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An Empirical Study of the Factors Influencing the Task Performances of SaaS Users

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A B S T R A C T

IT convergence services, as the main stream of the digital age, are currently on their way to include the concept of Software as a Service (SaaS), where IT products and services are integrated as one. In particular, the recently introduced web-service-based SaaS is expected to be a more developed SaaS model. This new model provides greater influence on clients' job performances than its previous models, such as application service providers and the web-native phase. However, the effects of technology maturity on task performance have been overlooked in adoption and performance studies. Accordingly, this study introduces SaaS technology maturity as the exogenous technological characteristic influencing job performance. This study also examines the relationships among various SaaS-related performances according to the different levels of SaaS maturity. Results suggest that applying innovative technologies (such as SaaS), particularly when the technology reaches a certain level of maturity, is more helpful for managers in improving task-technology fit and job performance. This study makes an academic contribution by establishing and validating a performance model empirically with SaaS technology maturity perspectives.

Keywords: Software as a Service, Technology Maturity, Task-Technology Fit Model, IS Continuance Theory, Partial Least Square (PLS)

Ⅰ. Introduction

Software as a Service (SaaS) is a form of information technology (IT) outsourcing service using a hosted application in which users tap into the applications they need using a service of other company rather than license, develop, or rent software in-house (Anthes, 2008). SaaS, along with Platform as a Service (PaaS) and Infrastructure as a Service (IaaS), is a component of the catalog that comprises cloud computing (Hsu et al., 2014; Voorsluys et al., 2011). Clouds are a style of computing consisting of a large

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pool of easily usable and accessible virtualized resources, which can be dynamically reconfigured for optimum resource utilization (Vaquero et al., 2009). The focus of this study is solely on the technological maturity of SaaS, not on the other technologies that comprise cloud computing. The emergence of cloud computing is closely linked to the maturity of SaaS (Voorsluys et al., 2011).

The emergence of the SaaS business model has attracted great attention from both researchers and practitioners (Ma, 2007). Moreover, the on-demand model represented by SaaS is considered an important technological development and it could certainly change the software industry (IDC, 2006). Despite the rosy outlook of SaaS, many corporations that can afford enough resources to develop in-house (on-premise) software hesitate or decide not to adopt SaaS (Herbert and Martorelli, 2008), and scholars assert SaaS will serve users with a light demand, whereas high-demand users will prefer to buy the software (Ma and Seidmann, 2008). Compared to existing on-premise-based ISs, SaaS technology is still under development, and it has not yet been determined whether the technology is mature enough to ensure reliability and availability, as well as the high speed and integrity of legacy ISs (Greschler and Mangan, 2002a; Kern et al., 2002a). In adopting and deciding on a novel technology, technology growth and maturity phases should be importantly considered (Kishore et al., 2004). However, the impact of technology maturity and its dynamic changes because of technological developments have not been typically included in IS adoption and performance studies (Legris et al., 2003). Even the existing IS maturity model based on Nolan's stage model emphasizes general technologies rather than the specific ones of a firm's ISs, thereby failing to reflect on the idiosyncratic characteristic of a single emerging IS technology.

In consideration of the matters above, this study suggests a performance model with an in-depth analysis of IS technology maturity, while centering on SaaS technology. Above all, we present a research model with the task-technology fit (TTF) theory (Goodhue, 1998; Goodhue and Thompson, 1995) and IS continuance theory (Oliver, 1999). The theories are broadly established based on the need to measure IS performance impacts and continuous utilization. Based on these theories, the model joins the two key elements of IS research streams. Then, an empirical analysis will be performed on which sorts of influences the established research model receives according to SaaS technology maturity stages. Our research is performed as follows. In Chapter II, we analyze and arrange traditional theories on SaaS maturity. This study made academic contributions by establishing the TTF model with the IS continuance theory and SaaS technology maturity perspectives, as well as empirically validated it.

Ⅱ. Theoretical Foundation

2.1 Software as a Service (SaaS)

SaaS refers to the terminologies from application service provider (ASP) to on-demand (IDC, 2004; SIIA, 2004), which includes seamless computing, hosted applications, and adaptive computing (Choudhary, 2007). Over the past two decades, organizations have outsourced their business processes and tasks using specialized outsourcers. Outsourcing trends provided new business opportunities to client/server systems-based solutions providers. However, reflecting on the past two decades, enterprise systems as a form of client server have been too complex to use

(Jaiswal et al., 2009) and they have demanded profound IT skills to develop and maintain (Patnayakuni and Seth, 2001). Later, ubiquitous Internet technology facilitated the delivery of software applications over the network; this led to the advent of the SaaS model as a new software and service acquisition method (Kern et al., 2002b). SaaS began as a new software provision method that spread in the U.S. in the latter half of the 1990s. In the early introduction stage, SaaS was used to outsource organizational non-core business processes by focusing on personal applications with low-level complexities (Patnayakuni and Seth, 2001). Thereafter, SaaS began to be applied to the core business and inter-organizational business areas (Dubey and Wagle, 2007). Organizations are now increasingly adopting SaaS for business-critical applications (Gartner, 2014).

In general, the term 'SaaS' can be described as 'genuine SaaS' when all of the following conditions are satisfied. The conditions are, first, software services should be provided from a remote server in a data center. Second, a wired or wireless dedicated line with web-based technology, rather than a stand-alone desktop environment, ought to be utilized as a service delivery architecture. Third, clients need to subscribe to application services as a form of IT outsourcing, including software, data, and hardware renting, although it used to be limited to only software renting during the initial stage in the 1990s. Fourth, the means of owning and using applications are practicable through 'the payment of a monthly user fee,' rather than 'a lump-sum payment.' The service provision is suspended under the SaaS price model if users do not pay monthly fees (recently, payment methods for usage have been diversified, including authorized deferred payment, advertisement fees, and free usage) (Gallup, 2007).

