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THE IMPACTS OF COMPATIBILITY BELIEFS AND PERSONAL INNOVATIVENESS ON USING ONLINE OFFICE APPLICATIONS

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Abstract

The online application service based on the new platform of cloud computing has been suggested as a major trend in information technology. Online office application is the most popular online service for individual users and it differs a lot with traditional stand-alone package. Based on innovation diffusion theory and technology acceptance model, this study investigated the influences of personal innovativeness and a variety of compatibility beliefs on using online office applications. The results indicate the value of innovativeness is a major cause and it brings both intrinsic and extrinsic motivations for using behaviour; conversely, the impact of perceived usefulness is insignificant. The results help us understand the early adopters of online office applications and the barriers for people to use this innovative service.

Keywords: Online service, innovation diffusion, compatibility, innovativeness.
1 INTRODUCTION

Enabled by the development of Internet and web-based technology, cloud computing has been a major trend in information technology and a new computational paradigm where enterprise and personal users can obtain a huge variety of resources without having to deal with configuration and implementation details (Cusumano 2000; Murugesan 2013; Oliveira et al. 2010; Weinhardt et al. 2009). Cloud computing provides services in infrastructure, platform, and application software (Armbrust et al. 2010; Weinhardt et al. 2009). Software as a Service (SaaS), as a major type of cloud computing, has revived the model of Application Service Provider (ASP) and been heralded as the new wave in application software distribution (Belian et al. 2009, 2011; Gillan et al. 1999; SIIA 2001; Walsh 2003). SaaS users do not need to install and maintain copies of application software on their own facilities; they can use just a browser to the access web-based services from a contractual service provider to get the applications they need. Because of the economics of scale and the possible network externality effect in online services, many companies urgently establish online services to attract people and gain early mover advantage (Belian et al. 2009; Cusumano 2000; Walsh 2003).

SaaS can be used for both personal and enterprise applications (Belian et al. 2009; Gillan et al. 1999; SIIA 2001; Walsh 2003; Weinhardt 2009). The suit of office applications, including word processing, spreadsheet, and presentation tool, may be the most popular application software for individual users. Office applications have also been a fast growing online service that many companies, including Google and Zoho, have provided office applications online (Belian et al. 2009; Weinhardt 2009). Online office applications reduce a large number of users' burden of managing and maintaining the system. Besides, users can author the same copy of document on different devices; online office applications can also support people to share document and co-authoring. Using online service, however, is a radical change for individual users and it may not be easy to attract people moving from desktop applications to use it. Users need to be able to use an Internet connected device to access the services; they also need to know how to evaluate whether the service provider can be trusted. People need a new work practice to enable the full benefits of online office applications. Users usually have had considerable experience in prior office applications, but the prior experiences may be a barrier for them to adopt the innovative services.

Previous studies widely used Innovation Diffusion Theory (IDT) and Technology Acceptance Model (TAM) to explain why people adopt an innovative product and accept the new information technology. Karahanna et al. (2006) integrated IDT and TAM by emphasizing compatibilities as the major independent variables of the model. They disaggregated the global compatibility construct into four distinct components and proposed a set of causal linkages that affect users’ acceptance of innovative technology. Compatibility is a barrier for radical innovation because radical change by definition is not compatible. The barriers of compatibility, however, can be reduced by compatibility of value, which was suggest in Karahanna et al. (2006) as the only antecedent variable in the model. Personal innovativeness can represent the general value in adopting an innovation; therefore, can be a critical factor that help overcome the barrier of compatibility (McGeoch & Irion 1952; Midgley & Dowling 1978; Roehrich 2004). Based on the model of Karahanna et al. (2006), this study investigated the impacts of compatibility beliefs and innovativeness on users’ adoption of online office applications. The results of this study can help enhance understanding of the factors affecting people using online office applications and the barriers for people to adopt the innovative service.

