

2010

# User Expectancy and Satisfaction of Open Source and Commercial Data Base Management Systems

Habin Lee

*Brunel University, habin.lee@brunel.ac.uk*

Jong Woo Kim

*Hanyang University, kjw@hanyang.ac.uk*

Jung Oh Moon

*Hanyang University, mjo200@paran.com*

Vishanth Weerakkody

*Brunel University, vishanth.weerakkody@brunel.ac.uk*

Ray Hackney

*Brunel University, ray.hackney@brunel.ac.uk*

Follow this and additional works at: <http://aisel.aisnet.org/ecis2010>

## Recommended Citation

Lee, Habin; Kim, Jong Woo; Moon, Jung Oh; Weerakkody, Vishanth; and Hackney, Ray, "User Expectancy and Satisfaction of Open Source and Commercial Data Base Management Systems" (2010). *ECIS 2010 Proceedings*. 153.  
<http://aisel.aisnet.org/ecis2010/153>

This material is brought to you by the European Conference on Information Systems (ECIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in ECIS 2010 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact [elibrary@aisnet.org](mailto:elibrary@aisnet.org).



**USER EXPECTANCY AND SATISFACTION OF OPEN SOURCE  
AND COMMERCIAL DATA BASE MANAGEMENT SYSTEMS**

Journal:	<i>18th European Conference on Information Systems</i>
Manuscript ID:	ECIS2010-0069
Submission Type:	Research Paper
Keyword:	OSS/FLOSS, Satisfaction, Database management systems (DBMS), Information technology adoption



# USER EXPECTANCY AND SATISFACTION OF OPEN SOURCE AND COMMERCIAL DATA BASE MANAGEMENT SYSTEMS

Lee, Habin, Brunel University, Kingston Lane, Uxbridge, UK, habin.lee@brunel.ac.uk

Kim, Jong Woo, Hanyang University, 17 Haengdang-dong Seongdong-gu, Seoul, S. Korea, kjw@hanyang.ac.uk

Moon, Jung Oh, Hanyang University, 17 Haengdang-dong Seongdong-gu, Seoul, S. Korea, mjo200@paran.com

Weerakkody, Vishanth, Brunel University, Kingston Lane, Uxbridge, UB8 3PH, UK, Vishanth.weerakkody@brunel.ac.uk

Hackney, Ray, Brunel University, Kingston Lane, Uxbridge, UB8 3PH, UK, ray.hackney@brunel.ac.uk

## Abstract

*Most of the existing studies on open source software (OSS) have been focusing on software development process while how and why OSS is accepted by software developers is yet to be uncovered. This paper adopts expectancy disconfirmation model to explain the process and major factors of user satisfaction on OSS. An empirical research based on questionnaire survey is performed to study the influence of user expectancy to user satisfaction of commercial and open source DBMSs. According to the survey results, reputation and past experiences influence significantly to user expectancy on DBMS, and price influences to user expectancy only for commercial DBMS users. The results also show that the expectancy disconfirmation influences significantly to user satisfaction of both types of DBMS. However, the degree of expectancy disconfirmation does not have linear relationship with the degree of user satisfaction.*

*Keywords: Disconfirmation, satisfaction, expectancy, performance, OSS/FLOSS, DBMS.*

## 1 INTRODUCTION

Open source software (OSS) has been widely accepted by software development community during the last decade. According to this trend, information systems (ISs) researchers have been working on the new type of information systems in the area of opensourcing (Ågerfalk and Fitzgerald, 2008), evolution of OSS (Fitzgerald, 2006), OSS project management (Stewart et al., 2006; Hahn et al., 2008) and so on. However, despite of the initial efforts to shed light on the nature of the new form of software development, it is not fully uncovered how OSS users' satisfaction is shaped in comparison with that of commercial software.

This paper aims to reveal a process that shapes user satisfaction on OSS. For this purpose, this paper employs the expectancy disconfirmation model (EDM) (Oliver and Desabo, 1988) as a basic model to explain the process in which users shape their expectancy and satisfaction on OSS. EDM suggests that consumers form judgment about products or services based on their prior expectations about the characteristics or benefits offered by a given product or service (Oliver, 1980). EDM has been applied widely in both the private (Rami et al., 2002; Anderson and Fornell, 1994; Maish, 1979) and the public administration domain to study citizen satisfaction towards public services (Lee et al., 2007; Van Ryzin, 2005). EDM provides a good theoretical framework to explain the adoption of OSS as users of OSS may expect inferior functionality and maintenance support compared with commercial software and the low expectation can affect the user satisfaction afterwards. A research model to explain a process in which user expectancy affects user satisfaction through disconfirmation between the expectancy and performance of Database Management Systems (DBMSs) is proposed and tested through a questionnaire survey on 283 DBMS users in South Korea. DBMS is selected as target software as open source (OS) DBMSs are gaining a significant market share in competition with commercial DBMSs.