2.2 SaaS Technology Maturity

Hagel (2001) divided the SaaS market (hosted application market) into three generation phases[1] (Hagel, 2002). The first generation was the earlier ASP stage, which used the Internet or a dedicated line for the application service. With hosting packaged software applications, the ASP vendors offer remote access to their clients. They have their own price policies: one-time license (significantly cheaper than conventional software), set-up fee, and various monthly charges for a recurring stream of periodic subscriptions, hosting, and maintenance (IDC, 2004; SIIA, 2004). For small- and medium-sized enterprise (SMEs), ASP attracted great attention in the early developing stage of SaaS before and after the year 2000. However, ASP offered same-for-all solutions without detailed customizations for client firms and their business processes, and it did not confer tangible benefits to their clients (Currie, 2004). Then, the SaaS technology developed into the second stage, wherein users in client corporations could obtain pure 'web-native applications' and adopt a subscription-based payment model. The web-native application stage consisted of applications specifically built for web-based deployment and delivery. It required a small set-up fee and fewer maintenance costs than traditional enterprise software based on-premise. Web-native applications were narrowly built around a specific business function or process (IDC, 2004; SIIA, 2004) and for 'one-to-many' shared

1) In addition, SaaS technology maturity is being explained as the '3-stage progress of ASP' (Hope, 2001) and a 'software service evolution' by IDC (IDC, 2002). However, the basic idea of '3 evolution stages of SaaS,' such as the 'early ASP stage,' 'ASP with web-native application stage,' and 'web-service based ASP' generates almost similar opinions among researchers, and it is used generally as the SaaS industry classification criteria in the U.S. (SIIA, 2004), Korea (NIA, 2008), etc.

application environments. The third and last stage refers to the web service stage. In this stage, SaaS is actually used in business core processes. It provides the on-demand-based functionalities, which can be applied to more detailed business processes (Hagel, 2002). Comprised of self-descriptions with web-based application components, web service (on-demand) applications make it possible for SaaS providers to create the rapidly growing market, unlike with previous-stage SaaS technologies (IDC, 2004; SIIA, 2004). Compared to previous stages, SaaS systematically resolved technical problems that were deteriorating efficient multi-user support indispensable for economies of scale, and it reached the actual commercialization stage, thereby differing from the earlier technology (David, 2006; Norton, 2006). The web-service (on-demand) application has a multi-tenant business model in which application components are distributed individually or in combination with support-specific work functions, and it adopted an on-demand and software-oriented architecture (SOA) as its technical format. In fact, SaaS is not fully diffused in the entire business processes of corporations until SaaS technology reaches the web-service stage (Hagel, 2002).

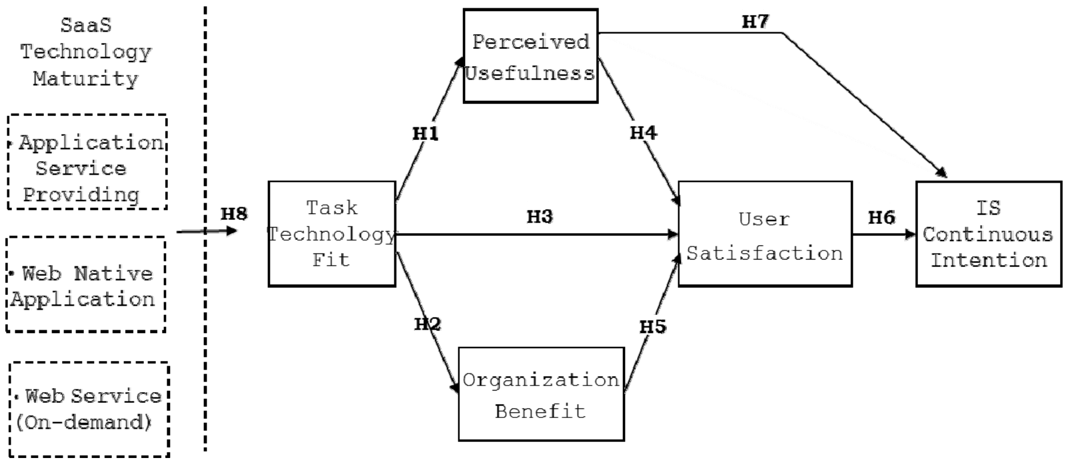
The high SaaS functional capability allows SaaS users to have a positive effect on perceived provider performance (Susarla, 2003). Tao (2001) described 'SaaS functionality' as 'the increasing levels of granularity,' supporting detailed business processes presented by outsourcing providers. With reference to technological maturity, Karimi (2004) asserted that IT assets, such as e-commerce technologies and applications, grow and mature, and the boundary between their growth and maturity phases is quite clear (Kishore et al., 2004). Likewise, SaaS technology will reach a matured level. Currently, failures in implementing a successful SaaS business model were attributed to the fact that many SaaS companies marketing themselves as full SaaS vendors are, in fact, SaaS 'pretenders' (Soliman et al., 2003). However, in the matured stage, SaaS will provide the on-demand (web-service)-based comprehensive application and integration platform pre-populated with clients' business applications or business services. In addition, it will include tenant-specific and end user-specific business applications on various levels to attract various types of end users, including large enterprise customers (RIED, 2008).

2.3 Complementarities of the Task-Technology Fit and the IS Continuance Model

Goodhue et al. (1995) concluded that TTF is the most important matter in enhancing task performance. Compared to utilization-centered research (Davis, 1989; Doll and Torkzadeh, 1988), Goodhue's research's significance is in its sense of having clarified that TTF helps an individual to be able to make optimal decisions, and explanatory power over performance was better supported consequently (Goodhue, 1995; Goodhue and Thompson, 1995; Goodhue, 1998). To grasp more correctly the performance resulting from SaaS technology maturity, this study will minutely explain the influence of both the task characteristic in the SaaS-introducing organization and its fit with SaaS technology depending on performance after SaaS adoption. In the meantime, as another alternative for a utilization-centered IS performance measurement, Bhattacherjee (2001) suggested the IS continuance theory; he asserted that while the utilization is the first step in measuring IS success, continuance usage is the core criteria of measuring success in ISs (Bhattacherjee, 2001). SaaS is a business model based on 'pay-per-use' or a total usage measurement. In addition, SaaS is a price model updating periodically after a given duration of a subscription (Bussler, 2002; Desisto, 2007). The 'pay-per-use'-based SaaS price model produces the effect of rental fee curtailment (Greschler and Mangan, 2002b; Jainschigg, 2008).

