

The role of exogenous factors in technology acceptance: The case of object-oriented technology

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Abstract

In spite of many theoretical models, the role of exogenous factors in accepting object-oriented technology has not been satisfactorily demonstrated. By comparing two competing models, our study examined the role and location of exogenous variables in explaining user acceptance of object-oriented technology. Based on the results, we developed a new model that combined the key ideas of both TAM and TPB and showed that both models are necessary in understanding the unique role of each exogenous variable.

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1. Introduction

Adoption of new information technology (IT) is critical for organizations in the competitive global business environment. Its life cycle is reducing, while technologies are becoming more complex and difficult to understand. Investing in new IT is a major decision for top management. In particular, the object-oriented (OO) paradigm has been adopted and used by organizations and has become of major interest. However, despite this rising importance, relatively little is known about the adoption process and factors that affect adoption. With few exceptions [27,29,31,32], most studies about acceptance of IT have dealt with personal computing [1,36,50,52]. Now, research on IT adoption and its related characteristics has been extended to the Internet [11].

Previous studies have presented a variety of models for technology adoption. Some are: (1) the push-pull model; (2) the model for micro-macro relationships [13]; (3) the organizational memory model [37]; (4) a unified model for technology adoption [30]; (5) theory of reasoned action [21]; (6) the technology acceptance model; (7) a unified theory of acceptance and use of technology [54].

The theory of reasoned action (TRA) was developed under the assumption that a particular behavior is under the person's control. In an attempt to apply it to situations where the behavior is not totally under the person's control, Ajzen [2] suggested a theory of planned behavior (TPB) because the organization plays a major role in initiating and launching new technologies. TPB is therefore considered more realistic in investigating the acceptance process.

Previous research has shown that individual, managerial, organizational, and environmental characteristics as well as personal perception of technology

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are important [7,33,44]. In TAM, these variables indirectly affect acceptance of technology through other mediating variables. However, TPB allows these exogenous variables to directly affect acceptance of technology through perceived behavioral control (PBC).

Our research was performed to analyze how exogenous variables affect user acceptance of a new technology by determining their proper place. More specifically, this empirical study was performed to investigate the location of each exogenous variable in explaining user acceptance of OO technology.

2. Theoretical foundations

New information technologies are rapidly replacing old ones by providing more powerful tools and speed for users. Their adoption can be successful, however, only when the employees accept and effectively use them. Therefore, an organization should understand the acceptance process and factors that are essential in making this process effective. Today, this is particularly true for OO technology and endeavors to maximize its effectiveness. Nevertheless, research on OO technology has focused mainly on technical and design aspects [19,20,40].

Davis [15] suggested a specific technology adoption model and applied it to analyze computer usage behavior. In the model, *perceived usefulness* and *ease of use* were considered two predecessors affecting attitude toward a technology, which affects behavioral intention to use that technology (which, in turn, leads to its actual use). This model dealt exclusively with the internal process of determining usage rather than with exogenous factors.

Davis et al. [17] later proposed a revised TAM in which the attitude construct was omitted. It explained user acceptance as due to three constructs: perceived usefulness, perceived ease of use, and intention. Again, exogenous variables such as system characteristics, the development process, and training were assumed to be mediated by perceived usefulness and ease of use. By following this model, Igarria et al. [24] tested the role of organizational factors on personal computing acceptance and found that they indirectly influenced usage through ease of use and perceived usefulness.

More recently, Venkatesh and Davis [53] theorized that perceived usefulness is influenced by social influence (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and ease of use). They proposed that computer self-efficacy acted as a

determinant of perceived ease of use, and that objective usability acted as a partial determinant.

Overall, TAM models theorized that exogenous variables indirectly influenced adoption of new technologies through perceived usefulness and ease of use. However, determinants of perceived usefulness and ease of use had certain characteristics that affected them.

3. Theory of planned behavior

When Fishbein and Ajzen proposed TRA, they assumed that it worked where behavior was under the person's volitional control: only when behavior is totally under the person's control can intention to perform a particular behavior be a predictor of it. If not, it is assumed that the relationship between behavioral intention and actual usage will be attenuated. In an attempt to incorporate behaviors in which people have incomplete volitional control, Ajzen [3] and Ajzen and Madden [4] proposed TPB.