The results confirm that the EDM can be used to explain user satisfaction on OS and commercial DBMSs. However, there is difference on the pre-implementation factors of user expectancy between the two types of DBMS. Also, non-linear relationship between expectancy disconfirmation and user satisfaction is found.

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 user satisfaction on product, service and information systems (ISs). Then, a research model to explain the process of user 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.

## 2 LITERATURE REVIEW

In the Marketing domain, EDM explains that consumers' satisfaction on a product is determined by expectancy on a product before they buy it, perceived performance after use of the product and the level of disconfirmation between the expectancy and the performance (Oliver and Desarbo, 1988). The origin of EDM goes up to Cardozo(1968)'s study that revealed that the consumers who consumed a ball-pen which showed better performance than their initial expectation on the quality were more satisfied with the consumption of the ball-pen.

Oliver and Desarbo (1988) defines consumer satisfaction as follows.

$S = f(E, P)$  where  $S$  is consumer's perceived satisfaction,  $E$  is the expectation on the product before use it, and  $P$  the perceived performance of the product after use it.

User expectancy has been one of the major factors for user satisfaction in IS literature since 1990s (as an example, Bernadette, 1993). However, as shown in Bernadette (1993)'s research, the early user satisfaction models with regard to user expectation were based on cognition dissonance theory that explains the tendency of users to assimilate the level of their perceived IS performance with their initial expectation on the IS. In the early 2000s, researchers started to adopt the expectancy

disconfirmation model to explain IS satisfaction is determined by the level of discrepancy between the expectancy and perceived performance (Bhattacharjee 2001; Au et al., 2002; McKinney et al., 2002; Bhattacharjee and Premkumar, 2004). Staples et al. (2002) specifically identify three major user expectation categories: system usefulness, ease of use and information quality. Au et al. (2002) propose a conceptual model for IS satisfaction in which expectancy disconfirmation theory plays a partial role in determining users' IS satisfaction. Expectancy disconfirmation model has also been used to explain the change of users' belief and attitude after the acceptance of an IS (Bhattacharjee and Premkumar, 2004; Bhattacharjee, 2001).

Bhattacharjee combined EDM with empirical findings in IS adoption to theorise a model for IS continuance. Au et al., (2002) suggest that the effects of expectation, disconfirmation and even product performance on user satisfaction of IS are likely to be more complex than those simply predicted by the original EDM. In the consumer behaviour and marketing literature, the gap between prior expectations and actual performance is termed 'expectancy disconfirmation' (Van Ryzin, 2004; Oliver 1997; Erevelles and Leavitt 1992; Yi 1990; and Maish, 1979). Van Ryzin (2004) and Maish (1979) notes that the 'disconfirmation' of expectations can be positive as well as negative in that performance can either exceed expectations (positive disconfirmation) or fall short of expectations (negative disconfirmation). A number of other researchers have validated this argument through empirical research relating to variety of products and services (Michael et al., 2001; Anderson and Sullivan 1993; Bearden and Teel 1983; Churchill and Suprenant 1982; Oliver and DeSarbo 1988). Considering the above arguments, the alternative model proposed by Au et al., (2002) evaluated user satisfaction of IS whereby 'predictive expectation' is used instead of 'desired expectation' propose in the original EDM. The authors argue that 'desired expectation' is the standard of how an ideal IS should perform in the user's mind, whereas 'predictive expectation', is dealing with beliefs in the likelihood of the performance level of the existing IS. Au et al., (2002) goes on to suggest that in practice manipulating the 'predictive' type of expectation of an IS currently used in an organization is much easier than changing the 'desired expectation' of an IS which may not even actually exist in some cases. While external influences such as promotional claims, word-of-mouth and product cues can provide information that creates or affects expectations in the end user's mind in the context of products and services in the marketing domain (Oliver, 1997), internally, the end user's past and current experiences with an IS also play an important role in expectation formation in the IS domain.

This paper also takes the expectancy disconfirmation model as the basis of explaining user satisfaction of OSS. This is based on the assumption that users have different expectation on 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 user satisfaction process via a disconfirmation model.

