The factors affecting adoption intention in navigational information system – a study of mariner's perception on utilizing ECDIS

HUI-LING YU
Department of Shipping Technology,
National Kaohsiung Marine Science & Technology, Taiwan
No.482, Jhongjhou 3rd Road, Cijin District, Kaohsiung City 805, TAIWAN.
yu1212@mail.nkmu.edu.tw

SHENG-FEI HSU
Center for General Education, National Formosa University, Taiwan
No.64, Wunhua Road, Huwei Township, Yunlin County 632, TAIWAN.
g9320803@yuntech.edu.tw

Abstract: **-** Although the International Maritime Organization had approved electronic chart display and information system as a paper chart equivalent, parts of mariners still doubted of its feasibility on safe navigation. For analyzing mariner's more or less hesitations on using such navigational information system, this study surveyed the samples of the students in the navigational department for understanding how the perceived risk affected the user's adoption intention over and above perceivability of usefulness and ease of use on electronic chart display and information system by comparing the students with/without practical experience on board. Research found that perceived risk presented different levels of negative influences on user's adoption intention directly and mediated through perceived usefulness and perceived ease of use as well.

Keywords: - International Maritime Organization (IMO), Electronic chart display and information system (ECDIS), Perceived risk, Perceived usefulness, Perceived ease of use, Adoption intention

1 Introduction

While fast and convenient computing equipments have been developed and applied on various domains in recent years, people expect that such advancement on information technology can improve current unsatisfied accuracy, efficiency and effectiveness. Similar expectance also appears in the marine transportation. While mariners once charted the seas using sun, moon, and the stars, modern ships are equipped with electronic chart display and information system (ECDIS), which provides 24-hour real-time positioning and anti-grounding capabilities. This advanced navigational system allows not only route recommendations and position tracking, but also generating audible and/or visual alarms when the vessel is in proximity to

navigational hazards. However, for all its capacity, some limitations still exist. Previous researches therefore suggested that the electronic chart should not be totally relied upon or lead the shipmate into a false sense on safety and security [1]. They also advised that over-confidence must not result from the fact that the ship's position was automatically shown on a chart. In other words, shipmates must be always wary as to how the system is actually performing in regard to accuracy and reliability. This needs to be aware of the deficiencies and risks of the overall system and its components. It must be recognized that the quality of the sum of the information is essentially dependent on the reliability of the each component of data and technology. Similar to any system, an ECDIS is not infallible, it has the same shortcomings that exist in any technical device [1]. While applying ECDIS on the ship has been an important issue, and it is also one of the required courses for the students majored in navigation at maritime college, there is still no sufficient empirical study to investigate whether perceived risk, and user's perceived usefulness as well as perceived ease of use affect their adoption intention in ECDIS. For examining and predicting user's intention in utilizing such an advanced navigational instrument under influence of these factors mentioned above, authors applies on Fetherman & Pavlou' s theory [2] to explore and analyze these influence. In addition, this investigation carries out by a comparison between students of navigational department without practical experience and senior students with at least six months practical experience on ship. Several hypotheses are proposed according to the related theory, and regression analysis and path chart is used as main tool to analyze the data collected by questionnaire.

2 Literature review

Bridge's shipmates had three main duties: navigation, collision avoidance, and ship management. For completing these jobs efficiently, the integrated bridge system was designed to reduce the time spent on navigation by eliminating manual data processing and providing the navigator with a display which aided him in quickly evaluating the navigation picture [3]. An integrated bridge system encompasses several possible combinations of equipments and software designed specifically for each individual vessel's needs, and ECDIS is one of the main equipments in integrated bridge system. ECDIS is a computer-based navigation information system that complies with International Maritime Organization (IMO) regulations and can be used as an alternative to paper navigation charts [1]. Even though, ECDIS standards are still under development. The IMO, in its performance standards for ECDIS, has mandated that individual national hydrographic offices (HO) would supply data of official electronic nautical chart for ECDIS use. For ensuring the reliability of the data, the ECDIS must not allow data from an unofficial source to erase, overwrite, or modify HO supplied data [3]. Further, ECDIS combined several different functions into one computerized system, it was possible to program it to sound alarms or display warnings when certain parameters were met or exceeded. This helped the mariners to monitor close navigation hazards. These hazards associated with the use of ECDIS fell into three categories [1]: First, the equipment itself, both hardware and software, might suffer from potential virus infection, power outages, loss of input of sensory equipment. Second, the charts themselves were at risk from permit expiry, out-of-date charts being used, updates not applied correctly, excessive zooming (in the case of Raster charts), inability to open the next chart required (Raster charts). And third, the particulars of these

