Determinants of the adoption of new equipment at the individual level within an organization

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Abstract

The purpose of this study is to develop a new equipment acceptance model in the industrial market and test it empirically using a field survey. To define new equipment acceptance factors of employees in the organization, we used the TAM as a useful model to analyze the acceptance process of new equipment. All of the data for the TAM were collected from the employees. Prior research studied the usage of general information technology using a computer and particular software, while we apply the TAM to the new equipment adoption. In this study, both theoretical review and empirical study were conducted and the model was set through the theoretical study which was tested through the empirical analysis. Management support and training/education were shown to have a positive effect on PU and PEOU. Personal innovativeness, management support, perceived usefulness and perceived ease of use were shown to have a positive effect on behavioral intention.

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1. Introduction

The adoption of a new product is a critical factor for success and development of a company in today's competitive global business environment. Two types of new product adoption within organizations can be identified: the new product adoption at the organization level and new product adoption at the individual level.

In the management perspective, the acceptance process can be considered a success only when the new product is accepted and employees demonstrate commitment by continuing to use it. Therefore, the individual adoption decision process and factors influencing it need to be identified. It is important to examine the acceptance of the new product within organizations because, if there is no acceptance among the users, the desired consequences cannot be realized and companies may eventually discontinue the intended adoption.

Once a primary adoption decision has been made by executives and managers(this can be considered as the adoption of the new product at an organizational level within an organization), then the intra-organizational adoption process begins and subsequently depends on the individual's discretion with respect to the focal new product. The individual adoption depends on the individual's discretion with respect to the focal new product. This is driven by the individual's perceptions of the new product, some of which may include those posited by both the Technology Acceptance Model (TAM) and the Diffusion of Innovation Theory (DOI).

Studying about the new product adoption at an organizational level will be an important issue to industrial suppliers. This is because they can make plans and strategies to create strong relationships with companies if they know the determinants of the adoption of new products at an organizational level. On the other hand, studying about the new

product adoption at an individual level will be important to every company. This is because it can affect both the employee's performance and the organization's performance. In fact, introducing new products within an organization isn't an easy thing. It is necessary for companies to consider personalities, and backgrounds of employees who actually use new products. A company's performance will improve depending on employees' intentions and attitudes in adopting new products.

Therefore, the purpose of our study is twofold: to examine the factors that lead to the personal acceptance of new equipment and to investigate its impact on behavioural intention. Our base model is TAM (Technology Acceptance Model) of Davis [10], as it has a reputation of accurately explaining whether the users will accept a particular product or not.

The paper is organized as follows: First, we review the literature on the new product adoption at the individual level. Second, we will consider the determinants of new product adoption by the individual and investigate its impact on behavioral intention. Third, we will set a research model through theoretical study, which will be tested through empirical analysis. Finally, we will discuss the results and implications and suggest further investigation of the industrial market.

2. Theoretical foundation and a research framework

In recent years, there have mainly been the TAM-based studies of the employees' adoption of new products, primarily hardware and software. In an aspect of hardware, the intra-organizational PC acceptance was studied [22][39] the CRM or TAM was studied in an aspect of software [1][5][8][43].

However, companies should introduce new products such as equipment, auxiliary equipment, raw materials, and parts in order to achieve

innovation and sell them in the markets. Therefore, it is needed to discuss either the acceptance of PC and software of employees or the adoption of equipment and auxiliary equipment of employees. The purpose of this study is to add to our understanding of factors influencing the acceptance at the individual level of new products such as robots, conveyors, test equipment, jigs & fixtures, and laser machines.