2 THEORETICAL MODEL

2.1 Innovations Diffusion Theory and Technology Acceptance Model

Rogers (1962) proposed innovations diffusion theory to explain why some innovations are fast accepted by users but others are not, and even may be failed. Diffusion of innovation is the process of
an innovation passing in members of a social system through specific channels over time. Rogers argued that innovation adoption is affected by perceived attributes of the innovation, including relative advantage, compatibility, complexity, trialability, and observability (Rogers 1995). Many studies followed and revised the five factors of Rogers. Tornatzky and Klein (1982) conducted a meta-analysis of 75 literatures on innovation and found that comparative advantage, compatibility and complexity are consistently related to innovation adoption.

Rogers (1995) defined relative advantage as the price and performance of new products compared to each other in the market, and complexity as the difficulty of using new products. Moore and Benbasat (1991) suggested that relative advantage is similar to the notion of perceived usefulness in TAM (Davis 1989); and complexity is similar to perceived ease of use. After that, many studies have integrated IDT and TAM to explain why people accept innovative information technology. Some studies based on IDT to suggest compatibility, perceived usefulness, and perceived ease of use as the three factors affecting users' attitude toward using the new tools (Agarwal & Prasad 1998; Chen et al. 2002; Taylor & Todd 1995; Truman et al. 2003), and some followed the arguments of TAM and suggested compatibility as a determinant of perceived usefulness and perceived ease of use (Chau & Hu 2001).

2.2 The Beliefs of Compatibility

Rogers (1962) defined compatibility as the degree to which using an innovation is perceived as consistent with the existing sociocultural values and beliefs, past and present experiences, and needs of potential adopters. This definition was widely accepted and it suggests the global compatibility includes compatibility with values, compatibility with prior experience, and compatibility with the needs of potential users. Moore and Benbasat (1991), however, indicated that if an innovation did not meet the needs of potential users at the beginning, this innovation would not be perceived as useful to them; because of the potential overlap between compatibility with potential adopter's needs and perceived usefulness, compatibility with needs should be removed from the model. Tornatzky and Klein (1982) also suggested compatibility includes normative or cognitive compatibility, which refers to compatibility with what people feel or think about an innovation, and practical or operational compatibility, which refers to compatibility with what people do.

Karahanna et al. (2006) attempted to resolve the inconsistencies between the conceptual and operational definitions of compatibility. They argued that compatibility with values is similar with Tornatzky and Klein's normative and cognitive compatibility. Except for the compatibility with prior experience, practical or operational compatibility can further be divided into compatibility with existing work practices and compatibility with preferred work style. Although compatibility with existing work practices may be identical with compatibility with preferred work style in certain situations, that is not always the case.

Therefore, Karahanna et al. summarized and disaggregated the components of compatibility into compatibility with existing work practices, compatibility with preferred work style, compatibility with prior experience, and compatibility with values. They also proposed a multivariate structural model to describe the linkages between the four dimensions of compatibility. Value is a stable and lasting belief that hidden in people's hearts and strongly motivates and drives individual perceptions and behaviors (Feather 1992). Values determine how individuals structure their behavior and predict individuals' preferences with regard to work practices. Karahanna et al. also suggested when a technology is compatible with values, all else being equal, it will also be compatible with the prior experiences the individual has had, relative to the extent that stable and enduring values determine past choices regarding the experiences in which one will engage. Therefore, the belief about compatibility with value should positively influence other compatibility beliefs. Besides, individuals seek to align their actual behavior with the preferences that reflect their self-concept to reduce cognitive dissonance (Festinger 1957). Because existing work practices may likely be modified to be consistent with
individual preference, the beliefs about the compatibility with preferred work style should positively influence the beliefs about compatibility with existing practices.

2.3  Innovativeness and the Structural Form of Compatibility

Innovativeness with values refers to the match between the possibilities offered by the technology and the user’s dominant value system (Karahanna et al. 2006). Values are concepts or beliefs about desirable end states or behaviors, and that transcend specific situations, guide selection or evaluation of behavior and events, and are ordered by relative importance (Schwartz & Bilsky 1987). Although the belief about compatibility with values is a dominant factor that affects other compatibility beliefs, except for some experts or professionals, most users may not really be able to perceive the value beliefs of using specific information technology. Being willing to using an innovative product early itself, however, may reflect a belief related to individual value system.