risks were unique to each vessel, crew, and equipment, and could only be assessed on a case-by-case basis. Previous researcher described risk as the likelihood of the hazard occurring, combined with the severity of the hazardous event. And Cunningham [4] defined risk as "the amount that would be lost if the consequences of an act were not favorable". Also, risk was depicted as the variation in the distribution of possible outcomes, their likelihood and their subjective values [5]. Perceived risk was introduced in the 1960s, it has been modeled as both a two-dimensional construct (i.e., uncertainty and negative consequences) [6][7]. Based on and developed from Mitchell definition [5], perceived risk in navigation could be defined as perceived negative variation in the distribution of possible outcomes, their likelihood and subjective values as a result of using ECDIS on the voyage.

While informational technology affected and changed traditional navigation, shipmate's perception and cognition on accepting and manipulating these modern informational equipments became interesting and worthy to explore. The technology acceptance model (TAM) was one of the most widely used models for examine such an issue. But Featherman and Pavlou's theory [2] not only involved the essence of technology acceptance model, but also extended TAM by integrating the construct of perceived risk as uncertainty regarding possible negative consequences of using a product or service. This theory utilized more parsimonious model (perceived usefulness and perceived ease of use as predictors of adoption intention) to better focus on interactions with the perceived risk variable.

3 Hypotheses

The following hypotheses were drawn for analyzing how the perceived risk, perceived usefulness, and perceived ease of use affected user's adoption intention, as well as the interactions between these three predictors.

In this study, perceived risk (PR) was commonly thought of as an uncertainty regarding possible negative consequences of using ECDIS. It has formally been defined as a combination of uncertainty plus seriousness of outcome involved [6]. In addition, TAM was designed to gather evaluative measures of information system quality and suitability to job requirements, and thereby enable predictions of acceptance and usage. Davis wrote "The goal of TAM is to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations" [8]. Therefore, TAM posited that an attitude toward using an information system was based on two primary antecedent variables - perceived usefulness, and perceived ease of use. But in this research, for enhancing the predicting power, adoption intention was use to substitute for the position of attitude toward using as described in Featherman and Pavlou's research [2]. Further, according to Davis's theory, perceived usefulness could be defined as "a prospective shipmate's subjective probability that using ECDIS will increase this or her job performance on voyage" [8][9]. And perceived ease of use could refer to "the degree to which the prospective shipmate expected the target system to be free of effort" [8][9]. TAM also assumed that perceived usefulness was influenced by perceived ease of use, because, other things being equal, the easier was a technology to use, the more useful it could be.

According to the theories mentioned above, while the negative uncertainty derived from the limitations of ECDIS existed, despite the well-known benefits of electronic nautical charts over paper charts, the maritime community has been rather slow

to adopt ECDIS, and such phenomenon also appeared on the shipmates. Further, the application of risk assessment has been used for a number of years to assist in safety procedures in various aspects of the running of a vessel. But, until now, it has not been extended specifically to ECDIS and all its functions [1]. Obviously, such a situation had negative influence on seafarers' confidence on using ECDIS, no matter manipulation or application. Therefore, the first three hypotheses were proposed:

Hypothesis H1: Perceived risk on ECDIS had negative impact on perceived usefulness.

Hypothesis H2: Perceived risk on ECDIS had negative impact on perceived ease of use.

Hypothesis H3: Perceived risk on ECDIS had negative impact on adoption intention.