There is not a common view about the determinants of the new product at the individual level in the aspect of hardware. The determinants differ from researchers [11][18][29][39][44] : organizational support, social factors, personal characteristics, attitude on innovation, supervisors and management support. We categorize these determinants into three items: organizational support [4][11][22][31][36][37][41] social influences [5]27][35][42] and personal characteristics [3][20][26][32][33][40].
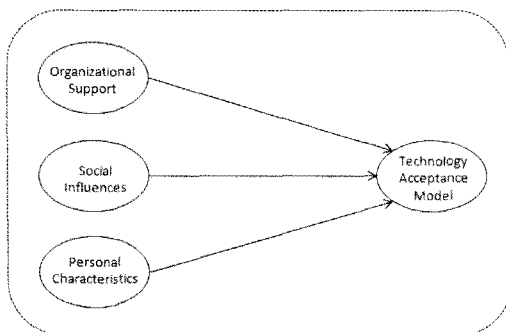
[Figure Ⅰ] Research conceptual framework

[Figure 1] was constructed for the purpose of synthesizing the literature and testing the relationship among three determinants (organizational support, social influences, and personal characteristics) and TAM (technology acceptance model).

3. Determinants of the individual-level adoption

3.1 Organizational support

Organizations will try to influence subordinates' adoption of new equipment and some individuals more easily accept certain new materials. Several studies indicate that individual acceptance of new equipment is based not only on personal characteristics but also on management strategies, policies, actions [23][29] and training and education [9][18][21] and technical support [39]. These factors affect the individual's adoption of new equipment and they influence employees' adaption of their job.

Organizational support can be crucial for successful adoption of new equipment. Our study identified two areas of organizational support: management support, and training and education.

A person's behavior can be altered by perceived management support. Management who has authority can encourage employers to adopt new products through some efforts and assistances (constant mention about the importance and productivity of the new product). So, employers will notice that management has a lot of interest in the adoption of new products and the importance of new products in their company. A message about the adoption of an innovation issued by an "authority source" [25] generally alters the receiver's adoption decision process more, either by making the decision for the receiver or by enforcing a decision already made [34] than does a message issued by a person without authority [29]. Davis et al. (1989) proposed that organizational support is an important variable that is likely to affect perceived usefulness and perceived ease of use [11]. Therefore, the following hypotheses are proposed:

H1. Management support will have a positive effect on perceived ease of use.
H2. Management support will have a positive effect on perceived usefulness.

The provision of management support for users of new equipment may be one type of facilitating condition that can influence new product utilization. Igbaria et al. (1997) found that computing support has a strong influence on personal computing acceptance [22]. Schultz and Slevin (1975) mentioned that management support has a positive impact on acceptance and usage of new product [37]. Trevino and Webster (1992) found a positive correlation between managerial support and behavioral intention [41]. Based on these reported findings, the following is proposed as the third hypothesis:

H3. Management support will have a positive effect on behavior intention.

Gist (1987) reported that user training plays an important role in increasing user confidence in the ability to learn and use new computers [15]. Raymond (1990) argued that computer training is a significant predictor of personal computing acceptance [36]. It was also found that training has a positive impact on technology acceptance [4]. Oh (2002) and Igbaria et al. (1997) reported that training has a positive effect on perceived ease of use and perceived usefulness [22][31]. Thus, we derived the following two hypotheses:

H4. Training and education will have a positive effect on perceived ease of use.
H5. Training and education will have a positive effect on perceived usefulness.

3.2 Social influences

The individual acceptance of new equipment is also driven by the usage of supervisors, colleagues, and competitors. Triandis (1980) argued that behavior is influenced by social factors, that is,

"the individual's internalization of the reference groups' subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" [42]. The most important social influence is the number of other people using the new product.

Potential users are influenced in their adoption decision by advice from their respected supervisor. Pulling et al.(2002) found that encouragement to use the SFA system was the second most important factor in creating the required enabling conditions for system acceptance by the sales force [35]. Avlonitis and Panagopoulos (2005) asserted that supervisor influence has a significant effect on perceived ease of use and CRM acceptance [5]. Therefore, the following hypotheses are proposed:

H6. Supervisors will have a positive effect on perceived ease of use.
H7. Supervisors will have a positive effect on perceived usefulness.

