at the learner's home, there was no significant difference on the achieved test scores. Nevertheless, having ERP software installed at home is recommended as the learners can promptly practice the software at home, especially when they cannot follow the lesson in the ERP class. Table 6 presents the occasions of SAP practice purposes at home. As shown, more non-IT learners tended to practice ERP software when the software was installed at home and used it for catching up the lessons.

TABLE VI:
OCCASION OF SAP PRACTICE AT HOME

	Never use	For catch up	For test prep
Installed	5	25	20
Not installed	9	14	18

C. TAM factors influencing on ERP learning

From the result of proposed model examination in the path analysis, it was found that PU had no significant effect on TS. So, the null hypothesis H22 was rejected whereas the null hypothesis H21, H23, and H24-H26 were accepted.

Therefore, the proposed model was adjusted as demonstrated in Fig. 5 and tested for goodness of fit with the observed data. Table 7 presents the measures for model fits whose values were in the acceptable range.

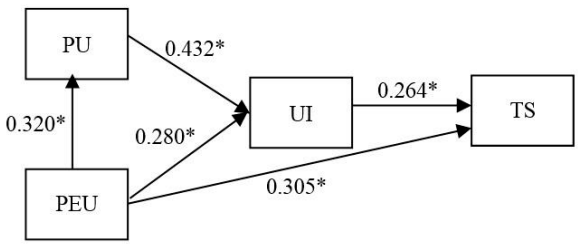

Fig. 5 Adjusted Measurement model (*Significant level at 0.05)

TABLE VII:
MEASURES FOR GOODNESS OF FIT

Measures	Recommended value	Obtained value
Chi square (p-value)	p>0.05	0.24 (p=0.62)
RMR	<0.050	0.008
RMSEA	<0.10	0
GFI	>0.90	0.99
NFI	>0.90	0.99
CFI	>0.90	1

In Fig. 5, the parameter estimates for each relationship are indicated. The results show that all the relationships except the pair of PU-TS were valid as in the originally proposed model shown in Fig. 4. Both PU and PEU had the positive and direct effects on UI while only PEU had the positive and direct effect on TS because PU had only the indirect effect. Also, UI had the positive and direct effect on TS. Thus, it can be said that PU had the positive but indirect effect on TS via UI.

The direct and indirect effects can be summarized as in Table 8 below. The results reveal that UI was directly influenced by PU in higher degree than by PEU (0.432 vs 0.280). But together with its indirect effect, PEU had an equivalent effect, compared with PU (0.418 vs 0.432). In contrast, TS was influenced by PEU directly and indirectly rather than by PU having no direct effect on TS. The factor PU had the only indirect effect on TS through UI (0.114) due to the existing effect of UI on TS (0.264). Since PEU had both direct (0.305) and indirect (0.110) effect on TS through UI; therefore, PEU had the stronger effect on TS than PU did (0.415 vs 0.114).

TABLE VIII:
PARAMETER ESTIMATES FOR EFFECTS

	From	Total	Indirect	Direct
TS	PU	0.114	0.114	-
	PEU	0.415	0.11	0.305
	UI	0.264	-	0.264
UI	PU	0.432	-	0.432
	PEU	0.418	0.138	0.28

VI. CONCLUSION AND DISCUSSION

From the result of model fit verification, Technology Acceptance Model (TAM) can be applied well to understand the technology acceptance of non-IT learners. It is apparent that two primary TAM factors, which are perceived usefulness and perceived ease of use, have positively an influence on the technology acceptance which is measured by the usage intention. Moreover, the perception of software usefulness has the greater impact on the usage intention than the perception of software easiness does. It is the natural sense that people will realize more awareness of the situations involved when they consider the situations are important to them; namely the software is useful. Thus, both primary TAM factors should be considered as fundamental motivation drivers of usage intention.

In terms of test score achievement, the effect of usage intention was found positively and directly. The possible explanation is that the usage intention leads to induce the actual execution of software usage in which the achievement of high test scores is resulted. As a matter of fact, this is what naturally can be expected. Therefore, both primary TAM factors causing the motivation have the indirect influence on the learning achievement by having the usage intention as mediating factor.

In addition, another important finding is that not only the indirect influence exists, but the greater direct influence of perceived ease of use on the test score achievement also exists without mediated. Non-IT learners prefer an ease of software usage to initiate their minimal effort in mastering the software. This result is similar to the findings found by Brown and et.al. [11], where the research setting was mandatory, same as in this study. Even though the data of this study was collected from the university students, the finding here is considered to be valid to be applied to the case of general non-IT learners in the real work environment due to the fact that the real work environment is based on mandatory setting as in the university class since the ERP software to be used in the company is the best selected and using only the selected software is compulsory.