It asserts that behavior is a direct function of behavioral intention and perceived behavioral control (PBC), which reflects beliefs regarding access to the resources and opportunities needed to perform a behavior to the internal and external factors that may impede performance. Taylor and Todd [48] classified this notion into two components: facilitating conditions and self-efficacy. Facilitating conditions reflect the availability of resources needed, such as time, money, etc. Self-efficacy is an individual's self-confidence in the ability to perform a behavior [49]. PBC, formed as the sum of these two components, was demonstrated to be a significant determinant of usage [14,23,39].

Ajzen felt that a person who has the required opportunities and resources (high perceived behavioral control) and intention to perform should succeed in performing the behavior. Then Ajzen and Madden proposed two versions of TPB: in the first, PBC emerged as a predictor of behavioral intentions, while in the second, PBC had both indirect and direct effects on actual behavior. According to work by Ajzen and Madden, PBC had a direct effect on actual behavior when the person did not have complete control of it.

Ajzen's argument provided a clue on exogenous variables; their components, when placed ahead of perceived usefulness and ease of use seemed to focus on technical aspects that would be introduced to the individual. Other exogenous variables should then be placed somewhere else to represent their roles in acceptance of the technology. Typically, when introducing innovation, the organization tries to launch it by

making favorable situations for users of the technology. Such organizational efforts and support constitute facilitating conditions: they are used to strengthen personal control of the situation.

4. Models for the location of exogenous variables

4.1. Model 1—Technology acceptance model

TAM explains usage behavior as a direct function of behavioral intention. However, it can be considered as a special case of TRA—the direct path from perceived usefulness to intention is not claimed in the TRA model, which reduces the impact of attitude on intention. According to the original and revised TAM models, exogenous factors not explicitly included are expected to influence intention and usage through ease of use and perceived usefulness. Following this, we placed exogenous variables ahead of ease of use and usefulness and tested how strongly they fit into the model (see Fig. 1).

4.2. Model 2—Theory of planned behavior

TPB asserts that behavior is a weighted function of intention and perceived behavioral control and that intention is the weighted sum of the attitude, subjective

norm, and perceived behavioral control (PCB, which is the individual’s perceptions of the availability of skills, resources, and opportunities necessary to perform the behavior). With favorable facilitating conditions and high self-efficacy, individuals would feel strongly that adopting the technology would be good.

Through PBC, two groups of exogenous variables are believed to facilitate new technology adoption: external and internal factors. *External factors* are used to boost perceived behavioral control by providing necessary resources and both technical and managerial support. *Internal factors* include requisite skills and will power that contribute to increasing perceived behavioral control. The IT literature has demonstrated that PBC is an important determinant of usage of new technologies. Our study placed the role of exogenous variables in influencing perceived behavioral control ahead of intention and usage, and tested how they fit into the model (see Fig. 2).

To date, despite the growing importance of OO technology, empirical research on its adoption has been limited [12,41]. In particular, efforts to understand the exact role of exogenous variables in the behavioral process of OO technology adoption are missing. Our study examined the impact of each exogenous variable on adoption of OO technology by comparing Model 1 with Model 2. After this comparison, we developed Model 3

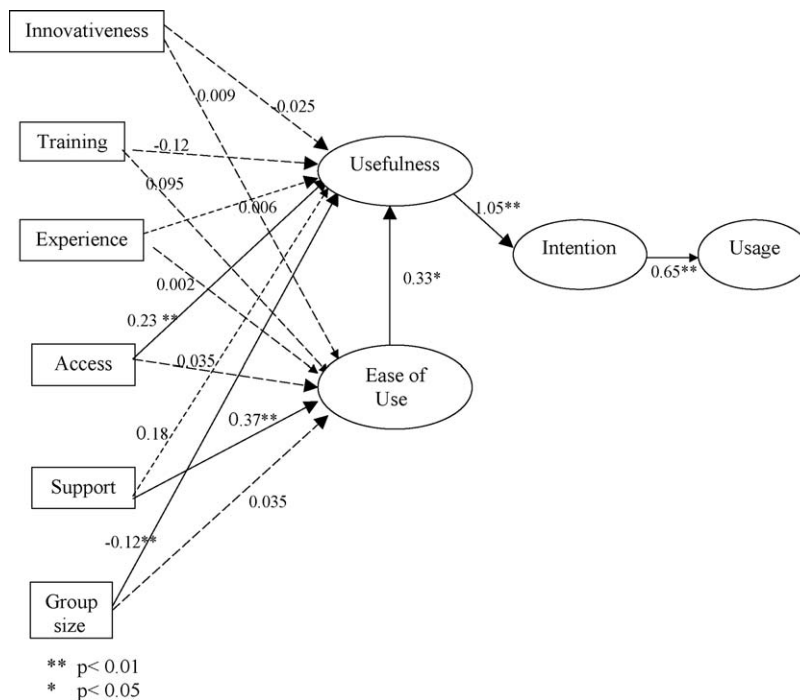


Fig. 1. Standardized path coefficients for TAM (Model 1).

