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Customer Satisfaction from Open Source Software Services in the Presence of Commercially Licensed Software

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A B S T R A C T

The limited literature on Open Source Software (OSS) customers' adoption does not provide explanations on how OSS services are adopted by customers in the presence of functionally superior commercially licensed software (CLS). This paper aims to uncover the process that shapes customer satisfaction of OSS services in comparison to CLS. Expectation Disconfirmation Theory (EDT) is adapted and integrated with pre implementation factor model that influences software customers' expectations including cost, reputation, and experience. The constructed research model is empirically validated using a field survey of OSS and CLS database management system (DBMS) customers in Korea. The theoretical contribution of the paper lies on the application of EDT to explain the wide adoption of OSS DBMS services in the presence of functionally superior CLS DBMSs. Furthermore, this paper integrates EDT with pre-implementation factors for customers' expectations, which has been considered a limitation of the theory. Among the practical contributions, this study draws attention to the substantive differences between OSS and CLS customers' expectations. Additionally, it offers initial explanations for the differences in customer behavior for OSS and CLS and the way that customers' expectations and actual performance are mingled together to form customer satisfaction.

Keywords: Expectancy Disconfirmation, Performance, Satisfaction, Open Source/Commercial Software, Database Management System

Ⅰ. Introduction

Open source software (OSS), such as open MySQL (http://www.mysql.com, a database system), Linux (http://www.linux.com, an operating system), and GlassFish (http://glssfish.jave.net, an application

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server platform), has been widely accepted by organizations (Kim, 2013). This trend is confirmed by Gartner's survey (2011) results indicating that more than half of organizations surveyed have adopted OSS solutions as part of their IT strategy. It is worth noting that software business has recently changed dramatically moving from product-oriented to service-oriented; a transformation which OSS had accelerated (Howison and Crowston, 2014; Choi et al., 2013; Midha and Palvia, 2012; Cusumano, 2008; Fitzgerald, 2006). Small service-centric software companies are making revenues by providing training, maintenance, and consultancy services to organizations that adopted OSS services. Traditional product sales and license fees have declined and product company revenues have shifted to services, such as annual maintenance payments. According to this trend, efforts have been thrown to examine the quality of OSS services by the stakeholders' perspective and explain why and how this new type of service is widely accepted by them. Technology Acceptance Model (TAM) (Davis, 1989; Gwebu and Wang, 2010a; Gwebu and Wang, 2010b) and the IS success model (DeLone and McLean, 1992) have been most frequently employed (Lee et al., 2009; Gallego et al., 2008) for this purpose.

While such studies contributed to understanding how and why IS stakeholders accept or continue using OSS services, we do not fully understand how such new type of services builds user satisfaction in the existence of the competition with commercially licensed software (CLS). This becomes even more intriguing if we consider the extreme reliance of businesses to information technology in order to deliver their services, satisfy their customers and accomplish their business goals. This is the reason why this study examines OSS not from a pure technology-centred perspective, but instead by focusing on OSS customers' satisfaction, expectations from the software and related IT services and the reasons behind adopting OSS instead of the superior CLS.

Competition dynamics between OSS and CLS have been one of the three research areas in OSS for last decade (Wasserman, 2013; Von Krogh and von Hippel, 2006). Studies in this area revealed how OSS can penetrate into the market in which CLS have large customer base with network externalities. Such studies are based on innovation diffusion literature (Rogers, 1995) in which OSS is considered as a new technology and OSS advocates play a critical role in the diffusion of OSS in the presence of large user base of CLS (Bonaccorisi and Rossi, 2003). Bitzer (2004) argues that product heterogeneity leads different behaviour (support OSS development or refuse it) of CLS providers in the existence of price pressure from OSS. However, the extant studies on competitive dynamics consider that an OSS has the similar (or even better) functionality with a CLS. The theoretical framework of innovation diffusion is mainly used to explain how innovative technology (which has higher performance) can be adopted in a market in which incumbent technology has built large user base. Economic analysis on how CLS can compete with OSS that has zero R&D cost do not incorporate the inferior functionality of OSS. The literature still do not fully understand how functionally inferior OSS satisfy customers in the existence of functionally superior CLS. While it is widely understood that customers have choice of lower cost of OSS and superior functionality of CLS, how each type of software and related IT services build customer satisfaction differently so that two types of software co-exist is yet to be revealed.

Expectation disconfirmation theory (Oliver and Desabo, 1988), EDT, is one of the theoretical frameworks that can be used to explain the myth. EDT suggests that consumers form judgment about services based on their prior expectations about the characteristics or benefits offered by a given service. It can explain the adoption of OSS in relation to CLS, as their customers may expect inferior functionality and maintenance support compared with CLS, and this lower expectation may have a role in the competitive position of OSS in the software market compared to CLS. Among the potential OSSs, Data Base Management Systems (DBMSs) are selected as target software to apply and validate the research model because open source DBMSs, such as Firebird, Ingres, LucidDB, PostgreSQL, MySQL etc., are gaining a significant market share in competition with CLS DBMSs. In particular, following research questions are addressed in this study.

RQ1: What are the factors that build user expectation for database management systems?
RQ2: How different level of user expectation for OSS and CLS DBMS affects the shaping of user satisfaction from the DBMSs?

Understanding the satisfaction from OSS and CLS DBMSs has theoretical and practical implications regarding software services, the relationship and interactions of software market with its business and individual customers. Regarding theoretical underpinnings, it will extend our understanding on how OSS can compete with CLS despite of its inferior functionality and after IT services. It also will provide an insight in understanding how the recipients of the IT-services differently build expectation for OSS and CLS. For managers, this study will provide them with insight on how to promote their OSS and CLS to build appropriate level of expectation for the maximized satisfaction of their future consumers.

This paper is organized as follows. The next section briefly reviews open source software history and market trends as well as relevant theories with regard to customer satisfaction of service, service and information systems (ISs). Then, a research model to explain the process of customer satisfaction via expectancy disconfirmation is proposed in relation with relevant theories. The model is tested through a questionnaire survey, and after that a discussion section follows to clarify the implications of the findings. Finally, the conclusion section summarizes this paper.

Ⅱ. Conceptual Background

2.1. Open Source Software

OSS has originated from free software that is defined by Free Software Foundation (FSF, http://www.fsf.org) as “software that gives you the use of the freedom to share, study and modify it. We call this free software because the user is free.” One of the representative examples of free software is Linux which has been invented by Linus Benedict Torvalds at University of Helsinki. However, the strict terms and conditions on the use of free software, lack of participation of software companies due to the difficulty of commercialization, and the wrong message on the term “free” led Eric S. Raymond to propose “open source software” in 1997. Open Source Software is an IT service defined by a set of features that are not limited only in the free access of the source code, as derived by the widely accepted definition provided by Open Source Initiative. Therefore this paper uses the term DBMS and DBMS service interchangeably meaning the same concept. These features also include a) free redistribution of the software allowance, b) a requirement that source code will be distributed with the software or otherwise will be made available for no more than the cost of distribution, c) permission to anyone to modify the software or derive other software from it, and to redistribute the modified software under the same license terms, and d) license production that is technologically-free, product-specific free and that does not exclude other software.