In order to reaffirm the findings from the model, the in-depth interview was conducted individually with four groups of selected learners from four quadrants (Group A1, A2, F1 and F2) as shown in Fig. 6. The criteria to

divide the quadrants were GPAX and the percent of test score obtained in ERP class.

In the interview, all groups of the learners mentioned that ERP software was difficult at the initial stage. But Group A1 and F1 realized that the software was not too difficult to master. While they started getting used to it, every single success in pursuing ERP software practices in the ERP class was counted and gained their confidence in pursuing the ERP class. They learned to improve their skills from their previous mistakes well. At the end, they felt less mentally stressed in using the software themselves. In other words, the initial difficulty of software usage is transformed during the ERP learning course as the learners are getting familiar with the software. Oppositely, Group A2 and F2 kept emphasizing that the ERP software was difficult. Especially, Group F2 showed very little of the indulged effort.

ERP test score	F1 GPAX < 2.50 Test score > 70%	A1 GPAX > 3.00 Test score > 70%
	F2 GPAX < 2.50 Test score < 50%	A2 GPAX > 3.00 Test score < 50%
	GPAX	

Fig. 6 Four quadrants of interview groups

Based on the analysis here, the most influencing factor of TAM model to make an achievement in using ERP software is the perception of ease of use, which can be gained along the learning course. Perceived ease of use can be acquired regardless of the previous academic achievement; namely high GPAX. The presence of Group F1 and A2 is the good evidence of this important finding. If perceived ease of use had had no influences, Group F1 should not have existed since the students with low GPAX should always have had the thought that ERP software was difficult. But the fact, some of non-IT learners with low GPAX could make an achievement if the ease of use was perceived. On the other hands, Group A2 with high GPAX, who have already proved their competitiveness in the prior classes, were expected to prove themselves again in ERP class. But in fact, they could not since they perceived only the difficulty of the software, which influenced their actual abilities.

In addition to perceived ease of use as a significant influence, there must be other influencing factors that play important roles in the learning achievement. As seen in Table 3, the groups with excellent GPAX gained significantly high test scores. From the interview, one student from Group A1 expressed that retaining high scores was one of the goals of learning. It is evident that the individual eagerness to obtain the high scores is also added into the motivation of test score achievement.

As a conclusion, the important factors for successful ERP learning of non-IT learners are the perceived ease of software usage with both a direct and indirect effect, and the software usefulness with an indirect effect. The instructors should facilitate the learning atmosphere in order to avoid the learning barriers and to enhance the learning process of non-IT learners so that the ease of proceeding the practices in the class can be obtained. For further research, antecedents of primary TAM factors shall be studied to understand the influence of external factors on TAM factors.

APPENDIX I:
Null Hypothesis in the Study

Hypo-thesis	Independent Variables (X)	Dependent Variables (Y)	State-ment
H1	Gender	Perceived Usefulness (PU)	X makes no significant difference on Y
H2	GPAX		
H3	Grade in computer class		
H4	Hours spent		
H5	SAP installation		
H6	Gender	Perceived Ease of Use (PEU)	
H7	GPAX		
H8	Grade in computer class		
H9	Hours spent		
H10	SAP installation		
H11	Gender	Usage Intention (UI)	
H12	GPAX		
H13	Grade in computer class		
H14	Hours spent		
H15	SAP installation		
H16	Gender	Ranking of Actual Test Scores (TS)	
H17	GPAX		
H18	Grade in computer class		
H19	Hours spent		
H20	SAP installation		
H21	PU	UI	X has sig. positive effect on Y
H22	PU	TS	
H23	PEU	PU	
H24	PEU	UI	
H25	PEU	TS	
H26	UI	TS	

APPENDIX II:
Psychometric measurement items in the questionnaire.

Perceived Usefulness (PU) - ERP/SAP would add your quality - ERP/SAP would be used to write on your resume - ERP/SAP would be beneficial to your future career - ERP/SAP would be important to the grade in the class - Studying ERP/SAP would make you to be hands on
Perceived Ease of Use (PEU) - I find ERP/SAP easy to use - ERP/SAP is easy to apply in the future job - It is easy to get familiar with ERP/SAP - It is easy to understand the ERP/SAP functional screen - It is easy to follow the class
Usage Intention (UI) - I want to work for the company using ERP/SAP - I want to know more about ERP/SAP at work - I want to be more skillful on ERP/SAP at work

ACKNOWLEDGMENT

This paper is based on work supported by Thai-Nichi-Institute of Technology.

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