The Technology Acceptance Model for Competitive Software Products

Hock Chuan CHAN  
Department of Information Systems  
National University of Singapore  
chanhc@comp.nus.edu.sg

Hock Hai TEO  
Department of Information Systems  
National University of Singapore  
teohh@comp.nus.edu.sg

Jing YANG  
Department of Information Systems  
National University of Singapore  
yangjin1@comp.nus.edu.sg

Yan LI  
Department of Information Systems  
National University of Singapore  
liyan@comp.nus.edu.sg

Abstract

The technology acceptance model has been widely used to study user acceptance of various software products and systems. As a widely-used theory, it is important to test it in very diverse settings, so as to know the applicability and boundary of the theory, and to derive new understandings. An extension is made by testing the model in a situation where there exist multiple competitive software products. It is hypothesized that in situations of close competition, perceived usefulness will not be a significant factor on the intention to use the less preferred product. A survey is conducted with respondents who have free access to Internet Explorer and Netscape. The hypothesis is validated: for users who prefer Internet Explorer, their intention to use Netscape is not dependent on their perceived usefulness of Netscape; similarly, for users who prefer Netscape, their intention to use Internet Explorer does not depend on perceived usefulness. This result highlights an important situation where the model is not fully applicable. The study also shows that the less preferred software product does not just disappear from use. Intention to use the less preferred software is still strongly affected by attitude. Attitude could be an important competition focus for companies of less preferred software products.

Keywords: technology acceptance model, competition, voluntary use, perceived usefulness, intention to use, relative values, Internet browser

1. Introduction

A widely used theory on the factors that affect usage of information systems is the technology acceptance model, TAM (Davis, 1989; Legris et al., 2003; Gefen et al., 2003). The core part of the model includes only a few factors: perceived usefulness (PU), perceived ease of use (PEOU), attitude (ATT) toward using, behavioral intention to use (BI), and usage (Davis, 1989; Legris et al., 2003). TAM has proven to be a robust model in explaining user acceptance for very different software products (e.g. Davis and Wiedenbeck, 2001; Dishaw and Strong, 1999; Lucas and Spitler, 1999; Straub et al., 1997; Lin and Lu, 2000; Igbaria et al., 1997).

A good theory should be subjected to tests under various conditions, so as to determine when the relationships among factors are valid (Eierman et al., 1995). Through this continual process, new boundary conditions for the theory, and new insights and implications may be derived. While TAM has been tested for many different software products, studies so far have not explicitly
considered situations where users have a choice of two or more similar (or competitive) software products. Every situation is treated as presenting only a specific software product or a homogeneous group of products available for the users (Eikebrokk and Sorebo, 1998; Davis, 1989).

Information system users today are exposed to many multiple-choice situations. Many users have access to both Internet Explorer and Netscape browsers, many different media players, and are offered many free services, such as email accounts or photo album storage systems, from different sites. Even for e-commerce, users have access to similar e-bookstores and different Internet search facilities. In situations where users have access to two or more similar software products, will TAM still be able to explain the usage, or behavioral intention to use, of the available software products? If not, what can software developers learn and what should they do? A survey is conducted to examine these research issues. Section 2 provides a brief literature review of the technology acceptance model. Section 3 outlines the research model and methodology for a survey of two similar software products, Internet Explorer and Netscape. The findings are presented and discussed in section 4. This is followed by the conclusion.

2. Literature Review

The technology acceptance model (TAM) (Figure 1) was derived primarily from the theory of reasoned action, the expectancy theory, and the self-efficacy theory. It aims to explain “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, while at the same time being both parsimonious and theoretically justified.” (Davis et al., 1989, p.985).