According to Gartner, the OSS DBMSs are extending their market share from 200 million US $ in 2007 to 270 million US $ in 2008 (35% increase). This is also confirmed by the study of International Data Corporation (Little and Stergiades, 2009), stating that the market for OSS will grow at an annual rate of 22.4% to reach $8.1 billion by 2013. In particular, rapidly growing numbers of web applications based on, so called, LAMP (LINUX, APACHE, MYSQL, PHP) helped OSS DBMSs increase their share in the web applications market and they are starting to compete with CLS DBMSs in enterprise DBMS market. The examples of such movement include PostgreSQL based EnterpriseDB which is compatible with Oracle, MySQL's cluster functionality support, and revealing sources of CA (Computer Association)'s Ingres DB.

2.2. User Acceptance and Satisfaction from OSS Services

Limited studies in IS literature explore OSS service acceptance, which can be divided into two main categories according to the stakeholders of OSS in consideration. Firstly, studies that are concerned with the factors that influence users' OSS acceptance and satisfaction. Secondly, studies on OSS projects mostly concerned with the motivators of developers who participate to OSS projects.

Belonging in the first category of studies, Lee et al. (2009) developed an OSS success model under the scope of identifying determinants of OSS stakeholders' satisfaction and their interrelations. Their study is conducted on the grounds of the IS success model developed by DeLone and McLean (1992). Using an adopted IS success model the researchers examine software quality and community service quality as determinants of user satisfaction and OSS use, which in turn, determine individual net benefits. Summarizing the findings of their study, OSS user satisfaction is found to be strongly determined by software quality and community service quality. In their turn, software quality and user satisfaction significantly influence OSS use. Finally, OSS use and user satisfaction when combined together influence individual net benefits. Among the outstanding results of their study is that they found no evidence that community service quality has significant effect on OSS use.

With a similar research objective to explain the rapid OSS adoption, Gallego et al. (2008) adopt TAM from a user perspective in order to identify the factors that determine individual attitude towards OSS adoption. Except from the traditional factors that have been found to affect IS acceptance (such as ease of use), Gallego et al. (2008) extend TAM with four variables that are assumed to affect OSS acceptance; namely software quality, system capability, social influence and software flexibility. All variables were found to affect OSS user acceptance, except social influence. Gwebu and Wang (2010a) extend the research of Gallego et al. (2008) by integrating TAM with social identity theory, based on the unique characteristics of OSS with regard to community building, sense of belonging, sharing of ideologies and practices. Social identification refers to the person's conception to identify him/herself as a member of a society or group. Their findings confirm the significant influence of perceived innovativeness using IT and social identification to OSS users' acceptance. Gwebu and Wang (2010b) propose that different stakeholder groups have different perceptions of, and satisfaction from, OSS. They segment stakeholders into four groups, based on the dimensions of belonging to OSS community or not and being a software developer or not. Also using the notions of TAM, they find evidence that the different groups indeed have variant perceptions that affect OSS adoption, which mainly refer to OSS compatibility with software philosophy and OSS compatibility with prior experience.

In the second category of studies, Wu et al. (2007) drawing upon expectancy-value theory examine the factors that influence OSS developers' intentions to continue their involvement in OSS projects. They identify as motivators that affect OSS satisfaction and intention to continue involvement in open source projects, the following: motivation on helping, financial incentives, motivation on career advancement and motivation on satisfying personal needs. Their empirical study confirmed all variables as motivators for OSS satisfactions and hence intention to continue involvement in OSS projects. In Krishnamurthy et al. (2014)'s recent study, they try to address a central challenge to the sustainability of OSS developers' acceptance of monetary rewards. They adopted the private-collective innovation models to clearly map the web of relationships between causal antecedents, and developers' acceptance behavior. Similarly, Hertel et al. (2003) explored the motivators of OSS developers focusing on Linux kernel development. They confirmed the influence of the following motivators: general and specific identification (a.k.a Linux user or Linux developer), pragmatic motives related to the improvement of one's own software and career advantages, norm-oriented motives related to reactions of relevant others, social and political motives, hedonistic motives such as pure enjoyment of programming, and motivational obstacles related to time losses due to Linux-related activities.

2.3. Expectancy Disconfirmation Theories and IS Services

The expectancy disconfirmation paradigm, which has been one of the most popular approaches for measuring customer satisfaction in marketing has three main antecedents: expectation, disconfirmation, and perceived performance (McKinney et al., 2002). Expectancy disconfirmation is two processes consisting of the formation of expectations and the disconfirmation of those expectations based on the performance comparisons (Oliver, 1980). Oliver (1980) describes four processes by which satisfaction judgements are reached in the expectancy-disconfirmation paradigm. Firstly, buyers form expectations of specific products or services prior to their purchases. Secondly, consumption conveys a perceived quality-level that is influenced by expectations if the difference between actual quality and expectations is perceived as being small. Perceived quality may increase or decrease directly with respect to the degree of expectation. Thirdly, perceived quality may either confirm or disconfirm pre-purchase. Fourth, satisfaction is positively affected by expectations and the perceived-level of disconfirmation. This means expectations provide a baseline or anchor for level of satisfaction.

That is, consumer satisfaction is defined as follows.

$S = f(E, P)$, where S is consumer's perceived satisfaction, E is the expectations from the service before use, and P the perceived performance of the service after use.

Anderson (1973) summarizes the psychological theories with regard to the expectancy discrepancy into four: cognitive dissonance (assimilation), contrast, generalized negativity, and assimilation-contrast. Researchers reporting cognitive dissonance argues that consumers who experience disparity between their initial expectation and actual performance of a service tend to adjust their perception on the service performance to be consistent with the initial expectation. On the other hand, contrast theory posits that the satisfaction of consumers will be low when the actual performance of the service does not meet the initial expectation and high if the actual performance is higher than initial expectation. Generalized negativity theory is similar to contrast theory but the positive gap between initial expectation and actual performance would not lead to positive evaluation but negative evaluation. That is, any mismatch between expectation and performance will lead to negative evaluation on a service. Finally, assimilation-contrast theory argues that there are perception zone which are maintained by consumers for assimilation and contrast. So, if the discrepancy is relatively small and within the zone, then the consumers will assimilate their perception on the actual performance to be close to the initial expectation. On the other hand, if the discrepancy is too big and out of the zone, then contrast effect will emerge.

User expectancy has been one of the major factors for user satisfaction in IS literature since 1990s. However, as shown in Bernadette and Scamell (1993)'s research, the early user satisfaction models were based on cognition dissonance theory that highlights the tendency of users to assimilate the level of their perceived performance to their initial expectation for an IS. In the early 2000s, researchers began to adopt the contrast theory to explain that IS satisfaction is determined by the level of disconfirmation between the expectancy and perceived performance (Au et al., 2002; Bhattacherjee, 2001; Bhattacherjee and Premkumar, 2004; McKinney et al., 2002). Staples et al. (2002) specifically identify three major user expectation categories: system usefulness, ease of use and information quality. Expectancy disconfirmation model has also been used to explain the change of users' belief and attitude after the acceptance of an IS (Bhattacherjee and Premkumar, 2004; Bhattacherjee, 2001).