Quoting from TAM as well as Featherman & Pavlou's theory [2], the shipmate's concepts of both perceived usefulness and perceived ease of use on using ECDIS were individual subjective judgments. In addition, prior study also showed that both of them, perceived usefulness and perceived ease of use, were distinct but related constructs, the former was a major belief factor, and the latter was a secondary belief factor in determining users' adoption intention in information technology [10]. Therefore, this study presumed that shipmate's adoption intention in ECDIS was affected by the usefulness as well as ease of use on this instrument. Further, previous researches also discussed and provided evidences that perceived ease of use indicated direct relationship on perceived usefulness [10][11][12]. Accordingly, another three hypotheses were posited:

Hypothesis H4: Perceived usefulness had positive impact on adoption intention in ECDIS.

Hypothesis H5: Perceived ease of use had positive impact on adoption intention in ECDIS.

Hypothesis F6: Perceived ease of use had positive impact on individual perceived usefulness.

4 Data collection and analysis

4.1 Sample and data collection

For testing these hypotheses, a convenience sample of 144 participants was recruited from the department of navigation at an university in southern Taiwan. All the participants in this survey were undergraduate students. Survey was administered in class, for insuring that the programmed questionnaire worked as intended, a pretest of the questionnaire on a convenience sample of 17 undergraduate students conducted prior to fielding the full-scale survey, that was used to assess its logical consistency, ease of understanding, sequence of items and contextual relevance. It led to several minor modifications of the wording and the item sequence. Further, for analyzing the factors affecting adoption intention in ECDIS, the participant students were divided into two distinct groups by the time served on board. In this research, one group of 64 participant students had not practical experience on board, and another group of 80 students had more than 6 months as cadet on board. The latter's mean age was 24, forty seven members of them were male. And the former's mean age was 21, fifty six of them were male.

4.2 Model construction and data analysis

According to the hypotheses mentioned above, four variables of construct appeared to comprise this research model. And for measuring the variables of construct, the questionnaire consisted of 18 items, which were designed to ask individuals to agree or disagree with statements using a Likert scale ranged from 1 = "strongly disagree", through 3 = "neutral", to 5 = "strongly agree". In this questionnaire, the items used to measure perceived usefulness, perceived ease of use, and adoption intention to use were adapted from Davis' research [9] and modified

to suit research's subjects. And the items used to measure perceived risk were taken from Weintrit and Stawicki's study [1].

Perceived risk (PR) would discourage shipmates from transacting and relying on ECDIS. Based upon the work of previous research [1], three items were used to measure the level of PR of the participants: (v1) human error, (v2) external barrier, (v3) internal obstacle. And perceived ease of use (EOU) referred to the degree to which a person believed that using a particular system would be free of effort. The measurements of EOU construct stressed on how easy and simple participants felt ECDIS. Based upon Davis's research in TAM [8][9][10], five questionnaire items were adopted to indicate the level of EOU: (v4) operability, (v5) simplicity, (v6) understandability, (V7) cumulative effort, (V8) cognitive valuation. Perceived usefulness (U) referred to the degree to which a person believed that using a particular system, such as ECDIS, would enhance his/her job performance. For measuring U, five items were adopted from prior studies in TAM [8][9][10]: (v9) quality improvement, (v10) time to accomplish task, (v11) supporting critical aspects of job, (v12) productivity, and (v13) performance improvement. Then, adoption intention (AI) reflected the extent to which person intended to adopt a particular system, such as ECDIS on the bridge of a ship. According to the literature about the measurement of the construct of AI [2], five questions were used to assess participants' adoption intention in ECDIS: (v14) expectance, (v15) desirability, (v16) comparative advantage, (v17) personal opinion, and (v18) whole evaluation.

In addition, the regression analysis was used as main tool in the following measuring procedure, and path chart would present the causal effects between related constructs. But before regression conducting, the factor loading of questionnaire items were firstly evaluated, it found that all the score of factor loading ranged from 0.634 to 0.914, well above the common acceptance levels of 0.50 [13]. And the KMO value (Kaiser-Meyer-Olkin measure) of constructs ranged from 0.674 to 0.577, greater than recommended accepting values 0.50 [14] (Table 1). The chi-square (X^2) of Bartlett's test of sphericity were checked and found significant.