OSS has been originated from free software which 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. Although OS DBMS means that the source code is open to anybody to be modified and distributed, this does not mean it is free. According to Gartner, the OS DBMSs are extending their market share from 200 million US \$ in 2007 to 270 million US \$ in 2008 (35% increase). In particular, rapidly growing numbers of web applications based on, so called, LAMP (LINUX, APACHE, MYSQL, PHP) helped OS DBMSs increase their share in the web applications market and they are starting to compete with commercial 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.

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 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 or Free Software alternatives. Lee et al. (2009) also propose an OSS success model in which user satisfaction is a key factor in the success of an OSS. However, the model simply relates information, system and service quality as determinants of user satisfaction of an OSS and does not consider how the expectancy of OSS users plays a role in shaping user satisfaction.

### 3 RESEARCH MODEL

Based on the literature review offered, this paper presents a research model that explains the major factors that affect user satisfaction on DBMSs. Figure 1 shows the proposed research model to explain DBMS user satisfaction and the model integrates the expectancy disconfirmation models of Cardozo (1965) and Oliver & Desabo (1988) and pre-implementation factors model by Szajna and Scamell (1993), Bolton and Drew (1991), and Clow and Krutz (1997).

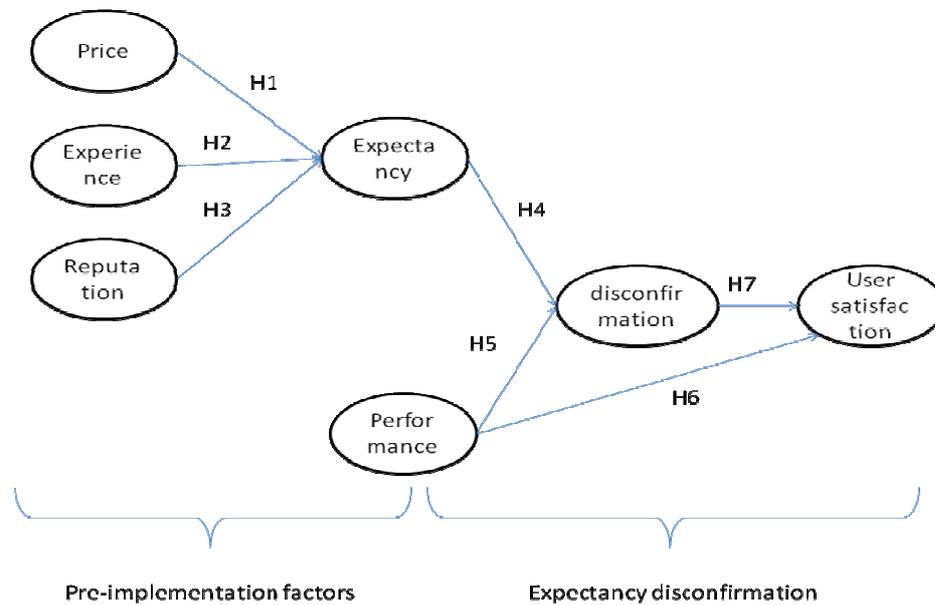


Figure 1. The research model

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 user expectancy on DBMSs. The second model is to reveal how the disconfirmation between the expectancy and performance affects the user satisfaction.

This paper identifies three major factors that affects user expectancy on DBMSs: words-of-mouth, price and past experience. Word-of-mouth is considered as one of the frequently used means to collect product information (Bolton and Drew, 1991; Grönroos, 1990). For example, in many cases people may go to a dentist who has been introduced by a friend rather than other dentists who are cheaper price. In this paper, reputation is defined as perception of users on a DBMS created through their information collection process on the on- and/or off-line before they purchase the DBMS. Price is always one of the most important factors to make decision on a product purchase. It particularly provides a criterion for gauging the level of expected quality of a product. For example, a company may opt for a consultancy service costing \$10,000 rather than another consultancy service costing \$7,000 as they tend to match the quality of the service with the price within their budget limit. In this paper, price is defined as all cost incurred from obtaining a DBMS including purchase and maintenance cost. Finally, Bitner (1990) asserts that a positive past consumption experience of a product or a service creates a positive reputation and this leads to re-purchase of the product or the service in the future. Clow and Krutz (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 and Krutz (1991) a durable provision of good quality of service leads to higher consumer expectancy. As a result, past experience of DBMS is considered as one of the major factors to user expectancy on a DBMS. Past experience is defined as a perception on a DBMS, which is created based on past experience on the performance of the DBMS.