The acceptance of a new product would become an imperative in the environment where employees are in a highly competitive situation and aware of the competitors' use of the new product at the same time. Kraut et al. (1998) mentioned that increased total number of subscribers in one period led to greater system use in the subsequent period [27]. Avlonitis and Panagopoulos (2005) proposed that social factors (supervisor, competition, and peers) will positively influence perceived ease of use and perceived usefulness [5].

Therefore, we put forward the following hypotheses:

H8. Competitors will have a positive effect on perceived ease of use.
H9. Competitors will have a positive effect on perceived usefulness.

3.3 Personal characteristics

Although the employees are working at the same organization, they differently recognize the conditions and new equipment. Thus, individual difference will affect the acceptance of new equipment.

Our study identified two personal characteristics: personal innovativeness, and self-efficacy.

Self-efficacy is usually defined as one's own capability to execute the action required to deal with prospective situations [7]. Bandura (1986) reported that self-efficacy is the belief in an individual's capabilities to organize and execute a specific task required to produce given attainments[6]. Self-efficacy reflects what individuals believe they can do with the skills they possess.

Many researchers [2][14][20] conducted research to predict new product usage by examining perceived usefulness and perceived ease of use factors. According to Igbaria and Iivary (1995) and Kwon and Choi (2005), self-efficacy has a direct impact on perceived ease of use and an indirect one on perceived usefulness[20][26]. Agarwal and Karahamma (2000) also maintained that self-efficacy is an important factor of the antecedents of perceived ease of use [2]. Oh (2003) and Ong and Lai (2006) reported that self-efficacy has a positive effect on perceived ease of use and perceived usefulness [32][33].

Thus, we derived two hypotheses as follows:

H10. Self-efficacy will have a positive effect on perceived ease of use.
H11. Self-efficacy will have a positive effect on perceived usefulness.

Some studies [3][29] have used the concept of personal innovativeness that affects acceptance of new equipment. Personal innovativeness refers to the tendency of a person to accept new equipment. The degree which members of an organization are receptive of change has shown to be an important determinant of innovation success [45][46]. Thus, innovative members of an organization will exhibit more positive attitudes towards using the new equipment.

Although a few research studies have claimed that personal innovativeness has a positive effect on perceived usefulness [26] does not have a positive effect on perceived ease of use and perceived usefulness [38] but most researchers [2][3] have reported that personal innovativeness does have a positive effect on perceived ease of use and perceived usefulness. Therefore, the higher level of personal innovativeness, the more perceived ease of use and usefulness of the new equipment - a claim reflected in the following hypotheses:

H12. Personal Innovativeness will have a positive effect on perceived ease of use.
H13. Personal Innovativeness will have a positive effect on perceived usefulness.

Tornatsky and Klein (1982), in a meta-analysis of 75 studies on the relationship between innovation characteristics and adoption, found that compatibility of the innovation with the norms of the potential adopters had a significant influence on adoption [40]. Furthermore, Agarwal and Prasad (1998) argued that personal innovativeness is an important concept for examining the acceptance of information technology innovation [3]. Therefore, the following hypothesis is proposed:

H14. Personal innovativeness will have a positive effect on behavior intention.

3.4 Technology Acceptance Model

During the past decade, researchers have

attempted to uncover the determinants of individual acceptance. The most widely used theoretical framework is the Technology Acceptance Model (TAM) (Davis, 1989), which presents a list of factors that lead to technology acceptance and use. The TAM explains the important effect of perceived ease of use toward perceived usefulness [2][11][44][11][19] perceived usefulness toward behavior intention [3][11][44][24] and perceived ease of use toward behavior intention [28]. Therefore, we hypothesize that:

H15. Perceived ease of use will have a positive effect on perceived usefulness.

H16. Perceived ease of use will have a positive effect on behavior intention.

H17. Perceived usefulness will have a positive effect on behavior intention.