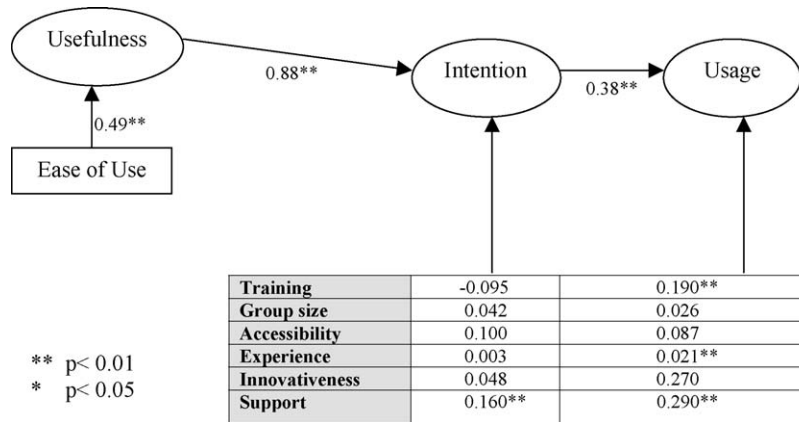


Fig. 2. Standardized path coefficients for TPB (Model 2).

by combining the two models and testing the location of each exogenous variable in accepting OO technology.

4.3. Hypothesized paths for endogenous variables

Each model in our study was composed of two groups both endogenous and exogenous variables. *Endogenous variables* explain the internal process, while *exogenous variables* are external factors that are posited to influence the internal mental process of technology acceptance.

Perceived usefulness was defined by Davis [16] as “the degree to which a person believes that using a particular system would enhance his or her job performance”. Based on TRA, it seemed that perceived usefulness directly affected behavioral intention to use it. Our study applies this to OO technology.

Davis defined *perceived ease of use* as “the degree to which a person believes that using a particular system would be free of effort”. In TAM, this was posited to affect perceived usefulness. Mathieson [35] and Szajna [47] showed that ease of use is a significant predictor of usefulness.

Behavioral intention was to mediate usefulness to actual usage. Especially in the revised TAM, in which attitude toward using a technology was not considered, behavioral intention was the only construct to mediate the effect of usefulness of the technology to its usage. Our study applied the relationships among these endogenous variables to OO technology.

Also user satisfaction [38,42,55] and system usage [46] are two primary indicators of technology acceptance. Considering that managers are interested in the practical value of system usage, this study uses the level of actual usage of OO technology as a measure of acceptance of OO technology.

4.4. Exogenous variables for adoption of OO technology

Among the numerous dimensions that affect technological innovation are individual, organizational, and technological factors [51]. The significance of these on adoption of new technologies depends on its type. Despite the value of OO technology in terms of productivity and quality, the adoption process has not been previously tested, and this leads to poor seeding of the technology in the organization. Understanding the roles of individual, organizational, and technological factors in adopting OO technology is one way to ascertain its successful adoption. We focused on two groups of variables that organizations find manageable: individual and organizational factors.

4.4.1. Individual characteristics

Zmud [56] proposed a theoretical model of the effect of individual differences on the success of the IS. Individual characteristics have been reported to play a key role in MIS success. Leonard-Barton and Deschamps [34] reported that factors connecting individuals and an organization are more important than the general personality types or demographic factors. In particular, these authors reported that personal innovativeness under change is a good predictor of successful technology implementation. Zmud [57] found that innovativeness or receptivity toward change of an organization’s members was an important determinant of innovation success. Following these studies, this research identifies innovativeness as an important exogenous individual variable that affected acceptance of OO technology.