Rogers (1962) argued that consumers who are the first to adopt an innovation differ substantially from late adopters in terms of their socio-economic characteristics, their communicative behavior, and their personal characteristics. The personal characteristic of innovativeness is the degree to which an individual is relatively earlier in adopting an innovation than other members of this system and it is the major factor determines the time individual adopts an innovation (Rogers & Shoemaker 1971). Users with higher levels of personal innovativeness are more willing to cope with the uncertainty of innovative technologies (Rogers 1995).

Personal innovativeness for consumers is also named as consumer innovativeness, which is the tendency to buy new products more often and more quickly than other people (Midgley & Dowling 1978). Midgley and Dowling (1978), however, argued that defining innovativeness in terms the actual behavior of relative time of adoption created a tautology. Hence, they suggested distinguishing innate innovativeness from actualized innovativeness to define the construct at a higher level of abstraction. Innate innovativeness is the degree to which an individual is receptive to new ideas and takes innovative decisions independently of the experiences related by other individuals and maintains that first adopters. It is a predisposition to buy new and different products and brands rather than remain with previous choices and consumer patterns (Steenkamp et al. 1999).

Hirschman (1980) focused on inherent novelty seeking and consumer desires to obtain information about innovations. She defined innovativeness as the desire to seek out something new and different. By focusing on novelty, Hirschman pushed innovativeness beyond the realm of new product consumption. Manning et al. (1995) further showed the differences between consumer novelty seeking and consumer independent judgment making. Their results indicate that consumer novelty seeking is positively related to early stages of the adoption process and consumer independent judgement making is only associated with later stages of the process. Le Louarn (1997, as cited in Roehrich 2004) building on the works of Midgley and Dowling and Hirschman, defined redispersion to innovate as a central predisposition to take innovative decisions, which expresses itself at every level of human activity. At product consumption level, this predisposition is about attraction to newness, autonomy in innovative decision, and ability to take risks in trying newness. Roehrich (2004) summarized and argued that consumer innate innovativeness should expresses individual need for stimulation, need for uniqueness, novel seeking, and independent toward other’s communicated experience.

Innovativeness has been widely accepted to explain the perceptions, intention, and adoption of innovation (Agarwal & Prasad 1998; Citrin et al. 2000; Hirunyawipada & Raswan 2006; Im et al. 2003; Karahanna et al. 2002). Except for the global innovativeness, there are also innovativeness in specific domains (Agarwal & Prasad 1998; Goldsmith et al. 1995). Users with higher personal innovativeness are more willing to cope with the uncertainty of innovative technologies (Rogers 1995), thus perceive less the threats caused by the inconsistency between the new and old technology. Online office application is a radical innovation and brings a radical change for most users who have been familiar with traditional stand-alone application. Therefore, people with higher innovativeness will perceive online office applications to be more compatible with their value. Following the arguments of
Karahanna et al. (2006), people with higher innovativeness will perceive online office applications to be higher compatible with their preferred work style, their existing work practices, and their prior experience. So we proposed a research model as in figure 1 and the hypotheses that:

**H1a:** Personal innovativeness positively influences the beliefs about compatibility of online office applications with preferred work style.

**H1b:** Personal innovativeness positively influences the beliefs about compatibility of online office applications with existing practices.

**H1c:** Personal innovativeness positively influences the beliefs about compatibility of online office applications with prior experience.

Karahanna et al. (2006) argued that according to the cognitive dissonance theory, because individuals would like to achieve internal consistency between their preferences and actual behavior to reduce cognitive inconsistency, when a technology is congruent with the way an individual prefers, it would also be congruent with the existing practice. Therefore, we proposed the following hypothesis:

**H2:** The beliefs about the compatibility of online office applications with preferred work style positively influence the beliefs about compatibility with existing work practices.