4. Methodology

4.1 Measures

The items to measure management support (MS) and training and education (TE) were generated based on those developed by Avlonitis and Panagopoulos (2005), Thompson, Higgins, and Howell (1991). The scales for supervisor (S) and competitor (C) were adopted from the study of Avlonitisand Panagopoulous (2005), while the scales for personal innovativeness (PI) and self-efficacy (SE) were based on those developed by Avlonitis and Panagopoulous (2005), Goldsmith and Hofacker (1991), and Chen et al. (2001). Measurement for perceived ease of use (PEOU) and perceived usefulness (PU) were developed from the study of Davis (1986) and Avlonitis and Panagopoulous (2005) with modification to fit the specific context of the new product. The scale for behavioral intention (BI) was adapted from the scale developed by Davis (1986) and Thompson (1991). All items were measured using a 5-point Likert-type scale with anchors from "strongly disagree" to "strongly agree."

<Table 1> Exploratory factor analysis

	PI	TE	S	SE	C	MS
PI2	**0.84023**	0.24370	0.22259	0.13212	-0.06295	0.00361
PI1	**0.82755**	0.10348	0.11258	0.10204	0.10307	0.16853
PI3	**0.78820**	0.10079	0.00098	0.25936	0.05950	0.09595
TE1	0.06067	**0.81860**	0.15095	0.18654	0.13154	0.10873
TE2	0.17114	**0.80042**	0.05513	0.12225	0.12132	0.21787
TE3	0.30889	**0.64460**	0.22770	-0.00022	0.18299	0.20659
S1	0.12897	0.27892	**0.85270**	0.12324	0.08438	0.02555
S2	0.15238	0.05037	**0.83923**	0.09984	0.17992	0.26782
SE2	0.23613	0.14854	0.00786	**0.82661**	0.22102	0.09025
SE1	0.23340	0.14350	0.27136	**0.76267**	0.09532	0.19408
C1	0.13874	0.19865	0.00579	0.12319	**0.82207**	0.22682
C2	-0.04546	0.12477	0.25255	0.15620	**0.81528**	-0.04792
MS2	0.14469	0.20112	0.23363	0.06610	0.19448	**0.82438**
MS1	0.12294	0.38469	0.06205	0.31566	-0.03357	**0.67307**
Eigen Value	2.347	2.173	1.767	1.578	1.560	1.444
Variance explanatory Proportion	16.76%	15.52%	12.62%	11.27%	11.14%	10.31%

Note: 1. S=supervisor, C=competitor, TE=training and education, MS=management support, PI=personal innovativeness, SE=self-efficacy
2. Numbers in bold indicate loading coefficients for items in each construct.

4.2 Data collection

Data were gathered from employees who had experience with new equipment within three years. We made a list of new equipment (robot, conveyor, test equipment, jig and fixture, laser machine, etc.) from the pretest and asked the respondents to choose one that they handled. They answered the questions related to that equipment. A total of 600 questionnaires were sent to workers at a major company in Korea. After deleting respondents who did not answer questions completely, 442 subjects were included in our study. The sample consisted of 87.35% male and 12.65% female participants. Tenure in the organization was varied: three and less than five years, 21.55% over five and less than ten years, 29.04% over ten and less than twenty years, 29.04% andover twenty years,

11.94%.

5. Results

To examine whether the variables were measured with correct items, this study carried out the principal component analysis. The results of the exploratory factor analysis are shown in <Table 1>. As shown in <Table 1>, there were five factors.

Reliability of the constructs was estimated by Cronbach's alpha <Table 2>. Cronbach's alpha for all constructs were above the recommended 0.60 [17]. Therefore, we could conclude that all constructs in the model had adequate reliability and validity. Also, correlation analysis results, presented in <Table 2>, show that there were significant correlations among nine variables.