Gist [22] reported that user training plays an important role in increasing user confidence in the

ability to learn and use computers. This supports the idea of PBC of TPB. Ajzen referred to internal factors such as information, skills, and abilities as sources of deciding the level of PBC, in which training has been used to increase individual skills and abilities of corresponding works. Raymond [43] argued that computer training is a significant predictor of personal computing acceptance. It was also found that training had a positive impact on technology acceptance [6]. In addition, user experience was also found to have a positive effect on system usage [18]. TPB and these prior research findings make it likely that the length of training and experience play an important role in accepting a new technology.

4.4.2. Organizational support

Organizational support has been shown to be crucial for successful adoption of a new system. Our study identified two broad areas: (1) technical support, which included access to technology champions inside the organization and the number of IS professionals in a working group; (2) management support, which included sufficient resources. Igbaria et al. [25] found that external computing support has a strong influence on personal computing acceptance; however, little work has been done on the effect of internal technical support on technology acceptance. Rothwell and Zegveld [45] described a product champion as a business innovator, technological gatekeeper, and problem solver. Likewise, technology champions must be information gatekeepers about new information technologies, problem solvers, and helpers. The number of IT professionals in a group may also affect group members' perceptions of using OO technology.

The effect of management support on system usage has been widely discussed for at least 40 years. In particular, management support is found to be associated with greater system usage.

In sum, we delineated three individual variables (innovativeness, experience, and length of training) and three organizational variables (accessibility to technology champions, group size, and managerial support) as important exogenous variables influencing acceptance of OO technology.

5. Methodology

5.1. Data collection

Data were gathered from information technology professionals of the Association of Information Technology Professionals (AITP) in four mid-western

states of the U.S. Before the questionnaires were distributed, phone calls were made to local presidents of AITP to solicit their members' participation. Subsequently, AITP directories were obtained, with their permission. Eight hundred and fifty four questionnaires were sent to the members of nine chapters. One hundred seventy nine subjects responded to the questionnaires (the response rate was 21%). After deleting respondents who did not answer questions completely, 165 subjects who had experience in using both the structured and object-oriented methods were included in our study. However, 11 more subjects provided incomplete surveys and thus 154 cases were included in the final statistical analysis. The average age of the subjects was 43 years. The gender distribution was: 78% males and 22% females. Most subjects had the job title of supervisor (42%), while other titles were both technical and managerial jobs. The average job experience was 18 years.

5.2. Measures

The means, standard deviations, and the internal consistency estimates (Cronbach's alpha) of the research variables with more than one item are shown in Table 1.

Research variables for this study were as follows:

- (1) Usefulness, ease of use, intention, actual usage: These were tested with items developed by Davis and Mathieson after being reworded. All of the items had five-point Likert type formats. Confirmatory factor analyses, in which one factor was forced for each variable, showed that every item for each variable had a meaningful loading coefficient with a very significant *t*-value. Internal consistency estimates for each variable measured by Cronbach's alpha were very high (see Table 1). The reliability of

Table 1
Summary statistics and reliability for each scale

Scale	Mean	S.D.	Reliability
Management support	12.08	3.16	0.76
Personal innovativeness	14.18	3.03	0.80
Perceived usefulness	12.52	3.80	0.95
Perceived ease of use	12.82	2.88	0.82
Intention to use	6.46	1.91	0.93
Actual usage	3.75	2.24	0.60 ^a
Group size	2.35	1.84	0.60 ^a
Training	1.87	1.45	0.60 ^a
Access	3.22	1.16	0.60 ^a
Experience	18.73	11.83	0.60 ^a

^a Set to 0.60.

actual usage had one item set to 0.60 to show that it had an acceptable level of error.

- (2) Personal innovativeness: the personal innovativeness scale developed by Leonard-Barton and Deschamps consisted of seven items with a five-point Likert type format. We used this scale for deciding the extent to which people innovatively think of solutions and cope with problems related to their work. Three items from the seven items were used for statistical analysis; this indicated maximum internal consistency (Cronbach's alpha = 0.80). Confirmatory factor analysis, in which one factor was forced, indicated that every item was loaded on this single factor with significant *t*-value.
- (3) Management support: based on the instrument of Leonard-Barton and Deschamps, we used their four items having a five-point Likert type format; one of the items was "Management support for using the object-oriented paradigm is strong". We adopted two items that were loaded on a single factor using exploratory factor analysis. Internal consistency estimate were fairly good (Cronbach's alpha = 0.76).
- (4) Accessibility to technology champions: we selected the scale developed by Alexander [5] for the adoption of the object-oriented paradigm. This was a five-point Likert type form that tested how easily respondents could get access to and advice from technology experts in their organization.
- (5) The amount of experience with structured methods, formal training period on the object-oriented paradigm, and group size of the professionals in a working group were also collected. One such scale was "What is the total number of days of formal training you have received about using the object-oriented paradigm?" These predictor variables were used to determine the validity of the statements: "the longer the experience in similar technologies, the longer the training period for OO technology", and "the more professionals in a working group, the easier people adopt the object-oriented paradigm". Reliabilities for these variables that were measured with one item were set to 0.60 to reflect that they contain modest levels of measurement errors.