### 2.4 Compatibility and TAM

Perceived ease of use refers to whether the users found it is easy to use online office applications to author their documents. Karahanna et al. (2006) suggested among the four beliefs of compatibility, compatibility with prior experience and compatibility with existing work practices are likely to influence perceived ease of use. The law of proactive interference argues that people base on their prior knowledge and experiences to proactively interference the ways to deal with the new situations they face (McGeoch & Irion 1952). Therefore, if the new technology is more similar with the current one or the users’ prior experiences, users will find it cognitively burden less to understand it and feel it is more ease to use the new technology. The suit of office application is popular software in personal computer. Most users have had many experiences and been familiar with the functions and user interface of existing software; they should have developed a working practice on how to use it to author and distribute documents, and to co-work with others. Current or prior experience may be able to help people to learn the new situation; however, if the new situation differs a lot with the past ones, the experience may not only cannot facilitate, but also constrain the learning process. Therefore, we proposed the hypotheses that:
H3a: The beliefs about the compatibility of online office applications with existing work practices positively influence the beliefs about its ease of use.

H3b: The beliefs about the compatibility of online office applications with prior experience positively influence the beliefs about its ease of use.

Perceived usefulness refers to the user's subjective perception that the use of a specific application tools can enhance the performance level (Davis 1989). Moore and Benbasat (1991) alluded to a possible relationship between compatibility and perceived usefulness and Chau and Hu (2001) argued that compatibility is an external variable in TAM that affect perceived usefulness and perceived ease of use. Karahanna et al. (2006) suggested all four beliefs of compatibility are likely to affect perceived usefulness. People are likely to perceive technologies that are consistent with their value system are as helping foster and promote such values, and thus contributing to enhance the perception of instrumentality. Online service is an innovation and personal innovativeness should be associated with the belief about the compatibility of using online service with individual values. People with more experiences in innovation may be more likely to feel the value and benefits brought by innovation adoption (Hirschman 1980). Previous studies have also showed innovativeness positively affects individual perception of usefulness of the new technology (Agarwal & Prasad 1998; Karahanna et al. 2002). Therefore, we proposed this hypothesis:

H4a: Personal innovativeness positively influences the beliefs about the usefulness of online office applications.

Moore and Benbasat (1991) pointed out that if a technology cannot be compatible with user's experience or work style, then the user is almost impossible to feel this technology offers a variety of advantages. Furthermore, if people perceive a new technology to be consistent with the work style they prefer, it would be likely that they perceive the technology to be useful to them. We proposed the hypotheses that:

H4b: The beliefs about the compatibility of online office applications with preferred work style positively influence the beliefs about its usefulness.

H4c: The beliefs about the compatibility of online office applications with existing work practices positively influence the beliefs about its usefulness.

H4d: The beliefs about the compatibility of online office applications with prior experience positively influence the beliefs about its usefulness.

Although TAM argues that user beliefs about the technology should affect the attitude toward the technology through the mediation of their effects on perceived usefulness and perceived ease of use, IDT suggests compatibility, alongside with relative advantage and complexity, affecting innovation adoption directly. Many studies followed the arguments of IDT and proposed compatibility, perceived usefulness, and perceived ease of use together as three determinants of the attitude toward the new technology (Agarwal & Prasad 1998; Chen et al. 2002; Taylor & Todd 1995; Truman et al. 2003). Karahanna et al. (2006) further suggested that compatibility with values and compatibility with preferred work style represent intrinsic motivators in that they help the user attain consistency with an internal belief system and overt actions (Vallerand 1997), thereby reducing cognitive dissonance. Using innovative products should bring similar effects for high innovativeness people. Previous studies also showed the direct effect of personal innovativeness on innovation adoption (Agarwal & Prasad 1998; Citrin et al. 2000; Hirunyawipada & Raswan 2006; Im et al. 2003). Therefore, we proposed the following hypotheses:

H5a: Personal innovativeness positively influences use of online office applications.

H5b: The beliefs about the compatibility of online office applications with preferred work style positively influence use of the application.
If the new technology itself brings a positive value for a potential user, compatibility with existing work practices and prior experience may provide the extrinsic motivation to engage in greater use (Karahanna et al. 2006). Except for taking less effort, similarity with prior experience and current practices will also reduce the uncertainty in using the new technology. Previous studies often use past experience as a factor to predict technology adoption (Igbaria 1990; Igbaria & Iivari 1995; Igbaria et al. 1995, 1996; Kettinger & Grover 1997; Thompson et al. 1994). So we proposed the following hypotheses:

\textbf{H5c:} The beliefs about the compatibility of online office applications with existing work practices positively influence use of the application.