Au et al. (2002) evaluated user satisfaction from IS whereby 'predictive expectation' is used instead of 'desired expectation' proposed in the original EDT. This paper also takes the expectancy disconfirmation model as the basis of explaining customer satisfaction from OSS. This is based on the assumption that software customers have different expectation for OSS from that on commercial software due to the different license policy. As a result, the paper aims to reveal how the different expectation affects the customer satisfaction process via a disconfirmation model.

Ⅲ. The Research Model for DBMS Service Satisfaction

Based on EDT, this paper presents a research model that explains the major factors that affect customer satisfaction of DBMS stakeholders; a.k.a. developers, administrators, IT and project managers, and IT consultants. EDT provides a good foundation for explaining functionally inferior OSS DBMSs build a similar level of user satisfaction with that from CLS DBMSs due to relatively lower expectation. Pre-implementation factors of DBMS expectation are identified first and then integrated into an expectation disconfirmation model to explain different processes of user satisfaction of the two DBMSs.

3.1. Expectations about DBMS: The Effects of Cost, Experience and Reputation

In this research, we use three factors (cost, experience, and reputation) as pre-implementation factors of expectation. Their impact on the expectation has both strong theoretical background and empirical evidence. A contingency model of the impact of purchase expectations (Voss et al., 1998) provides the rationale of inter-relatedness between cost and performance expectation. Those customers who did not experience the price-performance inconsistency can make an expectation based on the objective price as a quality cue. Impact of experience on the expectation can be derived from customer learning perspective taking place in the market. Initial beliefs and expectations are updated as information is accumulated over time (Johnson et al., 1995). Consumers learn from experiences of product/service usage (Hoch and Deighton, 1989). Such experiences give some information to consumers and contribute to the update of existing beliefs. This relationship implies a nature of changing expectation as consumption experiences are accumulated. There is very little theoretical reason to believe that customers use brand/reputation for product expectation. However, many studies verify the empirical evidence that the brand and reputation create certain expectation in that direction (Oliver, 1980; Selnes, 1993). All of these theoretical background and research evidence can be strong motivation to select the three constructs as pre-implementation factors.

Most researchers that examine IS satisfaction from an EDT perspective draw upon consumer satisfaction literature in order to conceptualise users' expectations (McKinney et al., 2002; Susarla et al., 2003). Users' expectations for an IS can be defined as a set of beliefs held by the targeted users of an IS associated with the eventual performance of the IS and with their performance using it (Bernadette and Scamell, 1993). Venkatesh and Goyal (2010) define IT expectation as a set of pre-exposure beliefs about the IT service. McKinney et al. (2002) summarize three alternative perspectives on conceptualizing IS users'expectations: the 'should' expectations (normative standard), the 'ideal' expectations (optimal performance) and the 'will' expectations (prediction of future performance). Susarla et al. (2003) use the ideal perspective for defining service expectations regarding application service providers. McKinney et al. (2002) adopt the 'will' perspective for examining web-customers satisfaction. In this paper we also adopt the 'will' perspective and we conceptualise expectations as DBMS expectations as beliefs on the DBMS' attributes, performance, and development efficiency at the future.

In this paper we identify three major pre-implementation factors that affect user expectations for DBMSs: reputation, cost and experience.

3.2. Reputation

Reputation, also called word-of-mouth, is considered as one of the frequently used means to collect service information (Bolton and Drew, 1991; Grőnroos, 1990). The relationships among purchase intention, expectations, and reputations attracted attention from relevant literatures. Especially, Bayesian decision theory provides a unified approach to modelling expectations and understanding their influence on purchase choice (Venkatesan et al., 2007). Regarding the relationship between reputation and expectations, Anderson and Mary (1993) indicate that the level of expectation can be affected by the reputation in their research for addressing the antecedents and consequence of customer satisfaction. The variance of expectation can be determined by the reputation of firms. In terms of measurement for reputation, Helm and Klode (2011) suggested both single and multiple measurement models. Reputation has been frequently reported as a major factor for building expectation and selecting a software service (Min, 1992; Chau, 1995; Ruyter et al., 2001). In this paper, reputation is defined as the perception of users on a DBMS created through their online and offline information collection process before they purchase the DBMS. DBMSs' reputation is usually built in independent forums such as Webmasters Forum or DBMS brand communities such as Ingres DBMS Community. At the former visitors and especially developers exchange their experience from various DBMSs and suggest a particular service based on criteria such as scalability, efficiency, capacity or cost. On the latter, visitors and members find responses to developer's questions, become informed for advancements of the branded DBMSs, influence future directions, etc.

3.3. Cost

Cost is one of the most important factors to make decision on a service purchase. It particularly provides a criterion for gauging the level of expected quality of a service. In this paper, cost is defined as all cost incurred from obtaining a DBMS including purchase and maintenance cost. The total cost of ownership for CLS DBMS represents a significant amount that consists of license fee, maintenance fee, programming cost, downtime cost, administrative cost, training and hardware cost. Although exact annual cost figures do not exist, the total cost of ownership of data warehousing can range between $124,000 on average annually for small and medium enterprises to $4 millions for large enterprises. However, the cost of OSS DBMS also remains significant, as switching to an OSS DBMS takes approximately a year and might cost $1 million or more, including application code, triggers, stored procedures, and the requirement to develop new skill sets for staff members.

3.4. Experience

Bitner (1990) asserts that a positive past consumption experience of a service creates a positive reputation and this leads to re-purchase of the service in the future. Clow et al. (1991) also asserts that the perception on a service by the service provider is determined based on its past experience on the service, and the expectancy of service consumers on a service is affected by how the service provider provided the service in the past for a longer term. According to Clow et al. (1991) a durable provision of good quality of service leads to higher consumer expectancy. Anderson and Mary (1993) indicate the personnel experience as one of the impact factors affecting the expectation with empirical evidence and theoretical background(Alba and Hutchinson, 1987; Hoch and Ha, 1986; Klayman and Ha, 1986). As a result, past experience of DBMS is considered as one of the major factors to user expectation for a DBMS. In DBMS context, DBMS customers usually tend to commit to a DBMS as depicted by the fact that the leading providers remain the same for the last five years (a.k.a. Oracle, IBM, Microsoft) according to Gartner press releases and IDC report (2011) from 2005 until today.

Hence we derive following three hypotheses with regard to the pre-implementation factors of user expectation for DBMSs.

H1: Cost of DBMS significantly affects the expectation of DBMS users.
H2: Experience of DBMS significantly affects the expectation of DBMS users.
H3: Reputation of DBMS significantly affects the expectation of DBMS users.