Table 1. KMO value and Bartlett's test of sphericity of constructs of students with/without practical experience on board

	Students without practical experience on board			Students with practical experience on board		
	KMO value	Chi-Square	Sig.	KMO value	Chi-Square	Sig.
Perceived risk	.741	100.062	.000	.674	43.811	.000
Perceived usefulness	.782	236.000	.000	.868	255.756	.000
Perceived ease of use	.877	169.853	.000	.797	157.645	.000
Adoption intention	.613	114.304	.000	.850	215.289	.000

4.3 Reliability and validity

The adequacy of the measurement model was evaluated on the criteria of reliability, convergent validity, and disconfirmation validity. Reliability was the extent to which varying approaches to construct measurement yielded the same results and was examined using the composite reliability values [15]. As listed in Table 2, all of these values were greater than or near 0.8 , well above the common acceptance levels of 0.60 [16]. And convergent validity was evaluated for the measurement scales by average variance extracted (AVE), that should exceed the

variance due to measurement error for that construct (i.e. AVE should exceed 0.50). [14][17]. In addition, discriminant validity was used to assess the extent to which a concept and its indicators differed from another concept and its indicators [18]. Discriminant validity was evaluated using the criteria recommended by Fornell and Larcker[17]: the square root of the AVE should exceed the correlation shared between the construct and other constructs in the model. In this research, Table 2 showed that convergent validity and discrimant validity valued well above the common acceptance levels.

Table 2. Reliability, validity, and correlation analysis

	CR	AVE	$AVE^{1/2}$	PR	U	EOU	AI
Students without practical experience on board							
PR	0.79	0.58	0.76	1			
U	0.92	0.75	0.87	-.462**	1		
EOU	0.90	0.70	0.84	-.480**	.477**	1	
AI	0.86	0.55	0.74	-.557**	.645**	.274*	1
Students with more than 6 months practical experience on board							
PR	0.84	0.64	0.80	1			
U	0.93	0.74	0.86	-.241*	1		
EOU	0.88	0.61	0.78	-.190	.438**	1	
AI	0.91	0.68	0.82	-.268*	.621**	.466**	1

*. $p < 0.05$, **. $p < 0.01$.

Legend: PR= Perceived risk, EOU= Perceived ease of use, U= Perceived usefulness, AI= Adoption intention.

1 Composite reliability (CR) $(=(\sum Li)^2/(\sum(Li)^2 + \sum Var(Ei)))$

2 Average variance extracted (AVE) $(=\sum Li^2/(\sum Li^2 + \sum Var(Ei)))$

5 Result and models

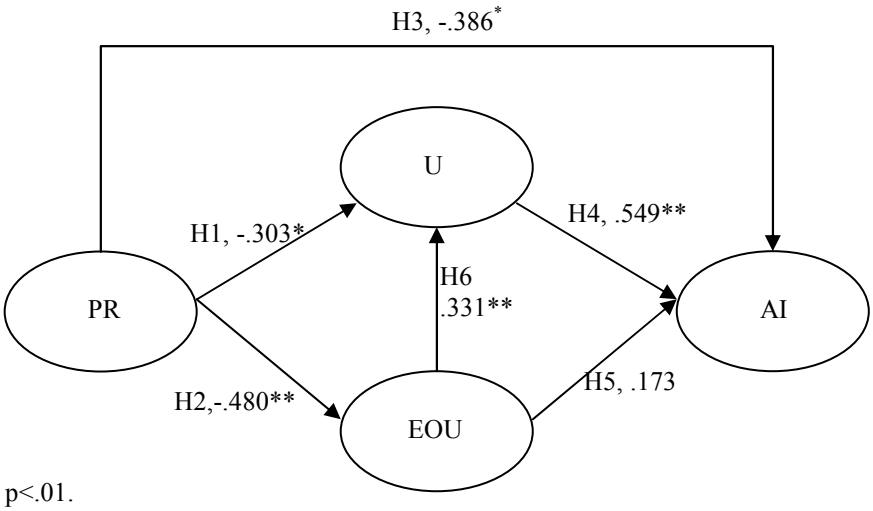
On the regression analysis, both R^2 and F test of related constructs were measured and most of them showed significant (Table 3), except that, to the students with more than 6 months practical experience on board, the low R^2 between EOU and PR indicated that the data points were scattered away from the best-fit line. That meant the independent variable was a poor predictor of the dependent variable, and the F value also indicated insignificant (p=.091>0.05).