\textbf{H5d:} The beliefs about the compatibility of online office applications with prior experience positively influence use of the application.

Finally, TAM proposes that people’s beliefs about the usefulness and ease of use of the new technology are two critical factors that affect whether a potential user will use the technology; they will affect users attitude, their intention to use, and then the actual using behavior; besides, perceived ease of use positively affect perceive usefulness (Davis 1989; Davis et al. 1989). Many studies have tested and shown the effects of perceived usefulness and perceived ease of use on the intention and using behavior to simplify the model (Legris et al. 2003). We followed TAM to propose these hypotheses:

\textbf{H6a:} The beliefs about ease of use of a technology positively influence the beliefs about its usefulness.

\textbf{H6b:} The beliefs about the usefulness of a technology positively influence use of the technology.

\textbf{H6c:} The beliefs about the ease of use of a technology positively influence use of the technology.

\section{3 RESEARCH METHOD}

We conducted an online survey to test the research model. Because people who are not familiar with online office applications may not be able to answer the questions, we invited only people who have known online office applications to take part in the study. Invitations were posted in several popular virtual communities for information technology in Taiwan. A drawing for fifteen 500 TWD gift certificates of popular chain stores was offered as an incentive for participants. We introduced what online office applications is in the beginning of the questionnaire, and then asked if the respondents know it well and invited those who do to participate in the study.

Most of measurement items were revised from previous studies. Compatibility with preferred work style, compatibility with existing work practices, and compatibility with prior experience were measured by the 4, 5, and 5 items revised from Karahanna et al. (2006). Innovativeness was measured by the six items of Le Louarn’s (1997; as cited in Roehrich 2004). Items of perceived usefulness and perceived ease of use were revised from Davis (1989). All the items mentioned above are in a 7-point Likert scale.

Many respondents in this study, who were familiar with online office applications, may have had the experiences in using the applications. Previous studies, however, suggested that trying a new tool is different from real adoption or use it (Ahuja & Thatcher 2005; Bagozzi & Warshaw 1990; Gould et al. 1997). Therefore, usage was operationally defined as the extent of using online applications for authoring word, spreadsheet, and presentation documents. It was measured by asking the respondents “the percentage of using online services for authoring word, spreadsheet, and presentation documents,” and “the average time I spend in using online office applications in a week.” These items were measured in 6 and 5 scales, respectively. The scales were tested and revised in a pretest to avoid serious skewed distribution.
Finally, 102 subjects were obtained. We dropped 11 responses showing a long sequence of questions with the same answers or showing similar scores between pairs of reversed items. In the 91 valid respondents, 31 are students and 42 are employees. All of the subjects in this study had used online office application before, however, 28.6% of them only had used it for less than one month and only 41.8% of them still used it in the time of the study. 71.5% of the respondents used online office applications for authoring less than 25% of their documents.

4.1 Measurement Model

Because usage was defined as a formative variable in this study and the sample size is small, we used partial least squares (PLS) to test our measurement model and hypotheses (Anderson & Gerbing 1988; Chin & Newsted 1999; Wold 1982). The result of a confirmatory factor analysis shows the factor loadings of two items in innovativeness and one item in compatibility with prior experience were not significant; therefore we dropped these items from further analysis. The factor loadings of the other items were all larger than 0.8, showing a good item reliability. The Cronbach’s α and composite reliabilities of all variables were larger than 0.9. Furthermore, the average variance extracted (AVE) of all reflective variables were all larger than 0.7, showing a good convergent validities of our measurement model (Fornell & Larcker 1981).

The correlations of all items with their theoretically assigned factor were larger than their correlations with the other factors, and the square root of the AVE of each latent variable was larger than the correlations between the variable and the others. These results suggest the discriminant validity of our model being acceptable (Chin 1998; Gefen & Straub 2005).