3.5. DBMS Satisfaction

With regard to the relationship between user expectancy and satisfaction, there are two contradicting theories; namely cognitive dissonance theory and expectancy disconfirmation theory. Cognitive dissonance theory (Festinger, 1957) asserts that people have tendency to assimilate their perceived satisfaction with their original expectancy to minimize cognitive dissonance (assimilation phenomenon). Applying this to consumer behaviour, Szajna and Scamell (1993) assert that consumers tend to adjust their service satisfaction to assimilate it with their initial expectation for the service. On the other hand, expectancy disconfirmation theory asserts that the level of customer satisfaction moves against to the customer expectancy (contrast phenomenon). Assuming the same quality of a service, the higher a customer's expectancy is, the lower the customer's satisfaction becomes and vice versa (Oliver, 1980). In IS literature, most of studies on user satisfaction have been based on the assimilation phenomenon while contrast phenomenon has been applied to explain consumer satisfaction. This paper is one of the few studies that takes contrast approach to explain user satisfaction of ISs and defines expectancy disconfirmation as the difference between the expectation for an IS before use it and the actual perceived performance after using the IS. The reason of the choice is that OSS DBMSs are gaining wide acceptance in the software market although their performance is usually lower that the performance of CLS DBMSs; hence the EDT provides a theoretical background to explain this contradictory phenomenon.

Customer satisfaction usually refers to perceived satisfaction rather than actual service performance or quality. In this paper we define DBMS customer satisfaction as the perceived level of satisfaction according to the disconfirmation between expectations for a DBMS before using it and perceived DBMS performance after using it.

3.6. Perceived Performance

As McKinney et al. (2002) mention, perceived performance can be defined as customers' perception of how a service performance fulfils their needs, wants, and desires. Kim et al. (2004) define IS performance as a perception on the actual IS performance after using it. They define IS quality and information quality as the two factors that determine the IS performance. They also argue that IS performance directly affects DBMSs customer satisfaction. This is based on Churchill and Suprenant (1983)'s assertion that service performance directly affects consumer satisfaction. As a result, in this paper we define DBMS performance as users' perception on a DBMS performance, development efficiency, and matching level with experience and the advertised DBMS information which are created after use of the DBMS.

3.7. Disconfirmation

In EDT, the concept of disconfirmation refers to the consumer's subjective judgments resulting from comparing their expectations and their perceptions of performance received (McKinney et al., 2002). Specifically, consumers compare their perceptions about a service's performance after they used it to the pre-established levels of expectations. Disconfirmation occurs when consumer evaluations of service performance are different from their pre-use expectations about the service (Olson and Dover, 1979).

Based on above explanations, this paper derives the following four hypotheses.

H4: Expectation of DBMS negatively affects disconfirmation of the DBMS.

H5: Perceived performance of DBMS positively affects disconfirmation of the DBMS.

H6: Expectation of DBMS positively affects user satisfaction.

H7: Disconfirmation of DBMS positively affects user satisfaction.

3.8. OSS vs CLS DBMS

While above seven hypotheses can explain what are the major factors building expectation for DBMS software and how disconfirmation can lead to consumer satisfaction, they do not explain how functionally inferior OSS DBMSs can compete with superior CLS DBMSs. According to EDT, satisfaction is determined by the level of disconfirmation between the expectancy prior to use of DBMS and the perceived performance after usage. We can infer that the consumers of OSS DBMSs have built relatively lower expectation for the performance of the DBMSs compared with CLS DBMSs due to the much lower price. Therefore the lower expectation for OSS DBMSs can depreciate the relatively higher performance of CLS DBMSs. Therefore we expect that the disconfirmation between the OSS and CLS DBMS customers will not be significant. Finally we hypothesize on the difference between the satisfaction from OSS and CLS DBMS. According to confirmation theorists, the satisfaction is shaped through an additive function of initial expectation and disconfirmation (Helson, 1964; Oliver, 1980).

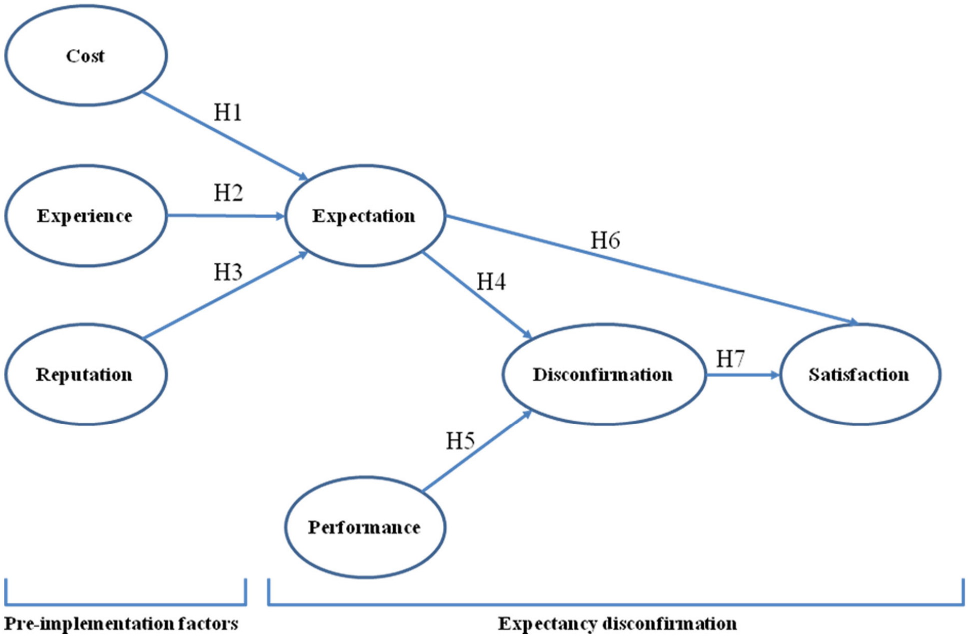
As a result, we can derive the following three hypotheses:

H8: Expectation of a commercial DBMS is higher than that of an OSS DBMS.

H9: Perceived performance of a commercial DBMS is higher than that of an OSS DBMS.

H10: There will be no significant difference on the satisfaction from OSS and CLS DBMS users.

<Figure 1> shows the proposed research model to explain DBMS customer satisfaction. The model consists of inter-linked two sub models: pre-implementation factors model and expectancy disconfirmation model. The first part of the model is concerned with identifying the major factors that affect the customer expectation for DBMSs (H1 ~ H3). The second part of the model is to reveal how the disconfirmation between the expectancy and performance affects the customer satisfaction (H4 ~ H7) (Bhattacherjee, 2001). Some studies (Churchill and Suprenant, 1983; Yi, 1993) include the direct relation of expectation and performance as well as performance and satisfaction based on the empirical evidence, however, this research adopt the very first origination of EDT itself to test the theory in more fundamental manner as Bhattacherjee (2001) did. In addition to these two parts in the model, differences between OSS and commercial DBMS in terms of expectation, performance and satisfaction are hypothesized (H8 ~ H10).



<Figure 1> The Research Model

Ⅳ. METHOD

A questionnaire survey was adopted to test the research model. <Table 1> summarizes measurement items of the constructs in the research model for the questionnaire survey. This paper employs indirect measurement of met expectations. That is, rather than asking the respondents about the degree of expectancy disconfirmation, this paper derives the level of the disconfirmation from their degree of perceived performance and expectancy through below formula.