<Table 2> Means, Standard Deviations, and Correlations

Variables	M	S.D	1	2	3	4	5	6	7	8	9
1	3.63	0.72	(0.79)								
2	3.56	0.75	0.405	(0.67)							
3	3.64	0.74	0.479	0.401	(0.78)						
4	3.66	0.70	0.490	0.315	0.564	(0.67)					
5	3.31	0.78	0.342	0.185	0.428	0.370	(0.83)				
6	3.69	0.68	0.415	0.382	0.424	0.446	0.475	(0.73)			
7	3.80	0.68	0.446	0.392	0.572	0.596	0.351	0.559	(0.88)		
8	3.44	0.66	0.302	0.270	0.421	0.434	0.388	0.438	0.568	(0.75)	
9	3.47	0.82	0.073	0.159	0.096	0.070	0.291	0.046	0.015	0.066	(0.73)

Note: 1.supervisor, 2.Competitor, 3.training and education, 4.Management support, 5.personal innovativeness, 6.self-efficacy, 7.perceived usefulness, 8.perceived ease of use, 9.behavioral intention

The research model was put into the structural equation model and the LISREL 8.80 program was used to analyze the structural model of our research.

The fitness of the overall measurement model was estimated by various indices provided by LISREL, but X^2 statistic was not used because of its sensitivity to a large sample size. Instead, many researchers have claimed that it is needed to assess the over-all fitness of the structural model

[13] [30]. The measurement model comprised of all of the items was tested with the global fit indices (incremental fit index [IFI]=.91, comparative fit index [CFI]=.90, root mean residual [RMR]=.04). The results indicated that the hypothesized factor structure well fitted the model, showing that the model was acceptable.

Hypotheses 1 and 2 suggest that management support will have a positive effect on perceived usefulness (PU) and perceived ease of use (PEOU).

We observed that management support had a significant impact on PU (γ= .10, p< .05) and PEOU (γ= .15, p< .05). This result was consistent with the result of Davis et al. (1989) and hypotheses 1 and 2 were supported. Also, hypothesis 3 suggests that management support will have a positive effect on behavioral intention. As the results of the structural model analysis suggest, management support had a significant impact on behavioral intention (γ= .13, p< .05).

Hypotheses 4 and 5 propose that training and education will have a positive effect on PU and PEOU. The effect of training and education influence on PU (γ= .08, p< .05) and PEOU (γ= .12, p< .05) was significant. Therefore, hypotheses 4 and 5 were supported these results were consistent with those of previous studies [22][31].

Hypotheses 6 and 7 suggest that supervisor influence will have a positive effect on PU and PEOU. Although the effect of supervisor influence on PEOU was significant (γ= .06, p< .05), the rest of the hypothesized relationships were not supported (γ= -.06, p< .05). These results were remarkably consistent with those of previous research [5].

With regard to the impact of competitor on PU and PEOU (hypothesis 6 and hypothesis 7), we observed that there was no significant effect of competitor on PU (γ= -.01, p< .05) and PEOU (γ= -.01, p< .05). Thus, hypothesis 8 and 9 were not supported. These results were remarkably consistent with those of previous research studies [5][28].

<Table 3> Standardized structural coefficients of model

Variable	Predictor variables	Hypothesized relationship	Standardized coefficients	t-value
PU	PI	[−]	0.10	1.68
	C	[−]	0.01	1.03
	TE	[+]	0.08	2.75
	SE	[−]	0.05	1.22
	S	[−]	-0.06	-1.89
	MS	[+]	0.10	3.04
PEOU	PI	[−]	0.02	0.75
	C	[−]	-0.01	-1.33
	TE	[+]	0.12	4.51
	SE	[+]	0.22	6.31
	S	[+]	0.06	2.42
	MS	[+]	0.15	5.02
BI	PU	[+]	0.75	4.35
	PEOU	[+]	0.33	2.03
	PI	[+]	0.22	4.29
	MS	[+]	0.13	3.25
PU	PEOU	[+]	1.60	6.25

Note: S=supervisor, C=competitor, TE=training and education, MS=management support, PI=personal innovativeness, SE=self-efficacy, PU=perceived usefulness, PEOU=perceived ease of use, BI=behavioural intention

Hypotheses 10 and 11 suggest that self-efficacy will have a positive effect on PU and PEOU. As the results of the structural model analysis

suggest, self-efficacy had a significant impact on PEOU (γ= .22, p< .05), but there was no significant effect of self-efficacy on PU (γ= .05, p<

.05). These results were remarkably consistent with the results of Kwon and Choi [26].