5.3. Validity of measures

To examine whether the variables were measured with correct items, convergent and discriminant validities were checked through exploratory and confirmatory factor analysis. Exploratory factor analysis showed that all the items that were intended to measure specific variables were converged into the

Table 2
Exploratory factor analysis

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Ease of use 1	0.92				
Ease of use 2	0.87				
Useful 1		0.94			
Useful 2		0.93			
Useful 3		0.93			
Useful 4		0.90			
Intention 1			0.92		
Intention 2			0.86		
Support 1				0.88	
Support 2				0.88	
Innovativeness 1					0.90
Innovativeness 2					0.85
Innovativeness 3					0.80

distinguished factors, which confirmed that the measures developed for the study had strong convergent and discriminant validities (Table 2). The minimum factor loading coefficient was 0.80, which is very high. Confirmatory factor analysis, in which each item was forced to be loaded onto the factor, verified that all the items were good measures for the variables (Table 3). Every single item had a high factor loading, higher than 0.40 with a significant *t*-value.

5.4. Data analysis

A covariance matrix was used as an input to the LISREL 8 program [28] to analyze the structural model of our research. The estimation method was maximum likelihood (ML). The covariance matrix is presented in Table 4. All variables were represented by the total scores on these scales.

Based on TAM (Model 1), the original path models are shown in Fig. 4. The personal innovativeness,

Table 3
Confirmatory factor analysis

Items	Factors	Factor loadings	R squared
Ease of use 1	Ease of use	0.49	0.45
Ease of use 2	Ease of use	0.94	0.82
Useful 1	Usefulness	0.93	0.87
Useful 2	Usefulness	0.94	0.85
Useful 3	Usefulness	0.87	0.85
Useful 4	Usefulness	0.89	0.77
Intention 1	Intention	0.89	0.83
Intention 2	Intention	0.92	0.86
Support 1	Support	0.73	0.48
Support 2	Support	0.96	0.63
Innovativeness 1	Innovativeness	0.92	0.62
Innovativeness 2	Innovativeness	0.57	0.61
Innovativeness 3	Innovativeness	0.80	0.51

Table 4
Covariance matrix

	1	2	3	4	5	6	7	8	9	10
1	1.66									
2	0.40	0.81								
3	0.45	0.28	0.67							
4	0.46	0.66	0.24	0.89						
5	0.51	0.24	0.32	0.30	1.01					
6	-0.12	-0.43	-0.15	-0.26	-0.29	3.13				
7	0.78	0.09	10.76	0.03	0.36	0.03	2.36			
8	0.40	0.20	0.09	0.26	0.08	0.26	0.40	1.32		
9	11.39	2.27	2.16	2.78	4.25	-0.60	10.76	4.78	311	
10	0.31	0.03	0.07	0.06	0.16	-0.10	0.17	0.01	3.86	0.57

1. Actual usage, 2. perceived usefulness, 3. perceived ease of use, 4 behavioral intention, 5. managerial support, 6. group size, 7. length of training, 8. accessibility to technology champions, 9. experience and 10. personal innovativeness.

experience with the structured methods, management support, length of training period, accessibility to champions and the size of group represented by the number of IT professionals were expected to influence usefulness (directly) and the ease of use of OO technology. The ease of use and usefulness were hypothesized to mediate the influence of all exogenous variables to behavioral intention directly. In particular, usefulness was assumed to mediate the influence of the ease of use on behavioral intention. Finally, behavioral intention was expected to affect the actual usage. The proposition of this model was that all of the exogenous variables were hypothesized to affect the actual usage indirectly through ease of use, usefulness, and intention.