RES_EX = RES – EX where RES_EX is expectancy disconfirmation, RES is performance measurement and EX is expectancy measurement.

The value range of RES_EX is between -4 and +4, and this value has been transformed into 5 Likert scale value as shown in <Table 2>. The direct measurement of expectancy disconfirmation has been criticized for its methodological error (Venkatesh and Goyal, 2010; Irving and Meyer, 1995). The values correspond to the answers to question “Was the DBMS performance higher than your expectation?” and ‘5’ means the performance is very much higher than expectation (positive disconfirmation) and ‘1’ the performance is very much lower than expectation (negative disconfirmation).

With regard to sampling of respondents, 500 DB administrators, IT managers, project managers, developers and IT consultants who had experience of using commercial and/or open source DBMS from 40 companies in South Korea have been randomly selected for data collection. The questionnaire survey was completed for three weeks during the period19th May and 8th June 2008. 350 questionnaires out of the 500 were collected and 67 incomplete or non-sensible questionnaires were filtered out to make the total sample size 283. Out of this 84 respondents had experience of using open source DBMS and

199 respondents for CLS DBMS. 87% of the respondents were male and most of the respondents were in their thirties (68%) and twenties (20%). About half of the respondents were working as developers (48%). 70% of the respondents had DBMS experience between 1 and 5 years, and 80% of the total respondents had experience of using two or more DBMS.

Two step Structured Equation Modeling (SEM) process as suggested by Anderson and Gerbing (1988), Anderson and Gerbing (1992) is followed in this paper as well. Initially, using confirmatory factor analysis, the measurement model is tested. Structural model is tested only after the measurement model suggested adequate fit. The results are explained in the next section.

<Table 1> Identifications of Measurement of Variables

Construct	Measurement items	Relevant studies
Cost (purchase / maintenance cost)	- I thought purchase cost of the DBMS was appropriate when I bought it. - I thought maintenance cost of the DBMS was appropriate when I bought it. - I thought performance of the DBMS was very good compared to the purchase/maintenance cost when I bought it.	Bitner, 1990; Clow and Kurtz, 1997; Clow et al., 1991
Experience	- I was overall satisfied with the DBMS in the past. - The experience of using the DBMS in the past was positive. - I think the performance of the DBMS was good in the past.	Bitner, 1990; Bolton and Drew, 1991; Clow and Krutz, 1997
Reputation	- The reputation of the DBMS was positive. - My acquaintances had a positive opinion on the DBMS. - I was telling positive things on the DBMS to others.	Bolton and Drew, 1991; Clow and Krutz, 1997; Grönroos, 1990; Helm and Klode, 2011
Expectation	- I had a high expectation for the DBMS. - I had a high expectation in terms of task execution and development. - I had a high expectation in terms of development performance and work processing. - I had a high expectation in terms of overall performance of the DBMS.	Bolton and Drew, 1991; Kim et al., 2004; Oliver and Desabo, 1988
Performance	- The performance (usefulness, ease of development) was very high. - The DBMS was useful for task processing and development. - The DBMS was easy to maintain and develop applications. - Overall, the DBMS showed high performance.	Churchil and Suprenant, 1982; Kim et al., 2004; Zeithaml et al., 1988
Disconfirmation	- Disconfirmation = performance – expectancy. - Operational variables	Kim et al., 2004; Oliver, 1980; Oliver and Desabo, 1988; Szajna and Scamell, 1993
Satisfaction	- Overall, I was happy with the use of the DBMS. - I was satisfied with the performance of the DBMS for task processing and application development. - I believe the DBMS will show satisfactory performance in the future.	Koo, 1999; Oliver and Desabo, 1988

<Table 2> Conversion of Disconfirmation into 5 Likert Scale Value

RES_EX	-4.0 ~ -2.4	-2.4 ~ -0.8	-0.8 ~ 0.8	0.8 ~ 2.4	2.4 ~ 4.0
5 Likert scale	1	2	3	4	5

Ⅴ. Results

Internal consistency of the collected data is measured using Chronbach's alpha and the figures shown in <Table 3> indicate high consistency as all of the Chronbach's alpha values of the constructs are higher than 0.6 and the measurement items can be considered as reliable (Nunnally, 1967).

Confirmatory Factor Analysis was conducted on AMOS to test the measurement model and the result is summarised in <Table 4>. χ^2 is 1119.733 with 677 degrees of freedom and p = .000. This result is expectable given the size of the problem (Hair et al., 2010). Normed χ^2, which is the χ^2 divided by degrees of freedom, is 1.654 well below the suggested threshold of 2.00 (Kline, 2005). CFI is .965 and RMSEA is 0.034 and it lies within the interval (0.031, 0.038) with .90 probability. This also indicates close approximate fit as it is $\leq$ 0.05 (Kline, 2005). Moreover Average Variance Extracted (AVE) and Construct Reliability (CR) calculated by using the formulas in Eq. (1) and Eq. (2) respectively are also indicative of good construct validity as suggested by Hair et al. (2010). An AVE of .5 or higher is a good rule of thumb suggesting adequate convergence whereas a CR of .7 or higher suggests good reliability. All of the constructs but disconfirmation satisfies these conditions. For the disconfirmation, we apply more relaxed criteria. By Fornell and Larcker (1981), on the basis of CR alone, the researcher may conclude that the convergent validity of the construct is adequate, even though more than 50% of the variance is due to error. As many research have done, we accept this relaxed rule for "disconfirmation" construct based on the high CR (.781) and retain this construct. For standardized item loading, considering that 0.4 is generally recommended lower score for item loading, rep3 is the only item lower than this criteria. Given that it is not substantially different from the criteria (0.353) and is only one item, it was retained.

The results in <Table 5> indicate that all constructs but performance have discriminant validity. This is because although performance and satisfaction are not the same concepts, they are highly correlated.

The discriminant validity is tested by checking the difference between the two models where the first model is the unconstrained CFA model and the second is the constrained model (where covariance between two constructs is set equal to 1). A significant chi-square difference between two models indicates discriminant validity between the con-

<Table 3> Constructs and Reliability

Construct	Number of Items	Consistency (Cronbach's a)	AVE	Reliability	Factor Correlations						
					Cost	Exp	Rep	Expec	Per	Dis	Sat
Cost	3	0.727	0.544	0.696	1						
Experience	3	0.836	0.636	0.943	0.177	1					
Reputation	3	0.701	0.573	0.827	0.004	0.554	1				
Expectation	4	0.87	0.644	0.934	0.111	0.495	0.491	1			
Performance	4	0.875	0.643	0.944	0.207	0.553	0.541	0.709	1		
Disconfirmation	4	0.688	0.339	0.781	0.075	0.044	0.057	-0.408	0.341	1	
Satisfaction	3	0.852	0.673	0.958	0.276	0.58	0.605	0.706	0.965	0.295	1

strained pair of constructs. <Table 5> indicates that such differences in this study ranged between 211.19 and 971.749 (p=0.000) suggesting adequate discriminant validity for all scales. A summary of the model fit is given in <Table 6> with acceptable thresholds for Normed c^2 (c^2/DF), CFI and RMSEA. For all three fit parameters, our model performs within the acceptable thresholds.