![Figure 1. Technology Acceptance Model](image)

Perceived usefulness (PU) is defined as “the prospective user’s subjective probability that using a specific application will increase his or her job performance within an organizational context” (Davis et al., 1989, p. 985). This definition suggests that PU “is a measure of outcome expectations for using a system” (Davis and Wiedenbeck, 2001, p. 554). Perceived ease of use (PEOU) is defined as “the degree to which a person believes that using a particular system would be free of effort.” (Davis et al., 1989, p. 985) Therefore, PEOU “can be considered a measure of self-efficacy because it is based on users’ perceptions of how easy it will be for them to successfully carry out desired courses of actions using the applications” (Davis and Wiedenbeck, 2001, p. 554). Attitude (ATT) is defined as the individual user’s positive or negative feelings about performing the target behavior (Fishbein and Ajzen, 1975). Behavioral intention (BI) is defined as “a measure of the strength of one’s intention to perform a specific behavior” (Fishbein and Ajzen, 1975, p. 288). The model postulates that usage is determined by behavioral intention,
which is jointly determined by the person’s attitude toward using the system and his perceived usefulness; attitude is jointly determined by PU and PEOU; and PEOU has a direct effect on PU (Davis et al., 1989).

Many studies have concentrated on this core portion of the TAM, without covering usage and external variables (e.g. Davis et al., 1989; Davis, 1989). Many more have added usage (e.g. Igbaria et al., 1995; Davis, 1993; Szajna, 1996; Venkatesh and Davis, 2000) or included external variables (e.g. Venkatesh and Davis, 1996; Liker and Sindi, 1997; Gefen et al., 2003). Many external variables have been studied, including social presence, user characteristics, organizational support, task characteristics, and subjective norms. A recent review of many of these studies can be found in Legris et al. (2003). In general, the relationships in the core portion (PEOU → PU, PU → ATT, PEOU → ATT, PU → BI and ATT → BI) are found to be significant in most studies reported in the literature (Legris et al., 2003).

3. Research Model and Methodology

Tests of TAM in situations where users have multiple software options appear to be rare. The first study of multiple alternative software products is probably by Eikebrokk and Sorebo (1998), who studied the effects of usefulness and ease of use on usage, in a situation where users have access to many different means of communication. Specifically, users can use email, telephone, mail, memo and physical dyadic and group meetings to communicate. Relative measures of the constructs were used for their regression analyses. Their findings “strongly suggest that technology acceptance in situations where several alternative technologies exist, is affected by a comparison between the alternatives.” (p. 95). They suggested that the findings have some inconsistencies because some of the options are not absolute alternatives but complementary methods of communication, e.g. meetings and mails. Thus, their study relates to a set of products that are both complementary as well as competitive. A related study is that by Ridings and Gefen (2000), which involved an old system and a new system that is replacing the old. This is not a competitive situation either as users are moving from one to the other.

The situation where two or more competitive software products are freely available is different. It is also different from the usual competitive situation where users will settle for just one product. As a type of product (e.g. Internet surfers), TAM is likely to apply, as intention to use a surfer software is likely to depend on perceived usefulness and attitude. Thus, for the preferred product, TAM is likely to apply. In this study, preference has the meaning of higher behavioral intention, as compared to that for a similar product. The use of intention as an indicator of preference is also mentioned by Ajzen and Fishbein (1980) and Azjen (2001). Since all products are freely available, users have the choice to use only one product or many of them. Studies have found that in discretionary environments, “fun and enjoyment may be a decisive competitive advantage” (Henderson et al., 1998, p. 397). In a study of an electronic supermarket, Henderson et al. (1998) found that intention did not depend on usefulness and usability, but depended on fun and enjoyment. Fun and enjoyment are similar to attitude, as seen in the usual questionnaire items used for attitude. Since users can perform their tasks with just the preferred software product, use of the less preferred product is totally discretionary and the finding by Henderson et al. (1998) may apply. If users find the less preferred software product fun to use, they may still use it occasionally. An analogy to other products will be usage of cars and bicycles. While cars
are more useful for getting around, the attitude factor (including liking it and finding it fun and attractive) gets people to use bicycles too. Thus, two hypotheses are made:

**H1**: For the product that is preferred, the technology acceptance model will show that perceived usefulness has an effect on behavioral intention. (The preferred product is the one with higher behavioral intention.)

**H2**: For the less preferred product, behavioral intention to use will not depend on perceived usefulness, but will depend on attitude.