Model 2 was proposed by incorporating individual, managerial, and organizational characteristics into the original TAM model and by changing the positions of these variables in accordance to TPB. In this model, except for the perceived usefulness and ease of use of OO technology, all the exogenous variables (length of formal training, personal innovativeness, managerial support, group size, accessibility to technology champion, and experience with a similar technology) were expected to affect both behavioral intention and actual usage of OO technology. These relationships were in accordance with the role of PBC based on TPB. The

usefulness was hypothesized as affecting behavioral intention. The actual use of OO technology was then affected by behavioral intention along with the perceived behavioral control variables. In Model 2, therefore, the usefulness and ease of use are shifted from endogenous variables to exogenous variables.

6. Results

An initial test of Model 1 and Model 2 showed several paths with non-significant *t*-values.

These paths were deleted one at a time and the model was re-estimated. The final model was obtained by deleting all paths with non-significant *t*-values, as shown in Figs. 3 and 4.

As expected, relationships of core variables of the original TAM model are strongly supported in OO technology acceptance. Perceived usefulness of OO technology has a direct effect on behavioral intention of using the technology (path coefficients: 1.05 (Model 1, Fig. 1), 0.88 (Model 2, Fig. 2); *P* < 0.01). The perceived ease of use of OO technology has a direct effect on perceived usefulness of the technology and indirect effect on intention through perceived usefulness of OO technology (path coefficients: 0.33 (Model 1, Fig. 1), 0.49 (Model 2, Fig. 2); *P* < 0.01). Behavioral intention

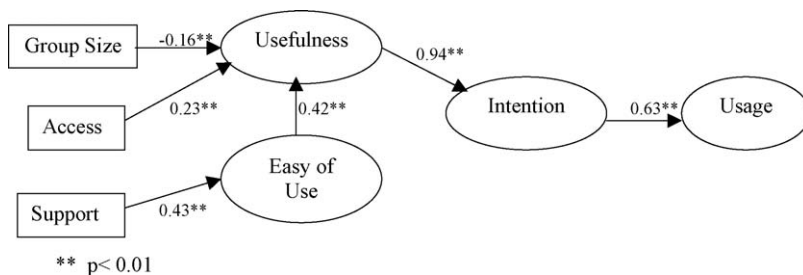


Fig. 3. Trimmed TAM (Model 1).

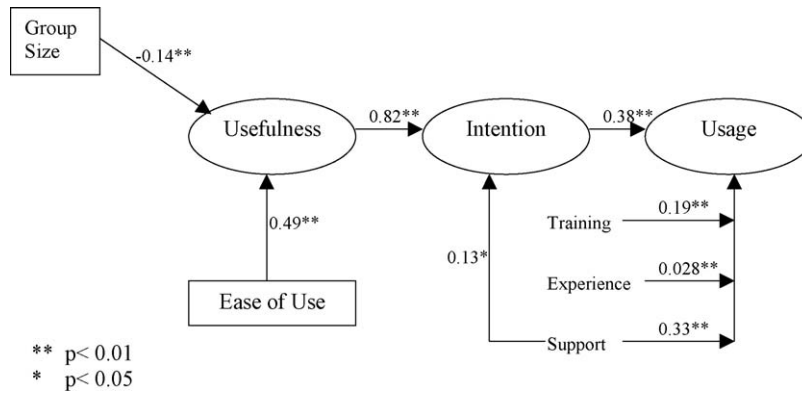


Fig. 4. Trimmed TPB (Model 2).

of using OO technology therefore had a direct effect on actual usage of the technology (path coefficients: 0.65 (Model 1), 0.38 (Model 2); $P < 0.01$).

From Fig. 3, management support was the only exogenous variable that significantly influenced ease of use of OO technology (path coefficient: 0.43; $P < 0.01$). The group size and accessibility to technology champions were shown to affect usefulness of OO technology (path coefficients: -0.16 , 0.23 ; $P < 0.01$). Other variables did not have significant influences on either ease of use or usefulness of OO technology.

From Fig. 4, the perceived behavioral control variables (such as training, experience with related technology, and management support) were shown to influence actual usage directly without being mediated by other variables (path coefficients: 0.19 , 0.028 , 0.33 ; $P < 0.01$). In addition, management support was shown to affect behavioral intention (path coefficient = 0.13 ; $P < 0.05$). Other perceived behavioral control variables such as group size, personal innovativeness, and accessibility to technology champions, did not influence either behavioral intention or actual usage.