This paves the way for firms to change SaaS solution vendors or return to on-premise-based in-house development. Accordingly, SaaS continuance usage intention should be included in the SaaS performance measurement model regarding whether customers extend subscriptions in what sort of business and technological occasion. Previous research studies have established the applicability of both the TTF and IS continuance theories to innovative IT, such as web-based IS (Bhattacherjee, 2001; Jarupathirun and Zahedi, 2007a; Larsen et al., 2009; Lee et al., 2007; Lin and Huang, 2008). These two theories are complementary to each other; especially, TTF has the extensive capability to explain IS continuance in that TTF and outcome variables (e.g., user satisfaction, perceived usefulness, and organization benefit) function as predictors of IS continuance intention (ICI). Considering this matter, through the conjunction of two models, we can measure diverse performances (e.g., user satisfaction, perceived usefulness, and organization benefit), which are shown through organizational task and SaaS technology fit. This performance－not as a final outcome variable, but as a mediating variable－enables the measurement of IS continuous usage, which is considered the final performance variable (Bhattacherjee, 2001) in IS theory, as well as the ultimate SaaS utilization target performance.

The research model reflected the existing IS theories in this study in <Figure 1>. This study selected task and individual characteristics, which appear in the SaaS adoption process, as the factors influencing the user evaluation of TTF. Alternatively, the outcome variables in the user evaluation of TTF, such as perceived usefulness, user satisfaction, and organization benefit, were selected as mediating variables. This study categorizes performance factors into individual performance and organizational performance. SMEs, as SaaS main target users, may lack human or financial resources; thus, employees in SMEs play roles as both 'SaaS end users' and 'SaaS service providers'



<Figure 1> Research Model

at the same time (Palvia, 1996; Palvia and Palvia, 1999). Due to a relatively small company size, users in SMEs are expected to grasp and respond appropriately to the degree of SaaS contributions to organizational performance, as well as to individual perceived usefulness. Thus, it is appropriate to measure both individual perceived usefulness and organizational performance simultaneously in this study. In previous SaaS studies, organizational performance and individual perceived usefulness (performance) were simultaneously measured (Kim, 2007; Kim, 2006), as with the publication of DeLone and McLean's IS success model (DeLone and McLean, 1992). Then, ICI was selected as the final dependence variable. In addition, technology maturity in SaaS-based IS was selected as a moderating variable, which influences the entire research model according to the maturity stage, to empirically analyze the influence of technology maturity on IS performance enhancement. As the exogenous environmental technical factor, technology maturity also has a direct effect on performance from SaaS adoption. However, depending on the maturity level, the performance from organizational and systemic perspectives may be variable. Thus, this study aims to research empirically SaaS technology maturity by utilizing it as a moderator.

Ⅲ. Research Hypothesis

It is asserted and validated that the user evaluation of TTF has effects on system use, perceived usefulness, or the relative advantages (Goodhue and Thompson, 1995; Jarupathirun and Zahedi, 2007b). Meantime, Larsen (2009) suggested that the more a technology meets specific job task characteristics, the higher the probability the technology will contribute to an improved job performance (Larsen et al., 2009). User evaluations of TTF could be statistically linked to perceived performance (Goodhue, 1995; Goodhue, 1998; Goodhue and Thompson, 1995; Jarupathirun and Zahedi, 2007b). TTF could measure both group performance and personal performance (Goodhue et al., 2000). Bhattacherjee (2001) suggested that it affects user satisfaction and perceptions of the technology's capabilities and expectations regarding the outcome when using the technology (Bhattacherjee, 2001). In addition, it is suggested that user evaluations of TTF are predictors of satisfaction, by following literatures (Jarupathirun and Zahedi, 2007a; Jarupathirun and Zahedi, 2007b). Hence, it is reasonable to expect that user-evaluated TTF influences SaaS satisfaction. All these prior causal relationships were empirically proven in the web-based IS utilization environment, which are applicable in the SaaS area – as the web based software service.

H1: The user evaluations of TTF will positively (+) affect perceived usefulness
H2: The user evaluations of TTF will positively (+) affect organizational benefit
H3: The user evaluations of TTF will positively (+) affect user satisfaction

In the meantime, Seddon (1997) asserted that individual performance has an influence on usage and user satisfaction. In using an IS, both perceived usefulness and individual performance measure the degree of job performance enhancement that an individual recognizes. Rai et al. (2002) also studied both individual performance, as with DeLone and McLean (1992), and perceived usefulness, as with Seddon (1997) (Rai et al., 2002). In addition, the performance and satisfaction in the expectation confirmation theory are set in the natural direction (Seddon, 1997). Accordingly, this model is established so that the perceived usefulness has influence on user satisfaction. In addition, the rationale for the importance of differentiating between technology functionality and task needs is equally strong at the group level, as suggested by DeSanctis and Poole (1994) and Zigurs and Buckland (1998), and this is noted in the organizational contingency literature (Goodhue et al., 2000). With reference to the impact of organizational benefit on user satisfaction, Seddon (1997) asserted that organizational and social benefits, as well as individual performance, have positive effects on user satisfaction. In addition, even DeLone and McLean (1992), who had become the foundation of the IS success model in Seddon (1997), mention that net benefit give and takes mutually affect user satisfaction in their IS success model. As the 'net benefit' they mention includes cost savings, the expended market, incremental additional sales, and reduced search costs, those are concepts similar to organizational benefits in this study. Accordingly, the assertion saying that organization benefits influence user satisfaction is judged as rational. With regards to SaaS, it is investigated that perceived usefulness (PU) and perceived functional capability are associated with satisfaction in ASP, the early model of SaaS (Park et al., 2004; Susaria et al., 2003).