In this study, the standard coefficient of β distribution was used to construct a path chart and verify its adequacy: For students without practical experience on board, PR, and U, had significant direct impact on AI respectively (β=-.386, p=.001<.05; β=.549, p=.000<.01), but OEU indicated insignificant impact on AI (β=.173, p=.113>.05); And both PR and EOU had significant impact on U (β=-.303, p=.016<.05; β=.331, p=.009<.01); PR also showed significant negative impact on EOU (β=-.480, p=.000<.01) (Fig. 1). Accordingly, PR's indirect effect on AI scored -.253, and the total effect was -.640. Further, to students with more than 6 months practical experience on board, U and EOU indicated significant positive impact on AI (β=.495, p=.000<.01; β=.230, p=.019<.05), but PR showed insignificant impact on AI (β=-.105, p=.241>.05); In addition, EOU and PR indicated significant impact on U respectively (β=.407, p=.000<.01; β=-.294, p=.017<.05), but PR had insignificant impact on EOU (β=-.190, p=.091>.05) (Fig. 2). Therefore, both PR's indirect effect and total effect scored -.146. Accordingly, to students without practical experience,

hypothesis H5 was insignificant. And to students with practical experience on board, hypotheses H1 and H3 also indicated insignificant.

Table 3. Regression analysis

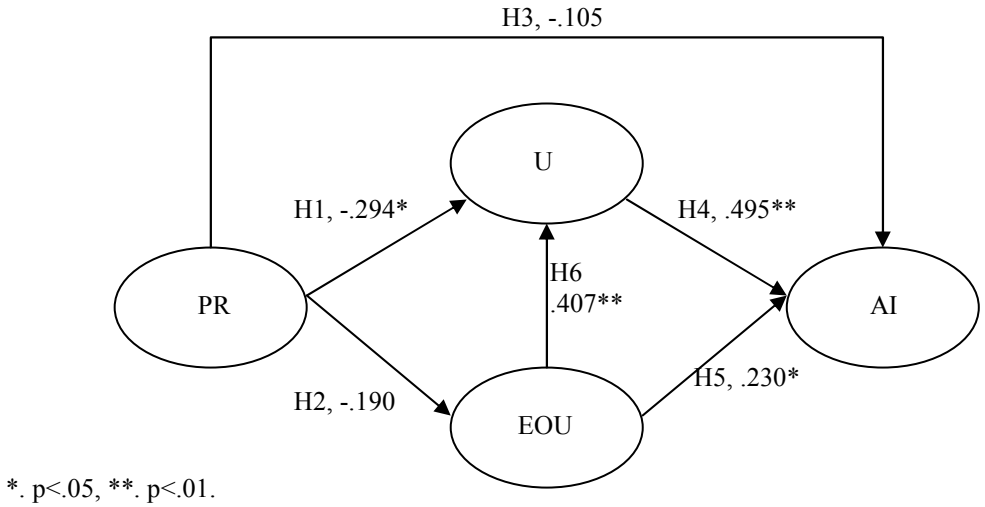
Model 1	R	R^2	F value	Sig.
Students without practical experience on board				
Dependent variable : Adoption intention (AI)	.722	.522	21.810	.000
Predictors : (Constant), Perceived risk (PR), Perceived usefulness (U), Perceived ease of use (EOU).				
Dependent variable : Perceived usefulness (U)	.546	.298	12.939	.000
Predictors : (Constant), Perceived risk (PR), Perceived ease of use (EOU).				
Dependent variable : Perceived ease of use (EOU)	.480	.231	18.574	.000
Predictors : (Constant), Perceived risk (PR).				
Students with more than 6 months practical experience on board				
Dependent variable : Adoption intention (AI)	.665	.442	20.080	.000
Predictors : (Constant), Perceived risk (PR), Perceived usefulness (U), Perceived ease of use (EOU).				
Dependent variable : Perceived usefulness (U)	.467	.218	10.713	.000
Predictors : (Constant), Perceived risk (PR), Perceived ease of use (EOU).				
Dependent variable : Perceived ease of use (EOU)	.190	.036	2.926	.091
Predictors : (Constant), Perceived risk (PR).				