Another interesting point is that the modification index for Model 2 suggested that a path from group size

to usefulness of OO technology should be added to increase fit of the model. The path coefficient of the path is -0.14 with the probability of less than 0.01 .

Several goodness of fit indices for Model 1, 2, and the Trimmed Models are shown in Table 3. Bentler and Bonnett [8] suggested that an NFI (Normed Fit Index) could be interpreted as an improvement in the fit of the hypothesized model over a baseline model. Because a better model-fit can always be obtained by adding parameters, James et al. [26] proposed a PNFI (Parsimonious Normed Fit Index) that gains the improvement in the model fit at the expense of degrees of freedom. In addition to these, the conventional chi-square statistic, GFI, AGFI, and RMSEA are reported for testing the goodness of fit of the models in this research. Except for the chi-square value and RMSEA, larger values are desirable. In addition, a single sample cross-validation index (ECVI) was used [10].

As can be seen in Table 5, compared to Model 1, Model 2 may be interpreted as having a better model fit. Even the two trimmed models with significant paths show that Trimmed Model 2 (Fig. 4) had a better fit than the Trimmed Model 1 (Fig. 3).

Table 5
Fit indices for each of the hypothesized models

	TAM (Model 1)	Trimmed TAM	TPB (Model 2)	Trimmed TPB	Combined Model (Model 3)
d.f.	14	23	9	16	20
Chi-squared	89.25**	97.99**	27.85**	33.30 ($P = 0.007$)	28.51 ($P = 0.098$)
RMSEA	0.17	0.13	0.15	0.08	0.05
ECVI	1.02	0.96	0.78	0.73	0.64
GFI	0.91	0.91	0.97	0.96	0.96
AGFI	0.66	0.77	0.79	0.86	0.90
NFI	0.78	0.76	0.93	0.92	0.93
PNFI	0.24	0.39	0.19	0.33	0.41

** $P < 0.01$.

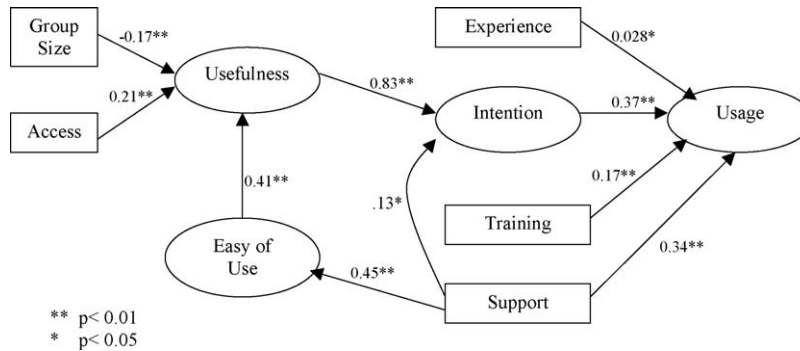


Fig. 5. The combined Model (Model 3).

In conclusion, it is evident that Model 2 is an improvement over Model 1.

7. Model 3—Combined research model

Even though overall test results showed that Model 2 was better in explaining the relationship between exogenous variables and acceptance of OO technology, both contributed to understanding the unique role of each exogenous variable for OO technology acceptance. First, some variables are more salient in influencing acceptance of OO technology when they are placed in the correct location. For example, group size and accessibility to technology champions are the two primary variables that influence acceptance of OO technology through its usefulness. Management support affected acceptance of OO technology by significantly increasing its ease of use. Model 2 showed that personal experience, length of training, and management support directly influenced acceptance of OO technology. In addition, management support indirectly affected acceptance by influencing behavioral intention of using OO technology.

But, interestingly, there is an exogenous variable that follows both the concepts of TAM and TPB when it is tested in the models: *Management support*—this directly influences acceptance of OO technology and indirectly affects it through ease of use. This could show that both models are effective in explaining the locations of some exogenous variables in adopting OO technology. However, considering that these results were obtained after exogenous variables were tested separately in each of the two models, it is unclear whether both locations of the exogenous variables would be effective when they are tested together in one model. Furthermore, the relative strength of the significant paths in the two models for exogenous variables is not well known. Thus, we developed a model that was intended to determine where exogenous variables should be placed when they were

tested in a model that combines the main ideas of both TAM and TPB. Thus, Model 3 was developed by locating all exogenous variables in front of the four endogenous variables; *usefulness* and *ease of use* in TAM and *intention* and *usage* in TPB. The test results of Model 3 are shown in Fig. 5. Goodness of fit indices (see Table 5) were good compared with those of both Model 1 and 2 (chi-square = 28.51 ($P = 0.098$); GFI = 0.96; AGFI = 0.90; NFI = 0.93; ECVI = 0.64).