H4: Perceived usefulness will positively (+) affect user satisfaction

H5: Organizational benefit will positively (+) affect user satisfaction

According to Desai (2003), SaaS occurs in low switching cost with low subscription fee (Desai and Currie, 2003). Low switching cost leads the decline of users' loyalty on specific solution, thus lock-in effect is disappeared gradually (Lee and Feick, 2001). These changes pave the way of firms to either change SaaS solution vendor or go back to on-premise based in-house development again. Thus, SaaS continuance is important in that it lets us know whether customers extend subscription in a certain business and technological occasion. Based on this reasoning, this dissertation sets SaaS continuance intention as the final dependent variable representing the entire SaaS performance model. Also, this dissertation regards performances as well as satisfaction to be predictors for SaaS continuance intention. According to Bhattacherjee (2001), user satisfaction and perceived usefulness with prior IS use (Anderson and Sullivan, 1993; Oliver, 1993) determine ICI and IS continuance directly supports this relationship. While synthesizing the aforementioned, this research led to the following hypotheses:

H6: Perceived usefulness will positively (+) affect IS continuance usage

H7: User satisfaction will positively (+) affect IS continuance usage

Technology maturity in this study is recognized as the variable of moderating performances of SaaS adopted firms. In the TTF related existing researches, the technology characteristic is described to have the feature of moderating antecedent of TTF (Goodhue, 1998; Goodhue and Thompson, 1995). According to Gebauer's studies, technology performance on technology maturity is the predictor of the user-evaluated measurement of TTF (Gebauer and Ginsburg, 2009; Gebauer and Ginsburg, 2008; Gebauer et al., 2007). Second, it is asserted that technology maturity and technology performance are important factors that can explain and predict not only satisfaction with technology, but also perceived usefulness and performance impacts (Gebauer and Ginsburg, 2008; Gebauer et al., 2007). It is clear that technology can hinder use and perceived usefulness, even if the user evaluation of TTF influences them (Gebauer et al., 2007). The progress of SaaS technology is presently ongoing, resulting in more facilitation of the SaaS usage conditions, such as higher functionality (Kern et al., 2002a), more improved user interface (UI), etc. (Patnayakuni and Seth, 2001). In addition, as SaaS technology matures, usability improvements are reported, including on-demand-based functionality, such as fast system updates (Anthes, 2008), secure system reliability, and availability (Choudhary, 2007). Furthermore, SaaS in higher technology maturity level are able to improve organizational benefits by providing more customized applications for the customers and reducing the dependence on the customers' IT assets (Patnayakuni and Seth, 2001). Synthetically, if firms use a SaaS application at a higher maturity as an exogenous environmental factor, technology maturity is able to influence the outcome variables, such as fit, satisfaction, and perceived usefulness, and ultimately possibly influences ICI. Based on the above contents, the following hypotheses were established:

H8: SaaS technology will positively (+) moderate the suggested research model.

H8a: The effect of the user evaluation of TTF on perceived usefulness is stronger for those whose SaaS applications are at a higher technological maturity level.

H8b: The effect of the user evaluation of TTF on organizational benefit is stronger for those whose SaaS applications are at a higher technological maturity level.

H8c: The effect of the user evaluation of TTF on user satisfaction is stronger for those whose SaaS applications are at a higher technological maturity level.

H8d: The effect of perceived usefulness on user satisfaction is stronger for those whose SaaS applications are at a higher technological maturity level.

H8e: The effect of organizational benefit on user satisfaction is stronger for those whose SaaS applications are at a higher technological maturity level.

H8f: The effect of user satisfaction on ICI is stronger for those whose SaaS applications are at a higher technological maturity level.

H8g: The effect of perceived usefulness on ICI is stronger for those whose SaaS applications are at a higher technological maturity level.

Ⅳ. Research Method

4.1. Pretest and Main Survey

We performed a field survey to investigate the research questions and test the hypotheses. Direct interviews with SaaS practitioners in three companies were also performed to pre-test the survey instruments with an IS professor. The field survey verified the content validity of the questionnaire and some wording in the interview results were slightly changed to reduce confusion in the survey questions. Thereafter, a pilot survey was conducted using the revised questionnaire items to enhance the validity of the proposed model's measurement items. In total, 45 SaaS users participated in the pilot survey through onsite visit surveys, who were clients of the major SaaS service providers, such as Salesforce.com, Checkpoint.com, Korea Telecom, etc. Conforming to the pretest result, we eliminated two survey items showing low item loading values from TTF and applied it to the main survey (see <Table 3> for detail). After conducting the pretest and pilot test, the final set of questionnaire items to be used in the main survey was confirmed. Respondent firms were sampled from industries that have implemented SaaS comprehensively with one sample per each corporation. Therefore, the unit of analysis is an individual corporation. They were registered in the Commercial-Net Korea (CNK) database, from which 253 companies were selected. Client firm information, which was registered in the CNK database, includes information on SaaS solution names and vendors and the corresponding maturity level they occupy. The government of the Republic of Korea (ROK) and CNK surveyed SaaS solution types according to three maturity stage divisions (ASP, web-native application, and web-service), as well as client firm satisfaction according to the detailed solution type and function. This previous survey enabled us to extract a similar number of samples per each maturity group and survey for our research model. All respondent firms agreed to participate in the survey and were included in the final sample. A structured interview was used as the main data collection method. Participation was first solicited from the contact person over the phone. The respondents were members of IS staff or managers who had been contacted over the phone. We obtained 207 responses from the main survey as eight companies refused to participate. In responses, the number of participants in Group 1, Group 2, and Group 3 was 66, 50, and 91, respectively. The majority of sample organizations have 100 and under employees (75.3%), and the manufacturing, service, retailing, and wholesale industries are most common. Details of sample organization characteristics are shown in <Table 1> and <Table 2>.

<Table 1> Sample Organization Characteristics

Item	Category	Freq.	%	Cumul. %
Number of Employees	up to 50	132	63.8	63.8
	50 up to 100	24	11.6	75.4
	100 up to 200	18	8.7	84.1
	200 up to 500	17	8.2	92.3
	Over 500	16	7.7	100.0
Industry	manufacturing	45	21.7	21.7
	services	42	20.3	42.0
	wholesale and retail trade	30	14.5	56.5
	construction	16	7.7	64.3
	telecommunication	11	5.3	69.6
	transportation	7	3.4	72.9
	information technologies	6	2.9	75.8
	S/W development & distribution	6	2.9	78.7
	Educational service	4	1.9	80.7
	finance & insurance	1	0.5	81.2
	Other services (e.g., car repairer, real estate, entertainment, etc.)	39	18.8	100.0
Duration of Adoption	up to 1 years	63	30.4	30.4
	1 years up to 2 years	32	15.5	45.9
	2 years up to 3 years	35	16.9	62.8
	3 years up to 4 years	30	14.5	77.3
	over 4 years	47	22.7	100.0

<Table 2> Sample Respondent Characteristics

Item	Category	Freq	%	Cumul. %
Gender	Male	122	58.9	58.9
	Female	85	41.1	100.0
Age	Less than 30	41	19.8	19.8
	30 to below 40	120	58.0	77.8
	40 to below 50	44	21.3	99.0
	More than 50	2	1.0	100.0
Education	High school	29	14.0	14.0
	Bachelor's degree	163	78.7	92.8
	Master's degree or higher	15	7.2	100.0

4.2. Measurement Development

A multiple-item method was used to construct the questionnaire. All measures used to operationalize the constructs were adopted from previous studies. The operational definitions of instruments and their related research are summarized in <Table 3>. All items except for user satisfaction (SAT) employed a seven-point Likert-type scale from 'strongly disagree' to 'strongly agree.' User satisfaction was measured by the use of the seven-point semantic differential scales. Among these, indicators of PU, OB, as well as SAT were re-used and measured from prior ASP - which is the earlier version of SaaS – research (Lee et al., 2007).