*. p<.05, **. p<.01.

Legend: PR= Perceived risk, EOU= Perceived ease of use, U= Perceived usefulness, AI= Adoption intention.

Figure 1. Path chart for students without practical experience.



*. p<.05, **. p<.01.
Legend: PR= Perceived risk, EOU= Perceived ease of use, U= Perceived usefulness, AI= Adoption intention.

Figure 2. Path chart for students with practical experience on board.

6 Discussion and implication

This study focused on advancing our understanding of the factors influencing on shipmate's adoption intention (AI) on ECDIS. According to Featherman and Pavlou's theory [2], authors hypothesized that the perceived risk (PR) as well as perceived usefulness (U) and perceived ease of use (ROU) had impact on shipmate's adoption intention. Based on the theory [2], the PR-AI relationship implied that perceived risk had negative impact on shipmate's adoption intention. The hypothesis of U-AI relationship was based the idea that shipmate formed adoption intention in ECDIS due to the beliefs of increasing his/her job performance. And as stated in Bandura's study [19], the EOU-AI relationship showed that the easier a system was to interact with, the greater should be the user's sense of efficacy. Further, perceived risk in prior study also showed its influence on adoption intention mediated through perceived usefulness and perceived ease of use. The first half of mediation in this research model presumed that perceived risk had negative influence on both U and EOU. Previous researches have found that the characteristics of a system or the environment involved had influences on U as well as EOU. Similarly, the potential risk from human error, external interference and internal obstacle of ECDIS were included in the construct of PR and measured to present PR's influence on U and EOU. In addition, improvements in EOU, as described in Featherman and Pavlou's theory [2], might also be contributing to increase performance. Effort saved due to improved EOU might be redeployed, enabling a person to accomplish more work for the same effort. To a certain extent that increased EOU contributed to improve performance. Accordingly, U and EOU were viewed as distinct but related constructs, empirical associations between variables similar to U and EOU have been observed in prior research [20]. But the result of analysis didn't support all the hypotheses. The path chart for the students without practical experience showed that, except the hypothesis H5 indicated insignificant, all the other five hypotheses were verified. The insignificant hypothesis meant that the perceived ease of use did not have significant causal effect on adopting an navigational information system. Further, the path chart for the students with more than 6 months practical experience on board

found that two hypotheses related the predictor of PR were insignificant, they were hypothesis H2 and H3. These insignificance implied that multiple checks by other instruments, such as modern GPS or traditional sextant, could effectively decrease the negative influence from perceived risk on using ECDIS.

Navigating with ECDIS is fundamentally different from navigating with paper charts, that is a system integrated several different functions into one computerized system. For monitoring close navigation hazards, ECDIS installs sound alarms or displays warnings when certain parameters are met or exceeded, and IMO standards also requires that certain alarms should be available on the ECDIS. But besides close navigation hazards, there has still potential risk that may threaten users' perceived usefulness and ease of use on ECDIS, and also has direct influence on user's adoption intention. The risk analyzed in the research emphasizes failures of hardware and software occurred on system, as well as potential human error. Therefore, promoting system performance and adequate educating as well as training will help to decrease the negative influence on person's adoption intention.

However, there are some limitations in this study. Firstly, the respondents are students, their limited experience cannot fully recognize all the potential risk. Secondly, the perceived risk on ECDIS may exist due to students' insufficient proficiency on manipulating this integrated system, but such influence doesn't involve in this study. And third, this research is done by empirically investigating and analyzing students' perception of the relationship between potential risk and adoption intention, the senior shipmates may have quite different comprehension , but they are not included in this study.

7 Conclusion

The official proposal to develop e-navigation was submitted to the Maritime Safety Committee of IMO in December 2005 as a strategic vision for the utilization of existing and new navigational tools, in particular electronic ones, in a holistic and systematic manner. And the major revision of STCW Convention 2010 also included new requirements relating to training modern technology, such as ECDIS, among the amendments. While the authority and maritime transport community focused on integrating and developing modern technological instrument for promoting the efficacy and effectiveness on navigation, users' subjective, psychological predispositions and social influences should not be ignored. Therefore, the objective of this study was to investigate how the perceived risk as well as perceived usefulness and perceived ease of use affected adoption intention on the students majored in navigation with or without practical experience. The finding showed that the perceived risk might decrease the levels of influence on all the user's adoption intention, or even became insignificant for the students with practical experience. Such result implied that, besides educating knowledge and skill in school, improving the cognitive effect of practical experience on board might increase students' perception on adoption intention.