The disconfirmation construct with low AVE could be explained by the fact that this is a calculated construct as explained earlier.

(1)

$$AVE = \frac{\sum_i^n L_i^2}{n}$$

<Table 4> Measurement Model

	Mean	Std. Deviation	Standardized Item Loading[a]	Error Loading	*t*-Statistic (for Loading)
Rep 1	3.77	.80	0.937	0.119	
Rep 2	3.71	.77	0.846	0.966	7.568
Rep 3	3.38	.92	0.353	0.335	8.854
Exper 1	3.54	.74	0.850	0.078	
Exper 2	3.53	.72	0.815	0.167	15.654
Exper 3	3.46	.74	0.721	0.733	5.854
Cost 1	3.11	1.08	0.947	0.150	
Cost 2	2.97	1.16	0.529	0.174	14.2
Cost 3	3.31	.79	0.675	0.265	12.592
Expec 1	3.41	.82	0.671	0.175	
Expec 2	3.61	.74	0.803	0.158	19.949
Expec 3	3.55	.73	0.871	0.292	18.308
Expec 4	3.61	.73	0.851	0.158	20.119
Per 1	3.64	.71	0.805	0.385	
Per 2	3.73	.71	0.829	0.195	17.62
Per 3	3.68	.77	0.731	0.122	17.677
Per 4	3.67	.73	0.838	0.146	18.301
Dis 1	3.17	.74	0.491	0.379	
Dis 2	3.12	.67	0.580	0.307	14.056
Dis 3	3.11	.69	0.557	0.322	13.22
Dis 4	3.07	.62	0.684	0.215	14.626
Sat 1	3.72	.68	0.861	0.118	
Sat 2	3.72	.68	0.844	0.134	18.251
Sat 3	3.59	.78	0.752	0.263	15.102

Note: Legend: rep=reputation, exper=experience, cost=cost, expec=expectation, per=performance, dis=disconfirmation, sat=satisfaction
Model fit: χ^2 = 1119.733 (df = 677, p < .000, χ^2/df = 1.661) NFI=.918, CFI=.965, RMSEA=0.034
[a]All item loadings are significant at 0.000 level

(2)

$$CR = \frac{(\sum_i^n L_i)^2}{(\sum_i^n L_i)^2 + (\sum_i^n r_i)^2}$$

Where n: number of indicators in a construct; i=1,$\cdots n$; Li: loading of the indicator.

<Table 5> Chi-Square Tests of Discriminant Validity

Variables Constrained	Chi-Square	Degrees of Freedom	Chi-Square Differences
None	1119.733	677	-
Cost - Experience	1367.19	678	247.457
Cost - Reputation	1402.45	678	282.717
Cost - Expectation	1410.918	678	291.185
Cost - Performance	1378.105	678	258.372
Cost - Disconfirmation	1551.739	678	432.006
Cost - Satisfaction	1348.466	678	228.733
Experience - Reputation	1330.923	678	211.19
Experience - Expectation	1419.916	678	300.183
Experience - Performance	1411.901	678	292.168
Experience - Disconfirmation	1713.439	678	593.706
Experience - Satisfaction	1399.461	678	279.728
Reputation - Expectation	1384.971	678	265.238
Reputation - Performance	1384.971	678	265.238
Reputation - Disconfirmation	1667.68	678	547.947
Reputation - Satisfaction	1350.072	678	230.339
Expectation - Performance	1350.072	678	230.339
Expectation - Disconfirmation	2091.482	678	971.749
Expectation - Satisfaction	1396.778	678	277.045
Performance - Disconfirmation	1446.329	678	326.596
Performance - Satisfaction	1396.778	678	277.045
Disconfirmation - Satisfaction	1661.312	678	541.579

Note: [a]All chi-square differences are significant at p = 0.000 level.

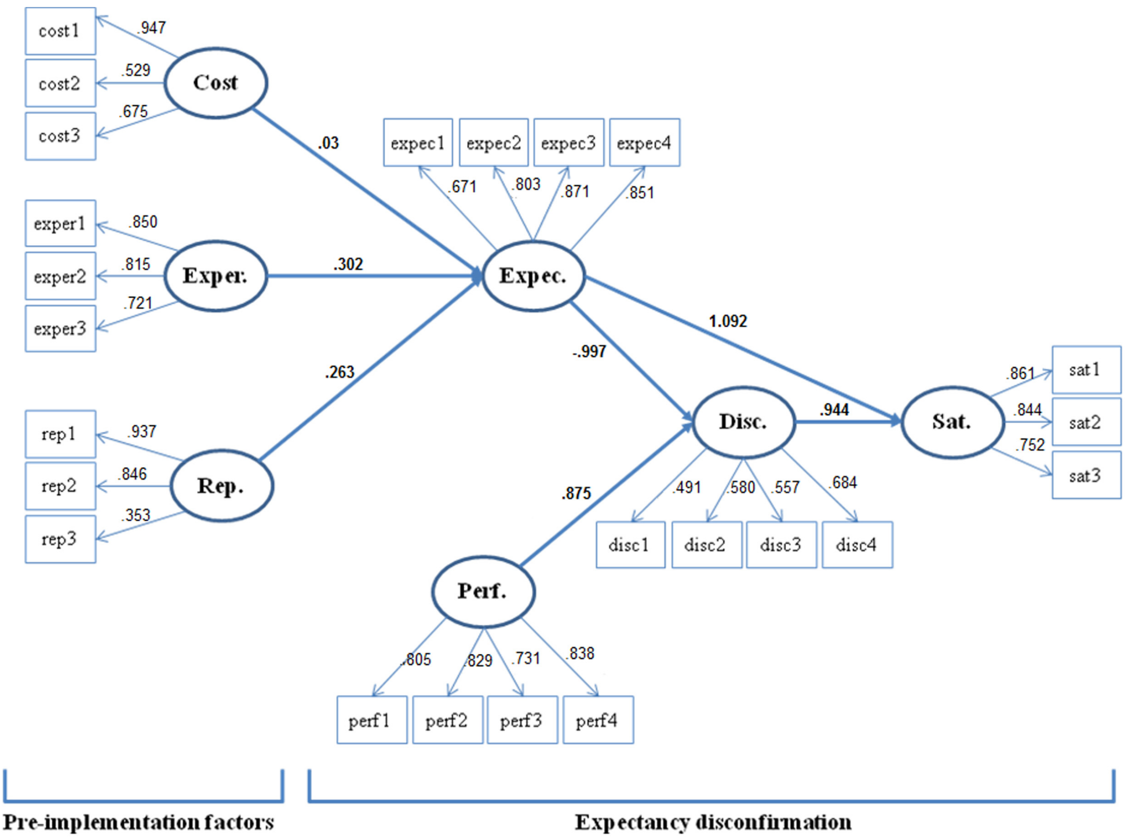
<Table 6> Model Fit Summary

Fit Parameter	Measurement Model	Structural Model	Suggested Threshold (Hair et al., 2010)
χ^2	1119.733	1277.834	Significant p values expected with n=283
Degree of freedom	677	693	
P	.000	.000	
Normed χ^2 (χ^2/DF)	1.654	1.844	< 2.0
CFI	.965	.954	> .92
RMSEA	.034 (.031, .038)	.039 (.035, .042)	< .07