Of particular mention, first, is that this research re-verified the survey items suggested by Goodhue and Thompson (1995) for measuring SaaS user evaluations of TTF through reviewing existing studies related to SaaS and whether each indicator is appropriate for measuring SaaS technology characteristics. Goodhue (1995) provided eight research variables that enable users to evaluate TTF. However, the corresponding variables from Goodhue were drawn to measure general and overall ISs rather than specific technology for the general applicability of the model (Goodhue and Thompson, 1995). Among these variables, 'timelineness' and 'relationship with users' were excluded because these constructs do not properly match the characteristics of SaaS technology after considering existing studies. Instead, we newly adopt 'cost,' 'assistance,' and 'accessibility,' which were dropped due to the lack of reliability or validity, even though they were originally included as TTF variables by Goodhue (1995) (Goodhue and Thompson, 1995).

Second, this study adopted gender, education, age, and experience as control variables having influence on the dependence variable. The selected control variables are being recognized as having influence on loyalty in existing research studies (Shankar et al., 2003; Yang and Peterson, 2004). In the existing IS research, loyalty is known as being composed largely of two indicators: 'continuance intention' and 'recommendation.' Accordingly, there is a necessity to examine the appearance function of these control variables as an additional factor affecting ICI, which is the final dependence variable in this study.

4.3. Analysis Method

PLS-Graph 3.0 was employed to analyze the data. Unlike other covariance-based structural equation modeling techniques, PLS does not have equal distribution assumptions while performing simultaneous assessments of both the measurement model and structural model, and it can analyze path coefficients by comparing different groups (Chin, 2000). In this study, that carries out a path difference analysis of three groups based on maturity of SaaS applications, all constructs are what is reflective and the maximum path numbers pointing to the specific construct are at most three pieces of the ICI. Thus, the sample numbers per group are enough for only 30 pieces in our study. However, even the sub-group

<Table 3> Conceptual Construct Definitions, Items and Sources

Measures	Remarks
(TTF)[3] Use Evaluation of TTF: The degree to which a technology assists an individual in performing his/her portfolio of tasks (TTF1) Sufficiently detailed data is maintained by the SaaS (TTF2) SaaS is locatable (TTF3) SaaS is helpful (TTF4) The exact data I want is either obvious or easy to find in SaaS applications (TTF5) SaaS is reliable and updated frequently (TTF6) SaaS is convenient and easy to use (TTF7) SaaS is available at a moderate cost (TTF8) Obtaining or distributing authorization for SaaS utilization is easy (TTF9) I can get access to SaaS whenever I want	Anthes 2008; Desai et al., 2003; Goodhue, 1998; Goodhue and Thompson, 1995; Goodhue et al., 2000; Kern et al., 2002a
(PU) Perceived Usefulness: The degree of believing task performance is enhanced by using a specific system (PU1) Using SaaS increases my productivity (PU2) SaaS is useful in my job (PU3) Using SaaS increases job-related effectiveness	Davis, 1989; Klopping and McKinney, 2004; Rai et al., 2002
(SAT) User Satisfaction: Users' feelings prior to SaaS application use (SAT1) Very dissatisfied/Very satisfied (SAT2) Very displeased/Very pleased (SAT3) Very frustrated/Very content	Bhattacherjee, 2001; Spreng et al., 1996
(OB) Organizational Benefit (OB1) Using SaaS, my company reduced costs related to IS development or purchases (OB2) Using SaaS, my company reduced IS-related costs (OB3) My company gained overall cost reductions using SaaS	DeLone and McLean, 1992; Liao et al., 2007; Minbaeva et al., 2003
(ICI) IS Continuance Intention: Users' intentions to continue using SaaS (ICI1) I intend to continue using SaaS rather than discontinue using it (ICI2) I prefer using SaaS to the previous system (ICI3) If I could, I would like to discontinue my use of SaaS	Bhattacherjee, 2001; Thong et al., 2006
(OA)* Outdoor Activity (OA1) I prefer being outside to staying at home (OA2) I prefer going outside during my free time	

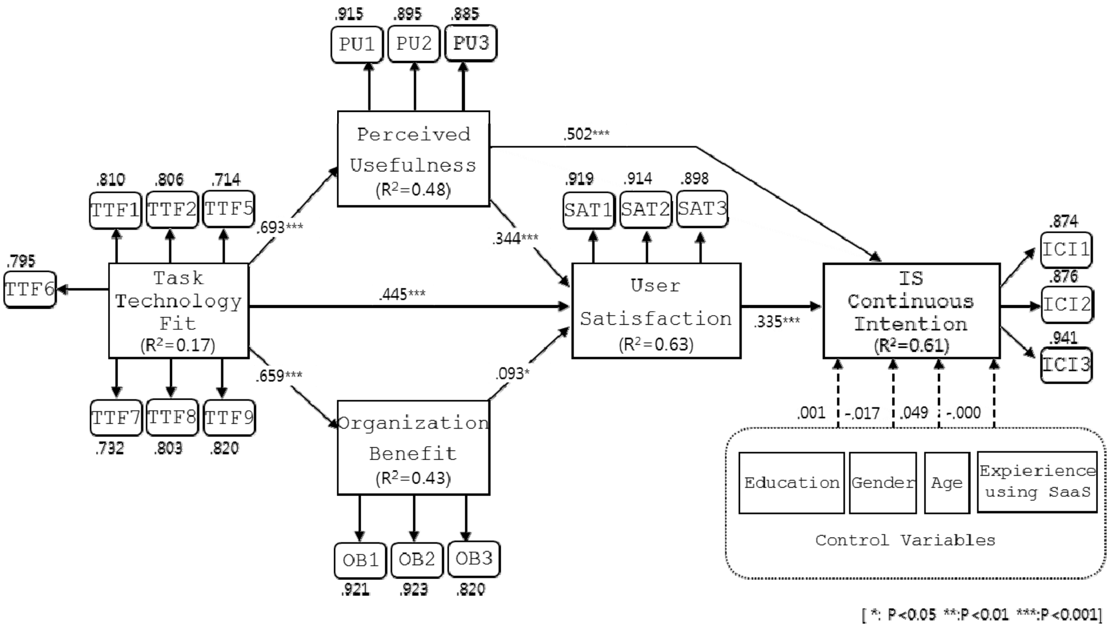
Note: * Marker Variable
[1] Dropped in the pre-test, [2] Reverse coded, [3] Reference for TTF variable from existing IS journals