A situation for testing the hypotheses is identified, where two alternative software products are available to a large group of users in a university environment. Students have access to Internet Explorer and Netscape browsers. These software products could be downloaded easily and freely through the university network. Students are known to be heavy users of the Internet. The student sample is not used as a replacement of other “real” users. For completeness, perceived ease of use is also measured. Thus, the research model is shown in Figure 1, without the external variables and usage.

Valid measurement scales are important for surveys. Davis (1989) developed and validated 6-item scales for PU and PEOU. Items for PU focus on features such as productivity, effectiveness and performance. Items on PEOU focus on ease to learn, controllability and flexibility. Both scales attained high reliability, and posses convergent and discriminant validity. A set of 4 questions was used in the study by Venkatesh and Davis (1996). These measures have been widely used in later studies on the TAM. Attitude questions have been studied by Ajzen and Fishbein (1980), and are widely used, e.g. by Agarwal and Prasad (1999). BI is usually measured with 2 to 4 questions, which are usually tailored for the individual studies. Intentions were assessed using two items constructed following the recommendation of Davis (1989). Such self-predictions, or “behavioral expectations,” are verified by previous researchers as one of the most accurate predictors available for an individual’s future behavior (Sheppard et al., 1988; Warshaw and Davis, 1985).

Before the survey, a pretest of the questionnaire was conducted, with ten respondents. Minor changes to format were made to improve clarity. The survey was conducted for a large class of undergraduate students on an information systems module. Each subject answered questions for both Internet Explorer and Netscape. Usable response forms were collected from 288 students, out of the total class size of 292. Participation in the survey was appreciated with a small cash payment.

4. Data Analysis and Discussion
Relationships in TAM are tested with multiple regression analysis, with SPSS (George and Mallery, 2001). Although TAM questions have been well validated, some psychometric properties are measured to confirm that the scales are good in this study. Internal consistency is typically measured with Cronbach’s coefficient alpha, which indicates the proportion of variance attributable to a latent variable. Scales in the range of .7 to .8 are considered “respectable”, and

$^1$ Tests with PLS, a partial least square analysis software, show the same significant and non-significant paths.
those from .8 to .9 are “very good”. Results show that reliability is good for all the measurements in our study. The correlation coefficient between BI for Netscape and for IE is -0.23 (p value= 0.002). The negative correlation indicates competitive software products, where more usage of one leads to less usage of the other.

To test the first hypothesis, the TAM was tested in the following ways: analysis of TAM factors for IE, for respondents who prefer IE, and analysis of TAM factors for Netscape for respondents who prefer Netscape. The results are shown in Table 1, 3rd and 6th columns. The findings support the hypothesis that perceived usefulness has a significant effect on behavioral intention to use the preferred product.

To test the second hypothesis, the TAM was tested in the following ways: analysis of TAM factors for IE, for respondents who prefer Netscape, and analysis of TAM factors for Netscape for respondents who prefer IE. The results are shown in Table 1, 4th and 5th columns. The findings support the hypothesis that perceived usefulness has no effect on behavioral intention to use the less preferred product.

The findings have interesting theoretical implications. Past studies on TAM, as reported by Legris et al. (2003), have mostly shown a significant relationship between perceived usefulness and behavioral intention, with a much smaller number of studies showing a non-significant relationship between these two factors. This study suggests a clue to help analyze such studies. Could those studies have examined a less preferred software product? Did their respondents have access to “more useful” alternatives? For example, one of the studies that show no effect from perceived usefulness is by Dishaw and Strong (1999). The software studied is a set of software maintenance support tools, and the respondents do have an alternative – the manual method of maintaining software. It should be noted that this study suggests one possible reason. There could be other reasons. For example, Jackson et al. (1997), who also find a lack of effect from perceived usefulness to behavioral intention, suggest that a reason may be that the users do not have sufficient exposure to the applications. This reason is not applicable to this study as subjects have used Internet browsers extensively.