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

H1: DBMS purchase/maintenance cost significantly affect the expectancy of DBMS users.

H2: Past experience of a DBMS significantly affects the expectancy of DBMS users.

H3: DBMS reputation significantly affects the expectancy of DBMS users.

With regard to the expectancy disconfirmation model, this paper adopts the works of Cardozo (1965) and Oliver & Desabo (1988). As a result, user expectancy on a DBMS, the performance of the DBMS and disconfirmation between the expectancy and performance are the major variables that affect user satisfaction on the DBMS. Olson and Dover (1979) defines user expectation as users' 'belief' on a product before they use it. Leichty and Churchill (1979) more specifically define user expectancy as a 'prediction' on the performance of a service. On the other hand, Holbrook (1984) defines user expectation as users' choice and preference on product quality, while Woodruff (1987) defines it as how well a product or service satisfies consumers' needs, desire and enthusiasm. Miller (1977) also makes a similar definition of user expectation as the level of performance required and/or pursued by consumers. The above definitions on user expectation can be applied to not only service or general product but also software like a DBMS. As a result, this paper defines user expectation on a DBMS as a user's belief on the performance, development efficiency, advertised information of a DBMS before s/he use it.

Kim et al. (2004) define IS performance as a perception on actual IS performance after use of the IS and he define IS quality and information quality as the two factors that determine the IS performance. He also proved that IS performance directly affects user satisfaction. This is based on Churchill and Suprenant (1983)'s assertion that product performance directly affects consumer satisfaction. As a result, this paper defines 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.

With regard to the relationship between user expectancy and satisfaction, there are two contradicting theories. 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 behavior, Szajna and Scamell (1993) assert that consumers tend to adjust their product satisfaction to assimilate it with their initial expectation on the product. On the other hand, expectancy disconfirmation theory asserts that the level of user satisfaction moves against to the user expectancy (contrast phenomenon). Assuming the same quality of a product, the higher a user's expectancy is, the lower the user'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 the major theory to explain consumer satisfaction. This paper is one of the few studies that aim to explain user satisfaction on ISs and defines expectancy disconfirmation as the difference between the expectancy on an IS before use it and the actual perceived performance after using the IS.

User satisfaction usually refers perceived satisfaction rather than actual product performance or quality. As a result, a perceived performance can be different from the actual performance according to the perception process (Ginzberg, 1981). In this paper user satisfaction on DBMS takes expectancy disconfirmation theory and is defined as perceived level of satisfaction according to the disconfirmation between expectancy on a DBMS before use it and perceived performance after using the DBMS.

Based on above explanation, this paper derives following four hypotheses.

H4: Expectancy on a DBMS significantly affects the expectancy disconfirmation.

H5: Perceived DBMS performance significantly affects the expectancy disconfirmation.

H6: Perceived DBMS performance significantly affects user satisfaction.

H7: The expectancy disconfirmation on a DBMS significantly affects user satisfaction.

Finally, the major difference between OS DBMSs and commercial DBMSs can be found from the difference on recognizing the price. Most users would consider reputation and past experiences than prices when they make decision to purchase an OS DBMS. On the other hand, users would have higher expectancy on the performance and satisfaction from a commercial DBMS than OS DBMS due to the higher cost to obtain the commercial DBMS.

As a result, we can derive following three hypotheses.

H8: The user expectancy of a commercial DBMS is higher than that of an OS DBMS.

H9: The perceived performance of a commercial DBMS is higher than that of an OS DBMS.

H10: User satisfaction of a commercial DBMS is higher than that of an OS DBMS.