with the lowest sample number in this study has a sample greater in size than this, with 50 people. In considering these, PLS is appropriate as the analyzing tool in this study (Chin, 1998).

Ⅴ. Results

5.1. Scale Validation

Reliability and construct validity were tested for scale validation. Each construct was examined by the recommended threshold values for reliability, and each value was above the recommend thresholds (see <Table 4> and <Figure 2>), providing support for the reliability of the instrument. Multiple measurement indicators within a construct must be highly correlated (convergent validity) and different constructs measured by the same method have low correlation (discriminant validity) to determine whether the constructs have validity. Convergent validity is evaluated by factor loading, composite reliability (CR), and average variance extracted (AVE). Convergent validity is established if individual factor loadings and CR are greater than 0.7 and if AVE exceeds 0.5 (Gefen et al., 2000). <Table 4> and <Figure 2> present the factor loading values of individual measurement items and the CR and AVE of each construct. All factor loadings and CR values are greater than 0.7 and all AVE values exceed 0.5. Thus, the measurement scales exhibit convergent validity. The square root of AVE can be used to determine discriminate validity, which is exhibited if the square root of AVE is greater than the off-diagonal elements of a correlation matrix (Fornell and Larcker, 1981). Discriminant validity is also determined through an examination of a cross-loading table, which must indicate that the measurement items load highly on



<Figure 2> PLS Analysis Results

their theoretically assigned factors and not highly on other factors (Gefen and Ridings, 2003). The cross-loading values in <Table 5> shows that the loadings of individual items on assigned constructs are higher than with other constructs. However, the loading values on other constructs also show relatively high values.

Furthermore, the indicators of user satisfaction (SAT) also show similarly high loading values. The relatively high loading values occur because the confirmatory factor analysis based on PLS, which was adopted in this study, may provide a higher loading value than other methods (Gefen et al., 2000; Gefen and Straub, 2005). Therefore, adopting a PLS-based analysis is recommended to set a cross-loading cut-off value that is relatively higher than other methods (Gefen and Straub, 2005). Finally, this study set “outdoor activity” as a marker variable to identify any common method bias during the data collection stage. After data collection, we found there were low correlations between the marker variable and other variables (minimum value was -0.172), of which a subtraction from the correlation between research variables does not affect the significance of the original correlations. This result indicates data collection was not contaminated by a common method variance.

5.2. Hypothesis Testing

<Figure 2> shows the results of the PLS analysis. SaaS users' ICI (ICI) explained 49.7% of the variance from perceived usefulness (PU) and 33.1% of the variance from user satisfaction (SAT). The strongest relationship exists between user evaluations of TTF (TTF) and performance variables (PU, OB, and SAT). The results indicate all hypotheses (H1~H7) are significant and supported at the 0.05 or 0.01 alpha level, except for H5 (OB→SAT), which is supported at the 0.1 alpha level (see <Table 6>). To compare the research model across the three maturity levels, it is modeled as a moderator, which is a multiple-group PLS analysis conducted by comparing differences in coefficients of the corresponding paths for the three sub-groups.

A comparison of the path coefficients was calculated using <Equation 1> (Chin, 1998). From the

<Table 4> Scale Properties and Square Root of the AVE

	α	CR	AVE	TTF	PU	SAT	OB	ICI	OA
TTF	.892	.918	.614	.784					
PU	.880	.926	.807	.693	.898				
SAT	.869	.919	.792	.744	.710	.911			
OB	.896	.936	.830	.659	.626	.601	.890		
ICI	.878	.926	.770	.678	.738	.696	.626	.898	
OA	.773	.898	.815	.001	.106	-.019	.072	.005	.903

Note: α: Cronbach's Alpha, CR: Composite Reliability, AVE: Average Variance Extracted
TTF: Use Evaluation of TTF, PU: Perceived Usefulness, SAT: User Satisfaction, OB: Organization Benefit,
ICI: IS Continuance intention, OA: Outdoor Activity (Marker Variable)

result of the path comparison analysis, a significant difference that translated into a t-value (Chin, 1998) was indicated between the ASP group and the higher maturity groups. The analytical result of the path coefficient differences is shown in <Table 7>. The three path coefficients between 'TTF and PU,' 'TTF and OB,' and 'OB and SAT' were indicated to have a greater influence in the case of corporations adopting higher technological stages of applications (web-native application). Likewise, a comparison of Group 1 (ASP stage) and Group 3 (web-service (on-demand) stage) also showed the same result with more significance. The t-value of the difference in the aforementioned three-path coefficient was over the cut-off value. However, in two higher SaaS technology maturity groups－web-native applications and web-service groups－the differences in all path coefficients were analyzed to be non-significant. The detailed results of the convergent validity and discriminant validity of the three groups are shown in <Appendix>.