With regard to the impact of personal innovativeness on PU and PEOU (hypothesis 12 and hypothesis 13), we observed that there was no significant effect of personal innovativeness on PU (γ= .10, p< .05) and PEOU (γ= .02, p< .05). Thus, hypotheses 12 and 13 were not supported, as also shown by Seo and Jeong (2004). Also hypothesis 14 suggests that personal innovativeness will have a positive effect on behavioral intention. As the results of the structural model analysis suggested, personal innovativeness had a significant impact on behavioral intention (γ= .22, p< .05), thereby providing support for hypothesis 14, similar to the results of Tornatsky and Klein [40].

Consistent with hypotheses 16 and 17, perceived ease of use and perceived usefulness both positively affected behavior intention (β= .33, p< .05 and β= .75, p< .05, respectively). Thus, hypotheses 16 and 17 were supported, like the results of other previous research studies [3][11][24][28][44].

Furthermore, hypothesis 15 suggests that perceived ease of use will have a positive effect on perceived usefulness. As the results of the structural model analysis suggested, perceived ease of use demonstrated a significant impact on perceived usefulness (β= 1.60, p< .05). These results were remarkably consistent with those of previous research [2][10][11][19][44].

6. Discussion and implications

The main purpose of this paper was to examine what factors would determine the user acceptance of new equipment. We could evaluate the behavioral intention of new equipment with the technology acceptance model. Prior research studied the usage of general information technology using a computer and particular software, while we applied the TAM to new equipment adoption.

Our findings may have major implications for managers and supervisors. First, management support and training/education were shown to have a positive effect on PU and PEOU. Management must focus on the development of accurate expectations regarding new equipment adoption so that employees have an obvious picture of what management expects from new equipment acceptance. More educated employees are expected to perceive new equipment has having more usefulness and ease of use, so regular training/education is necessary. Second, personal innovativeness and management support were shown to have a positive effect on behavioral intention. Especially, management must pay attention to the personal innovativeness in the recruitment and hiring process. Finally, self-efficacy and supervisor were shown to have a positive effect on PEOU. Supervisors have a major role in the perceived ease of use with new equipment, by supporting and encouraging employees to adopt new equipment. This result demonstrates that the higher self-efficacy employees have, the less difficulty they feel to use new products. Therefore, employers should give employees who have higher self-efficacy the precedence to all the others.

As with any study, there are certain limitations that should be recognized. The empirical part of the study focuses on new equipment, but new products are generally expensive, making their purchase rare in the organization. We conducted the survey of employees having experiences with new products within a period of three years. Therefore, if the experiences came from two or three years ago, the survey responses would be based on the employees' memories of using the equipment. The data were cross-sectional in nature and, hence, a longitudinal research design would be essential to confirm the causal linkages among the study variables.

Some limitations of this study provide a basis

for further investigation of the industrial market.

First, although this study explored the test with behavior intention as the only dependent variable, additional research could be concerned with the influences between behavior intention and taking action or performance.
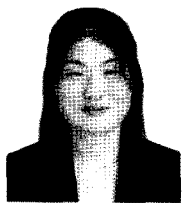
Second, even though we tested the new product adoption of employees in a different point of view from previous studies, it would be highly meaningful to compare the software acceptance to this study in order to discover the differences. As a result, new issues would be indicated for employers and the new equipment importing department by the differences between factors influencing the hardware acceptance, the software acceptance, and the types of new products.

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