According to the test results, *group size* and *accessibility to technology champions* are variables that influence acceptance of OO technology by increasing usefulness of OO technology. *Length of training* and *experience* directly affect usage of OO technology. But *management support* indirectly affects *acceptance of OO technology* by increasing *ease of use* of the technology and *behavioral intention* directly affects acceptance of OO technology.

8. Discussion and conclusions

8.1. Summary

In line with the findings by Davis, usefulness and the ease of use of OO technology were found to influence its actual usage through behavioral intention. While this research included the concept of planned behavior, the main idea of TAM was also confirmed. We investigated the difference between TAM and a model developed by incorporating the main idea of TPB. According to goodness of fit indices resulting from our experiments, the TPB based model is superior to TAM. The main difference is the position of exogenous variables.

These results are encouraging in that the model by TPB showed a potential role of PBC for adoption of new technologies. With the addition of PBC, our work found that some exogenous variables directly influence behavioral intention and actual usage of OO technology and

that they are not channeled through usefulness and ease of use of the technology.

With regard to the effects of research variables on technology adoption, most of the results of this study are in line with those of the previous research. Individual experience, management support, and the length of training period were shown to critically influence the adoption of OO technology. However, the other variables, such as the accessibility to technology champions and the group size, did not directly influence the adoption of OO technology.

8.2. Exogenous variables for OO technology acceptance

Our study confirmed that exogenous variables follow both TAM and PBC concepts. It is interesting that there is an exogenous variable (managerial support) that follows both concepts in influencing acceptance of OO technology.

Understanding why exogenous variables follow different paths when dealing with OO technology is useful to practitioners who seek effective adoption of the technology. First, group size and accessibility to technology champions significantly affected usefulness of the technology. Group size had a negative relationship to usefulness, which meant that a bigger group size was detrimental to its perceived usefulness; lack of interaction among members in a big group might lead to misconception of value of the technology. Allowing group members to access technology champions whenever necessary may be helpful in making them realize the usefulness of the technology.

Personal experience and length of training were found to have a direct influence on usage of OO technology. People with more experience with a similar technology and longer training may be better aware of the benefits of using OO technology, which makes accepting OO technology easier.

Managerial support was found to have positive relationships to ease of use, behavioral intention, and usage of OO technology. From the perspective of TAM, better managerial support may be necessary to increase ease of use of the technology, leading to better acceptance of it. On the other hand, from the perspective of PBC, this variable is contributory in making people more capable in controlling the environment for using OO technology, which would prompt them to be more willing to accept the technology.

This seeming controversy indicates that management support is critical, as it triggers the message about the importance of a new technology. Nevertheless,

management support must be the result of careful deliberations because strong support too soon could result in damage to the organization.

Our findings were quite compelling; by knowing the characteristics of the variables, practitioners can find more effective ways of adopting OO technology.

8.3. Limitations of the study

The research had some limitations. First, the sample size was somewhat small. Bentler and Chou [9] recommended that the ratio of the sample size to the number of free parameters be at least 10:1. In light of this criterion, this research may have produced some unstable estimation of parameters. For small sample sizes, ML (Maximum Likelihood) or GLS (Generalized Least Squares) estimates would be helpful, and the parameter estimates of our study might not be too far out of line. Second, some of the measurement items did not show univariate normal distribution, as measured by kurtosis and skewness. This could have exaggerated the chi-square value and lowered SEs and parameter estimates. But it could be said that this problem should not seriously affect the results. Third, the sample was collected in the Mid-western area of the U.S. This might limit the external validity of the work.

This study focused mainly on the role of perceived behavioral control variables in relation to their affecting OO technology acceptance, which was theorized to be based on TPB. An important finding was that some exogenous variables directly affected OO technology acceptance without being mediated by perceptual variables, such as perceived usefulness and ease of use of the technology.

Another limitation of the study was that it dealt only with exogenous factors at the individual and organizational levels of the U.S. There are numerous other factors that are outside organizational control, including, but not limited to, cultural differences, global trends, demographic changes, government policies, technological advances, etc.

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