<Table 5> Cross Loading for the Measurement Model

	TTF	PU	OB	SAT	ICI	OA
TTF1	.810	.622	.558	.689	.552	-.045
TTF2	.806	.579	.503	.566	.509	-.045
TTF3	.714	.486	.419	.544	.498	-.006
TTF4	.795	.524	.451	.586	.591	-.065
TTF5	.732	.418	.491	.469	.454	-.004
TTF6	.803	.556	.542	.569	.528	.058
TTF7	.820	.586	.621	.630	.576	.095
PU1	.646	.915	.602	.688	.669	.095
PU2	.564	.895	.513	.621	.635	.098
PU3	.654	.885	.569	.603	.683	.093
OB1	.583	.542	.921	.494	.514	.058
OB2	.580	.501	.923	.515	.522	.016
OB3	.589	.618	.820	.586	.623	.114
SAT1	.698	.617	.565	.919	.635	-.031
SAT2	.672	.572	.555	.914	.577	-.029
SAT3	.663	.739	.524	.898	.681	.006
ICI1	.646	.721	.607	.639	.874	.048
ICI2	.516	.570	.443	.553	.941	-.068
ICI3	.607	.633	.580	.628	.876	-.004
OA1	-.053	.066	.037	-.077	-.057	.903
OA2	.054	.125	.094	.043	.048	.903

<Table 6> Hypothesis Testing Result

Hypothesis	Path Coefficient (β) Value							
	Main Model		Group 1		Group 2		Group 3	
H1: TTF→PU	.693***	S	.277***	S	.805***	S	.771***	S
H2: TTF→SAT	.445***	S	.435***	S	.395***	S	.391***	S
H3: TTF→OB	.659***	S	.424***	S	.678***	S	.685***	S
H4: PU→SAT	.344***	S	.397***	S	.395***	S	.347***	S
H5: OB→SAT	.093*	N	-.168	N	.136*	S	.162*	S
H6: SAT→ICI	.335***	S	.276***	S	.359***	S	.296***	S
H7: PU→ICI	.502***	S	.366***	S	.523***	S	.544***	S

Note: *S*: Supported, N: Not Supported
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$
Group1: ASP stage, Group2: Web-native application, Group3: Web-service(on-demand)

<Table 7> Path Comparison Statistics (*t*-value) between Groups

Hypothesis	Path Coefficient Difference (*t*-Value)					
	Group 1-2		Group 1-3		Group 2-3	
H8a: TTF→PU	4.223***	S	3.664***	S	-.485	N
H8b: TTF→SAT	-.238	N	-.202	N	-.019	N
H8c: TTF→OB	2.049**	S	1.849**	S	.072	N
H8d: PU→SAT	-.014	N	-.267	N	-.26	N
H8e: OB→SAT	1.523*	S	1.39*	S	.137	N
H8f: SAT→ICI	.765	N	.098	N	-.649	N
H8g: PU→ICI	.642	N	.881	S	.382	N

Note: *S*: Supported, *N*: Not Supported
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

<Equation 1> *T*-test for Multi-Group PLS Analysis (Chin, 1998)

$$t = \frac{Path_{sample\_1} - Path_{sample\_2}}{\left[\sqrt{\frac{(m-1)^2}{(m+n-2)} * S.E.^2_{sample1} + \frac{(n-1)^2}{(m+n-2)} * S.E.^2_{sample2}}\right] * \left[\sqrt{\frac{1}{m} + \frac{1}{n}}\right]}$$

Note: *pi*: i-th path coefficient, ni: i-th sample size
SE i: i-th standard error for path coefficient

Ⅵ. Discussion

In this research, we described the relationship among TTF, performances, and IS continuance usage variables with technology maturity for SaaS-adopted work-site corporations. Out of two research objectives aimed to be achieved through this study, the first was how the existing IS theories are applied to measuring performance in SaaS and which result is shown. Relying on theories of TTF and perceived IS continuance, as well as additional psychology and IS research theories, we identified that antecedents of TTF influence user evaluations of TTF and this is transferred to ICI through the outcome variable.

According to the results of our data analysis, the better the user evaluation of TTF, the higher perceived usefulness (PU), organizational benefit (OB), and user satisfaction (SAT) were. In addition, the performance variables in the user evaluation of TTF positively affect the continued use of SaaS. In other words, all paths from the user evaluation of TTF to ICI showed results at a significance level of 95%. Only the path from organizational benefit (OB) to user satisfaction (SAT) was significant at a significance level of 90%. This proves contrary to what is said about users not being relatively satisfied with the group performance offered by SaaS. This path coefficient is expected to be increased according to the maturity of future SaaS technology.

The second research objective was to determine what influences are received upon user evaluation of TTF, performance, and ICI according to the SaaS maturity development change (ASP→web-native application→web service). The result of our data suggests that an important role is played by SaaS technology maturity to moderate the influence of user evaluations of TTF based on performance variables, such as perceived usefulness (PU) and organizational benefit (OB). However, there was a difference in influential power. In the case of Group 2, rather than the influence of the task characteristic, perceived usefulness (PU) and organizational benefit (OB) were led by the high user evaluation of TTF (TTF) regarding the aspect of a familiar web environment. However, in the case of Group 3 (web-service: on-demand), inversely, the influence of self-efficacy on user evaluations of TTF was not significant (significant: on-demand). In addition, its difference was not statistically significant. However, the fit of task characteristics in firms using SaaS in Group 3, which was enhanced more than Group 2, was indicated to have influence on user evaluations of TTF (TTF) and its outcome variables. In addition, Group 2 (web-native) and Group 3 (web-service: on-demand) showed that organizational benefit (OB) influences user satisfaction (SAT) along with perceived usefulness (PU) and user evaluations of TTF (TTF). The path from the user evaluation of TTF (TTF) and perceived usefulness to user satisfaction did not indicate a big difference depending on maturity. According to our result, the influence on SaaS continuance intention did not show a statistically significant difference for each path among the three groups. However, Group 1 (ASP method) showed that user satisfaction (SAT) mainly influenced continuance intention. On the other hand, in Groups 2 and 3, the influence of perceived usefulness (PU) on ICI (ICI) increased, as well as the influence of user satisfaction (SAT).