4.2 Structural Model

The results of hypothesis testing are shown in figure 2. Figure 2 also shows the total effects on using behaviour and determination coefficients ($R^2$) of all variables. Determination coefficient is the major predictor in the structural model.
indicator for evaluating the “goodness of fit” of the structural model in PLS (Götz 2010). Our model shows a good explanatory power that can explain about 89% of the variance of using behavior, and explain more than half of variance for most of the dependent variables. Among all explanatory variable, innovativeness shows the biggest effects on using behavior, and then goes to perceived ease of use and compatibility with preferred work style.

The hypotheses of H1 and H2, about the effects of innovativeness on the beliefs about compatibility with preferred work style, existing work practices, and prior experience and the effects between compatibility beliefs, were all supported. The results also supported H3, for the impacts of compatibility with existing work practices and with prior experience on perceived ease of use. For the four hypotheses of H4, about the effects of compatibility beliefs on perceived usefulness, however, H4b was the only supported one. The effects of innovativeness, compatibility with existing work style and compatibility with prior experience were insignificant. H5a and H5b were supported, showing the effects of intrinsic motivations on using behavior. On the other hand, the effects of extrinsic motivations, H5c and H5d, were insignificant. Finally, among the three hypotheses of TAM, perceived usefulness showed an insignificant effect on using behavior.

5 CONCLUSIONS

This study investigated the influences of innovativeness and compatibility beliefs on using online office applications. Some interesting findings of this study should be noted. Perceived usefulness usually shows a significant effect on acceptance new technology in previous studies on TAM (Legris et al. 2003), but the impact of perceived usefulness on using behaviour was insignificant in this study. This result, however, may show the special features of the early adopters. Moore (1991) suggested there is a big difference between early adopters and early majority for disruptive innovations. The early adopters, or the visionaries, are primarily driven by a vision or a dream of the future of using new technology. Unlike the early majority, who are also called the pragmatists, early adopters may be less pragmatic and consider less the real benefits of the innovation. Therefore, as shown in this study, personal value of innovativeness turned into the factor brought the biggest effect on using behaviour. Innovativeness brought intrinsic motivations for using online office application, which affected usage directly and through the mediation of its effect on compatibility with preferred work style. Conversely, the effect of perceived usefulness on user behaviour was insignificant.

Except for the intrinsic motivations, innovativeness also brought extrinsic motivations, which affected using behaviour through the mediations of compatibilities with existing working practices and prior experience, and then through perceived ease of use. The early adopters differ with the innovators or the techies, who are not afraid of or even like facing the challenge of using the new technology (Moore 1991). Ease of use is an important condition for the early adopters to accept innovation. Christensen (1997) also indicates that a disruptive innovation is usually less complicated and may not be as useful as the old one, in terms of the functions it provides; however, it may attract users and enter the market because it is simpler and easier to be used. The new technology may gradually replace the old one when it becomes mature and provides more functions. As shown in this study, compatibility with existing work practices and compatibility with prior experience affected using behaviour through the mediation of perceived ease of use. This result suggests although the new tool may not be compatible with the current one, it will not be a serious barrier if the new tool is easy to use.

It should be noted that there were only 91 subjects in the study; the finding mentioned above is the result of a small sample-sized study. Furthermore, as discussed above, the validity of these results represent and restrict to current diffusion stage of online office applications. Online service may be an important trend in IT industry; however, it may not be so useful in its early stage. Comparing with the mature stand-alone packages, the function of online service may be simpler and online service may be less reliable and responsive. We may also need to have a new practice to effectively use the new tool. Furthermore, most users should have invested a sunk cost in obtain the legacy package. The results of
this study, however, suggest that these may not be important barriers for online service in the early stage of diffusion. The early adopters can be driven by a good value proposition, and they will be willing to try the new tool if it’s not too difficult. Online service can be more useful, for example, as the environment of mobile computing to be more mature. As online service is more widely accepted, major users will move from the early adopters to the early majority and their considerations will not be the same. We can follow the development of online service in future to understand factors affecting user behaviour in different stage of innovation diffusion.

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