Path analysis has been employed to verify the whole research model proposed in this paper. SPSS AMOS V7.0 has been used to test the research model and the analysis result is summarized in <Figure 2>:

<Table 7> summarizes the regression coefficients for the whole sample, OSS DBMS users, and CLS DBMS users. The hypothesis that cost has a significant impact on user expectations (H1) is rejected for the whole sample as well as the OSS DBMS users. On the other hand, the reputation and experience turned out to have significant impact on the user expectancy for the whole sample. In terms of the break-down of pre-implementation factors for OSS DBMS and CLS DBMS users, experience significantly affects expectation for OSS DBMS users whereas it does not have an effect on expectation for CLS DBMS users. It is interesting to note that while cost and reputation do not affect expectation in the case of OSS DBMS users, they do affect expectation for CLS DBMS users. On the other hand, Table 7 shows that the expectancy disconfirmation and DBMS performance significantly affect the user satisfaction.

Independent samples tests were performed to test hypotheses 8-10. H8 was that expectations from commercial DBMS are higher than OS DBMS. All three indicators for expectation and the summative scale for expectation are compared without assuming equal variances. <Table 8> summarizes the results.



<Figure 2> Path Analysis Results: Standardized Estimates
(All of the estimates except the estimate for cost-expectation are significant at 0.001 level)

<Table 7> Path Analysis Results: Regression Weights

	Hypothesis	Dependent Variable		Independent Variable	Estimate	S.E.	C.R.	*P*	Decision
ALL	H1	Expectation	←	Cost	0.03	0.032	0.936	0.35	Reject
	H2	Expectation	←	Reputation	0.263	0.058	4.533	***	
	H3	Expectation	←	Experience	0.302	0.071	4.218	***	
	H4	Disconfirmation	←	Expectation	-0.997	0.057	-17.474	***	
	H5	Disconfirmation	←	Performance	0.875	0.018	48.33	***	
	H6	Satisfaction	←	Expectation	1.092	0.073	15.035	***	
	H7	Satisfaction	←	Disconfirmation	0.944	0.058	16.344	***	
OSS	H1	Expectation	←	Cost	-0.034	0.06	-0.561	0.575	Reject
	H2	Expectation	←	Reputation	0.156	0.085	1.821	0.069	Reject
	H3	Expectation	←	Experience	0.35	0.12	2.923	0.003	
	H4	Disconfirmation	←	Expectation	-1.003	0.119	-8.424	***	
	H5	Disconfirmation	←	Performance	0.824	0.038	21.884	***	
	H6	Satisfaction	←	Expectation	1.18	0.165	7.136	***	
	H7	Satisfaction	←	Disconfirmation	1.152	0.14	8.218	***	
CLS	H1	Expectation	←	Cost	0.278	0.068	4.053	***	
	H2	Expectation	←	Reputation	0.362	0.076	4.784	***	
	H3	Expectation	←	Experience	0.146	0.086	1.698	0.089	Reject
	H4	Disconfirmation	←	Expectation	-0.984	0.066	-14.864	***	
	H5	Disconfirmation	←	Performance	0.874	0.021	41.766	***	
	H6	Satisfaction	←	Expectation	1.074	0.08	13.441	***	
	H7	Satisfaction	←	Disconfirmation	0.921	0.066	14.035	***	

<Table 8> Testing H8 that Expectation from Commercial DBMS is Higher than OS DBMS

	DBMS	*N*	Mean	Std. Dev.	Std. Error Mean	Mean Difference	*t*	Sig. (2-tailed)
Expec 1	OSS	84	3.214	.762	.083			
	COMM	199	3.492	.834	.059	-.278	-2.728	.007
Expec 2	OSS	84	3.392	.761	.083			
	COMM	199	3.698	.710	.050	-.306	-3.148	.002
Expec 3	OSS	84	3.381	.710	.077			
	COMM	199	3.623	.727	.052	-.242	-2.603	.010
Expec 4	OSS	84	3.404	.696	.076			
	COMM	199	3.698	.724	.051	-.294	-3.203	.002
Expectation	OSS	84	3.348	.610	.067			
	COMM	199	3.628	.636	.045	-.280	-3.482	.001

As it can be concluded from the figures given in <Table 8>, there is not enough evidence to reject H8. In other words, our sample supports the hypothesis (H8) that expectation from commercial DBMS is higher than the expectations from OSS DBMS. This is supported by our finding on pre-implementation factors that cost does have an impact on expectations of the commercial DBMS customers and here commercial DBMS customers expect more compared to the OSS DBMS customers.

The next analysis tests whether performance of commercial DBMS is perceived higher than OSS DBMS. <Table 9> details the mean scores and differences between OSS and commercial DBMS users.

Even though the perceived performance from CLS DBMSs is overall higher than that from OSS DBMS the difference is not statistically significant therefore H9 is rejected. There is not enough evidence to conclude that commercial DBMS performance is higher than OSS DBMS. None of the indicators of performance were significantly different for the two user groups.

Finally H10 hypothesizes that there is no significant difference on user satisfaction from CLS and OSS

<Table 9> Testing H9 that Performance of Commercial DBMS is Higher than OSS DBMS

	DBMS	*N*	Mean	Std. Dev.	Std. Error Mean	Mean Difference	*t*	Sig. (2-tailed)
Per 1	OSS	84	3.536	.768	.084			
	COMM	199	3.683	.686	.049	-.14770	-1.526	.129
Per 2	OSS	84	3.691	.694	.076			
	COMM	199	3.754	.721	.051	-.06329	-.693	.489
Per 3	OSS	84	3.655	.768	.084			
	COMM	199	3.688	.768	.054	-.03368	-.337	.737
Per 4	OSS	84	3.571	.765	.083			
	COMM	199	3.709	.715	.051	-.13711	-1.404	.162
Performance	OSS	84	3.613	.636	.069			
	COMM	199	3.709	.617	.044	-.09545	-1.164	.246

<Table 10> Testing H10 that Satisfaction from Commercial DBMS is Higher than OSS DBMS

	DBMS	*N*	Mean	Std. Dev.	Std. Error Mean	Mean Difference	*t*	Sig. (2-tailed)
Sat 1	OSS	84	3.655	.720	.079			
	COMM	199	3.749	.657	.047	-.094	-1.029	.305
Sat 2	OSS	84	3.643	.705	.077			
	COMM	199	3.749	.672	.048	-.106	-1.170	.244
Sat 3	OSS	84	3.417	.780	.085			
	COMM	199	3.663	.767	.054	-.247	-2.444	.016
Satisfaction	OSS	84	3.571	.618	.067			
	COMM	199	3.720	.627	.044	-.149	-1.843	.067

DBMSs. The findings of the hypothesis test for this argument is given in <Table 10>.