Our findings have practical implications for SaaS adoption decision making. We found significant evidence that the linkage among TTF, performances, and the resulting ICI are tempered by the role of technology maturity. However, this difference was shown in comparisons mainly of the 'ASP stage' and other groups ('web-native' or 'web-service (on-demand)'). No difference was shown between

Groups 2 and 3. No big difference between Group 2 and Group 3 disproves the argument that users fail to recognize the merits of SaaS. This is because, first, the real situation is that vendors that described themselves as SaaS providers turned out to be selling an old-style hosted app (Jainschigg, 2008). Moreover, even in web-service (on-demand) applications corresponding to a high level of SaaS technology, the system reliability and system compatibility, emphasized as peculiar features of SaaS, are being doubted. This could be because of a drop in speed according to bandwagon limitation availability problems (Greschler and Mangan, 2002a; Kern et al., 2002a) and integration problems between the existing legacy system and SaaS (Bussler, 2002; Hoffman, 2006). As the maturity in SaaS technology is improved hereafter, those characteristics will be fully incorporated and the influence of TTF on performance will grow in the real web-service (on-demand) stage. Second, even in the ASP stage, which is the earliest phase, a fact found in this research should not be trivial, such as saying of having been significant in the paths of variables (perceived usefulness, user satisfaction, and ICI), which indicate individual performance depending on the SaaS TTF. This result can be taken from the application characteristics in the ASP stage and the organizational characteristics of using applications in this stage. As for organizations using the ASP method in this survey, relatively small-scale organizations were surveyed. The average employee size per corporation in the ASP stage is 53.34, while those of web-native applications and web services are 450.6 and 215.7, respectively. The difference among the groups was statistically supported by the Kruskal–Wallis analysis result (p = 0.002). ASP was adopted by target SMEs starting in the early 2000s because of its merits, such as low set-up and maintenance costs (Lee and Kim, 2007). It is supplied mainly centering on personal-use applications (Patnayakuni and Seth, 2001), thereby showing it continues to support the tasks of SMEs. According to the results of this study, the greater the rise in technology maturity of SaaS, the greater the rise in performance. However, the latest technology does not need to be used, depending on the task characteristics and the scale in the organization. Even the use of the previous technology may suggest a satisfactory outcome. It is important that managers who consider implementing emerging technologies in the workplace are sure to meet a certain degree of technology maturity according to their task characteristics and past web-based IS experiences, while managers need to be mindful of the fact that maturity could be variable.

Ⅶ. Conclusion

The important contribution of our study is to complement previous research studies that have applied the TTF and IS continuance models to web-based technologies (Jarupathirun and Zahedi, 2007a; Lee et al., 2007; Lin and Huang, 2008). Traditional studies on TTF and the related technology-to-performance chain have suggested the causal effect among fit, perceived usefulness, and user performance. In our study, however, those influences appear to be limited to some extent if the technology is not yet sufficiently evolved. We suggest that our finding is important because research questions regarding IS use and performance have been asked regarding technologies that are novel or may not be fully mature at the time of implementation. As technology progresses, user perceptions of the better system (system performance) appear to be variable and progressing. Thus, our results indicate the technology maturity concept needs to be included in the analysis of IT adoption and user expectations about system performance. On the other hand, our study contributes to recent research studies on SaaS technology. To explain and predict the success of SaaS as an IT outsourcing technology, we showed the applicability of previously established theories and approaches. Especially, as emphasized already in our paper, our results indicate the need to take into explicit consideration the SaaS technology idiosyncrasies; we included the user evaluation of TTF indicators representing SaaS idiosyncratic characteristics with academic and technological references.

Limitations of our study need to be acknowledged to indicate opportunities for future research. First, the statistically non-significant path coefficients are different between Group 2 (web-native application) and Group 3 (web-service), which may confound some of our findings. The limitations notwithstanding, the supported results (between 'Groups 1 and 2' and 'Groups 1 and 3') appeared to be statistically robust and well supported the existing theories. We are hopeful that future research studies will not only provide additional support for the findings reported in the current paper, but will also provide a reasonable explanation for the path difference hypothesis between Group 2 and Group 3. Some hypotheses regarding moderating effects (e.g., H8d ~ H8g) are needed to deeper investigations focusing on well supported results in the future study after gathering more sample. This may be done after enough time has passed, when SaaS technology reaches a high enough maturity level that we were unable to statistically support in this study. In addition, this study has the same limitations as most empirical research studies that question how realistic the experimental settings are, in that we focused only on perceptual constructs, such as the user evaluation of TTF, satisfaction, and individual and organizational performances, without including objective measures. However, a further extension of the model should include the objective measures of performance for a comparison with perceived performance. Then, the future model would be interesting and helpful to SaaS providers and researchers because it would allow them to determine how SaaS users perceive how performance and actual performance match and to explore factors that may cause perceived performance to deviate from objective performance. On the one hand, as further referring to performance variables, future studies must observe performance variables through longitudinal studies, because organizational IS continuance in use may be increased or decreased. If a longitudinal study in its complete form is actually difficult, it may be fully meaningful for a future study to verify each performance variable in each time interval. Finally, from the analysis point of view, a sense of frustration can be indicated regarding which sample size was small. This is because of the inability to balance the sample number of each group in a situation of having been relatively small in the number of companies that used ASP solutions in the early stage due to the recent expansion in web-based solutions. If a large number of samples is secured, a more stable analysis is expected to be performed of each group.

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<Appendix> Convergent and Discriminant Validity Test Result

Gr	Con	α	CR	AVE	TTF	PU	OB	SAT	ICI
1	TTF	.875	.869	.488	(.699)				
	PU	.908	.927	808	.277	(.899)			
	OB	.871	.847	.650	.474	.457	(.806)		
	SAT	.887	.831	.621	.424	.364	.161	(.788)	
	ICI	.819	.860	.674	.407	.501	.489	.433	(.821)
2	TTF	.875	.931	.660	(.812)				
	PU	.908	.947	.857	.805	(.926)			
	OB	.871	.919	.792	.805	.811	(.928)		
	SAT	.887	.949	.861	.678	.722	.689	(.890)	
	ICI	.819	.931	.819	.743	.809	.797	.741	(.905)
3	TTF	.875	.917	.614	(.784)				
	PU	.908	.908	.768	.771	(.876)			
	OB	.871	.922	.799	.769	.753	(.894)		
	SAT	.887	.949	.861	.685	.649	.655	(.928)	
	ICI	.819	.906	.762	.704	.774	.715	.596	(.873)

Note: α: Cronbach's Alpha, CR: Composite Reliability, AVE: Average Variance Extracted
Group 1: ASP stage, Group 2: Web-native application, Group 3: Web-service(on-demand)

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