References

[1] Weintrit, A. and Stawicki, K., Operational requirements for electronic achar display and information systems (ECDIS) – risk of overreliance on ECDIS, *Transport Problems*, 2008, Nr2, Vol. 3, pp.75-82.

[2] Featherman, M.S. and Pavlou, P.A., Predicting eservices adoption: A perceived risk facets perspective, *International Journal of Human-Computer Studies,* 2003, Vol.59, pp.451-474.

[3] Bowditch, N., *American practical navigator*, 2002 Bicentennial Edition, National Imagery and Mapping Agency, pp.219-221

[4] Cunningham, S. M., The major dimensions of perceived risk. In D. F. Cox (Ed), Risk taking and Information Handling in Consumer Behavior. Graduate School of Business Administration, *Harvard University Press*: Boston, 1967, pp.82-108.

[5] Mitchell, V., Consumer perceived risk: conceptualizations and models, *European Journal of Marketing*, 1998, 33: pp.163-195.

[6] Bauer, Raymond, A., *Consumer Behavior as Risk Taking, in Dynamic Marketing for a Changing World*, R.S. Hancock, ed. Chicago: American Marketing Association, 1960, pp389-398.

[7] Cox and Donald, F., Risk Taking and Information Handling in Consumer Behavior. Boston, MA: *Harvard University Press*, 1967.

[8] Davis, F. D., Bagozzi, R. P., & Warshaw, P. R., User acceptance of computer technology: a comparison of two theoretical models, *Management Science*, 1989, (35:8), 982-1003.

[9] Davis, F. D., (1989) Perceived usefulness, perceived ease of use, and use acceptance of information technology, *MIS Quarterly*, Vol. 13, no.3, pp.319-340.

[10] Davis, F. D., User acceptance of information technology: System characteristics, user perceptions and behavioral impacts, *International Journal of Man-Machine Studies*, 1993, vol. 38, no.3, pp. 475-487.

[11] Hsu, C. L. and Lu, H. P., (2004) Why do people play on-line games? An extended TAM with social influences and flow experience, *Information & Management*, Vol. 41, no.7, pp. 853-868.

[12] Yu, J., I. Ha, M. Choi, and Rho, J., (2005) Extending the TAM for a t-commerce, *Information & Management*, Vol. 42, no.7, pp. 965-976.

[13] Hair, J. F., Anderson, R. E., Tatham, R. L., and Black, W. C., *Multivariate Data Analysis*, Prentice-Hall International, Inc., 5th Edition, 1998, Chapter 11.

[14] Cathy, S. Lina, Sheng Wub, Ray J. Tsaic., Integrating perceived playfulness into expectation- confirmation model for web portal context, *Information & management*, 2005, Vol.42. pp.683–693.

[15] Campbell, D. T., and Fiske, D. W., Convergent and discriminant validation by the multitrait-multimethod matrix, *Psychological Bulletin*, 1959, Vol. 56, No 2, pp. 81-105.

[16] Bagozzi, R., and Yi, Y., On the evaluation of structural equation models, Journal of the Academic of Marketing Science, 1988, No 16, pp. 74-94.

[17] Fornell, C., and Larcker, D.F., Evaluating structural equation models with unobservables and measurement error, *Journal of Marketing Research*, 1981, Vol. 18, No1, pp. 39-50.

[18] Bagozzi, R., Yi, Y., and Phillips, L., Assessing construct validity inorganizational research, *Administrative Science Quarterly*, 1991, Vol. 36 No 3 pp. 421-458.

[19] Bandura, *Self-Efficacy Mechanism in Human Agency*, Amer. Psychologist, 1982, Vol.37, pp.122-147.

[20] Barrett, G. V., Thornton, C.L., and Cabe, P.A., Human factors evaluation of a computer based storage and retrieval system. *Human Factors*, 1968, Vol.10, 4, pp.431-436.