Satisfaction has three indicators, namely, overall satisfaction, satisfaction from the past performance, satisfaction from the future performance. As it can be seen in <Table 10>, only the third indicator for satisfaction is significantly higher for commercial DBMS than OSS DBMS. However, when average satisfaction is also compared for the two types of DBMSs, there is no statistically significant difference between users of commercial DBMS and OSS DBMS. Therefore H10 is accepted; there is not enough evidence to suggest that user satisfaction from a commercial DBMS is higher than OSS DBMS.

Ⅵ. Discussion

Due to the unique characteristics of OSS, researchers have been working on uncovering major aspects of OSS development and success. However, most of the efforts have been focused on the success of OSS projects rather than how an OSS service is perceived by end users (Crowston et al., 2003). Raghu et al. (2008) turns focus on the behavior of OSS users by investigating when users would pay price for commercial software in the presence of OSS service or Free Software alternatives. Researchers from different disciplines have attempted to uncover the reasons of OSS service adoption in relation to the presence of proprietary software adoption from an economic perspective (Kauffman and Mohtadi, 2004), a managerial and business perspective (Holck et al., 2005; Ven et al., 2008), and a commercial perspective (Lin, 2008; Sen, 2007). However, existing studies fail to explain how OSS service can enlarge their own market in the presence of the competition with functionally superior CLS. Unfolding this process is crucial for the OSS service market because by shedding light on the differences between OSS and CLS customers and understanding the way that customers form their expectation, selection and evaluation of the related IT services, we are able to reveal the factors that affect these decisions respectively; especially since a debate still exists on the actual influence of the dominant factors such as cost of software, reputation and previous experience.

To authors' knowledge, this paper is one of the first studies to propose a unified framework to explain how OSS DBMS services shape consumer satisfaction despite of inferior IT services, such as functionality and maintenance, compared with CLS DBMSs. In particular, EDT has been adopted as a theoretical lens, and it was revealed that there was no significant difference between disconfirmation of OSS and CLS DBMS services meaning the superior functionality of CLS DBMS services is depreciated by the higher expectancy from the consumers leading to similar level of user satisfaction from the two types of DBMS services. The empirical results from this study show that the expectation for OSS DBMS services was significantly lower than that on CLS DBMS services. This led to the indifference on perceived satisfaction from two types of DBMS services. The findings can be one of explanations on how inferior OSS DBMCS services are successfully competing with functionally superior CLS DBMS services in the market.

Another theoretical contribution constituted by this research is the integrated model that combines pre-implementation factors for customer expectancy with an EDT. One of the major critics on the EDT was the difficulty of measuring customer expectancy (Yüksel and Yüksel, 2001). This paper identified pre-implementation factors of customer expectation for DBMS services and linked it to the EDT through verification of the pre-implementation factors model.

This paper reveals that reputation and past experience are significant pre-implementation factors of OSS DBMS services customer expectation while cost affects customer expectation only for CLS DBMS services.

Beginning with the results related to the cost factors, the study reveals that cost made a significant impact only to the customer expectation for CLS DBMS services but not for OSS DBMS services. This implies that DBMS customers do not consider cost in shaping expectation for OSS DBMS services despite of the cost that may derive from adopting OSS, such as switching to OSS, maintenance, dual-licensing and ownership. Considering that the adoption of OSS services might eventually be even more expensive than proprietary software (Ven et al., 2008), due to these costs, the results of the present study indicate that software customers might be misled and ignore the side-costs of OSS adoption. This acknowledgement is especially important for both academics and practitioners who need to raise their awareness on the fact that the cost advantage of OSS over CLS might be limited or even absent.

Regarding the results related to the reputation factor, this has been identified as the strongest pre-implementation factor of the customer expectation for CLS DBMS services. Reputation factor made stronger impact to the customer expectancy of CLS DBMS services than that of OSS DBMS services. Despite this the strong positive relationship of reputation to OSS customer expectancy is an indicator that quality models can actually influence customers' decisions. Therefore, attempts to establish OSS quality criteria that are in progress, such are SQO-OSS model (Samoladas et al., 2008), are fundamental to OSS diffusion and adoption.

Past experience, along with reputation, is one of the major factors that determine the level of the user expectancy. The respondents had overall positive past experiences on both types of service, and this made a positive impact to the customer expectancy of both types of service. Also, there was no significant difference on the level of impact to the customer expectancy between the two types of service.

This study also contributes to the user acceptance of OSS in IS literature. Recently, user acceptance and IS success model have been applied to explain why users accept and continuously use OSS in IS literature (Lee et al., 2009; Gallego et al., 2008; Gwebu and Wang, 2010a; Gwebu and Wang, 2010b). However, these studies are mostly focusing on the identification of motivators of accepting OSS without considering the competing nature of the software with CLS. The findings from this paper suggest that the lower expectation for OSS in terms of cost, reputation, and experience can be one of major factors for the acceptance of OSS in the presence of CLS. This provides new insight in understanding the user acceptance of OSS in relation with CLS.

Implication for practitioners also can be derived from research findings. The cost and reputation are significant precedence factors of expectation and satisfaction of CLS DBMS. This means that the cost level of DBMS is most important factor considered for the highly reputed company to enhance the customers' satisfaction. The results offers the reason the CLS DMBS vendor should have different perspective on the customer satisfaction from OSS service vendor. The research shows the difference between OSS and CLS customers' expectations.

Ⅶ. Conclusion

This paper has proposed a unified framework to explain customer satisfaction from OSS and CLS IT services. The framework was tested through an empirical study on DBMS users. The proposed model integrated a pre-implementation factor model for customer expectancy with the EDT to trace a process in which customers shape their satisfaction. The satisfaction shaping process was turned out to go through two stages: expectancy formation stage and satisfaction shaping stage via the expectancy disconfirmation. The model has been applied to both OSS and CLS DBMS customers to find any differences on the process and factors that shape customer satisfaction. The results confirmed significant relationship between expectancy disconfirmation and customer satisfaction of both types of DBMS service. Reputation and past experience have been proved to be the major determinants of customer expectation for both types of service but cost has turned out to be a significant factor only for CLS DBMS. Performance and disconfirmation between customer expectancy and performance of DBMS turned out to be the major factors determining the level of customer satisfaction of both OSS and CLS DBMS services. This confirms the proposition that users have lower expectation for OSS than commercial software and that leads to reasonable degree of customer satisfaction due to a positive expectancy disconfirmation.

Our future research will focus on finding more constructs that are critical to the expectation disconfirmation and customer satisfaction in the context of OSS and CLS DBMS service. As some studies in marketing field indicate, the direct relationship among EDT constructs based on empirical evidence, to clarify these relations will be valuable future research on the basis of theoretical perspectives. Throughout more comprehensive literature reviews on expectation theory, we believe that the stronger statistical power can be obtained, while this research has some limitation in terms of lack of strong statistical power for disconfirmation construct. In addition, we can specify the disconfirmation in terms of knowledge sharing and social interaction. Considering that the knowledge sharing in virtual community is very critical factor for developers involving implementation of DBMS, disconfirmation is needed to be specified in this manner. This future research direction will be able to show more concrete perspective on the DBMS customer satisfaction process.

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