Future studies could consider such a factor. For example, if we examine TAM for a less preferred e-commerce site, we would be likely to find less or no effect from perceived usefulness, as compared to a much preferred alternative e-commerce site. The theoretical contribution is the

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Predictor Variables</th>
<th>Internet Explorer</th>
<th>Netscape</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Intention IE&gt;NET</td>
<td>Intention IE&lt;NET</td>
</tr>
<tr>
<td>BI</td>
<td>PU</td>
<td>.201 (.003)</td>
<td>-.192 (.480)</td>
</tr>
<tr>
<td></td>
<td>ATT</td>
<td>.264 (.001)</td>
<td>.855 (.007)</td>
</tr>
<tr>
<td></td>
<td>r²</td>
<td>.152 (.001)</td>
<td>.471 (.009)</td>
</tr>
<tr>
<td>ATT</td>
<td>PU</td>
<td>.368 (.001)</td>
<td>.849 (.009)</td>
</tr>
<tr>
<td></td>
<td>PEOU</td>
<td>.238 (.001)</td>
<td>-.268 (.344)</td>
</tr>
<tr>
<td></td>
<td>r²</td>
<td>.254 (.001)</td>
<td>.411 (.017)</td>
</tr>
<tr>
<td>PU</td>
<td>PEOU</td>
<td>.385 (.001)</td>
<td>.656 (.008)</td>
</tr>
<tr>
<td></td>
<td>r²</td>
<td>.145 (.001)</td>
<td>.386 (.008)</td>
</tr>
</tbody>
</table>

Table 1. Factors Coefficients and R Squares, with p Values
identification of the competitive software environment as a place where TAM can behave differently for very similar software products.

The findings have practical implications for companies of competitive software products. After a software product has gained the upper hand, whether the competitor lingers on will depend more on user attitude than on perceived usefulness (of the lesser product). For the company with a less preferred product, it should concentrate efforts on influencing user attitude. These could include efforts to make their product more attractive and fun to use.

As an early study in this area, the results should be treated tentatively. Both the findings and the plausible explanations need further verification in other environments. For example, surveys of other alternative software products could be conducted to check if the lack of effect of perceived usefulness is also present there. Furthermore, the possibility of a new software product leading to a re-evaluation of perceived usefulness for the older software product could be tested in an experiment setting.

Future work can also consider this alternative software situation with many external variables that have been studied with TAM. For example, one of the factors is voluntariness (Martin and Kellermanns, 2001; Venkatesh and Davis, 2000). This study has a situation where users have free access to two alternative software products. Using at least one of the software product (Internet Explorer or Netscape) is, in a certain way, compulsory, since all the subjects have to access the Internet, either for their study or for other reasons such as simple browsing, news, virtual community participation or e-shopping. This is confirmed in the data, which shows that all subjects have a BI above 2.5 for at least one software product. The compulsion does not come from a higher management, but from the simple fact that there are no other ways to perform the functions of surfing the Internet. But once a person has selected a preferred software product, use of the other software product becomes totally voluntary. There is no compulsion from higher management, and no compulsion from job, study, or recreational needs.

5. Conclusion
Most current studies with the technology acceptance model on user intention to use software products have concentrated on a single software product or a homogeneous set of products. It is likely that the model’s applicability could be affected by the presence of competitive software products. Following this line of thought, Eikerbrokk and Sorebo (1998) studied relative values of usefulness and ease of use on relative usage.

A different and more theoretical objective is pursued in this study: we want to test whether the technology acceptance model applies to each software product in an environment where alternative competitive software products are freely available. Specifically, it is hypothesized that perceived usefulness will continue to be an important factor of behavioral intention for the preferred product, but not for the less preferred product.

The survey supports the hypotheses. The theoretical implication is that future studies on user acceptance of software products should consider the competitive landscape. Another theoretical implication is that TAM studies that pool data on different software products should be careful not to pool from competitive products. The findings also suggest that in such situations,
behavioral intention to use the less preferred software is strongly influenced by attitude. Thus, more emotional aspects, such as fun and attractiveness of the software, should be the focus of competition for the company of the less preferred product.

References