Variable	Measurement items	Relevant studies
DBMS reputation	<ul style="list-style-type: none"> <li>- The reputation on the product heard from others was positive.</li> <li>- Other people he had contacted were positive on the product.</li> <li>- I was talking about positive side of the products to others</li> </ul>	Clow & Krutz (1997), Bolton & Drew (1991), Grönroos (1990)
Previous experience	<ul style="list-style-type: none"> <li>- Overall I was satisfied when I used the DBMS in the past.</li> <li>- Overall I have negative experience of using the DBMS in the past.</li> <li>- I think the performance of the DBMS was ok when I used it in the past.</li> </ul>	Clow and Krutz (1997), Bitner (1990), Bolton and Drew (1991)
Price (purchase / maintenance cost)	<ul style="list-style-type: none"> <li>- I thought the price of the DBMS was reasonable.</li> <li>- I thought the purchase and/or maintenance cost of the DBMS was too expensive considering its performance.</li> <li>- I thought the performance of the DBMS was excellent compared with its purchase and/or maintenance cost.</li> </ul>	Clow and Krutz (1997), Bitner (1990), Clow and Krutz (1991)
Expectancy	<ul style="list-style-type: none"> <li>- I had a high expectation on the DBMS.</li> <li>- I had high expectation on the DBMS for task execution and development.</li> <li>- The DBMS was expected to have high performance for processing tasks and development.</li> <li>- I thought the performance of the DBMS would be very high.</li> </ul>	Oliver and Desabo (1988), Bolton and Drew (1991), Kim et al. (2004)
Performance	<ul style="list-style-type: none"> <li>- The performance (usefulness, ease of development) was very high.</li> <li>- The DBMS was useful for task processing and development.</li> <li>- The DBMS was easy to maintain and develop applications.</li> <li>- Overall, the DBMS showed high performance.</li> </ul>	Kim et al.(2004), Churchill and Suprenant (1982), Zeithami and Parasuraman (1988).
Expectancy disconfirmation	<ul style="list-style-type: none"> <li>- disconfirmation = performance – expectancy.</li> <li>- operational variables</li> </ul>	Oliver and Desabo (1988), Szajna and Scamell (1993), Kim et al.(2004), Oliver (1980).
Satisfaction	<ul style="list-style-type: none"> <li>- Overall, I was happy with the use of the DBMS.</li> <li>- I was satisfied with the performance of the DBMS for task processing and application development.</li> <li>- I believe the DBMS will show satisfactory performance in the future.</li> </ul>	Oliver and Desabo (1988), Koo (1999).

Table 1. Identifications of measurement of variables.

## 4 METHODS

Table 1 summarizes the variables and measurement items for questionnaire survey of the study to test the research model in Figure 1.

In this paper, the questions to measure expectancy disconfirmation are not included in the questionnaire. Instead, it has been derived from measurement items for the performance and the expectancy as follows.

$RES\_EX = RES - EX$  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.

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

Table 2. Conversion of disconfirmation into 5 Likert scale value

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 period 19<sup>th</sup> May and 8<sup>th</sup> 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 commercial 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.

## 5 RESULTS

Chronbach’s alpha has been used to measure the reliability of the collected data and the result is shown in table 4. All the Chronbach’s alpha values of the variables are bigger than 0.6 and the measurement items can be considered as reliable. Factor analysis has been used for the validity test of the data. Principle component analysis (PCA) has been used to extract factors whose Eigen Value is larger than 1. Then, varimax rotation was performed on the extracted factors. The factor loading values are bigger than 0.5 (minimum value is 0.727) and the independent variables can be said to represent the dependent variables reasonably. Finally, multicollinearity analysis has been employed to test any dependencies between independent variables. All the tolerance values are less than 1 and the VIF (Variance Inflation Factor) values are less than 10, and no significant issue has been found on the dependencies among the dependent variables. The detailed test data is now provided for the conciseness of the paper.

For the research model test, firstly, regression analysis has been employed to identify the relationships between the expectancy variable and three variables (price, experience and reputation) that affect the user expectancy and the estimated regression equations are as follows.

All DBMS users:

$$EX = 1.411 + 0.358RP + 0.252 PA, R^2 = 0.288$$

Commercial DBMS users:

$$EX = 1.029 + 0.381RP + 0.231PA + 0.132PR, R^2 = 0.303$$

Open source DBMS users:

$$EX = 1.839 + 0.287RP + 0.247PA, R^2 = 0.295$$

The details of the regression analysis are shown in table 3. With 5% of significance level, price has been turned out to affect the user expectancy for only commercial DBMSs. As a result, H2 and H3 have been accepted while H1 is rejected.

	Model	Coefficient		Std. coefficients	t	Sig.	
		B	Std Error	Beta			
All DBMSs R <sup>2</sup> =0.288	(constant)	1.411	.233		6.064	.000	Reject
	Reputation	.358	.057	.368	6.310	.000	
	Experience	.252	.059	.250	4.282	.000	
	Price	-.015	.040	-.019	-.376	.707	
Commercial DBMS only R <sup>2</sup> =0.303	(constant)	1.029	.291		3.542	.000	
	Reputation	.381	.070	.369	5.471	.000	
	Experience	.231	.071	.222	3.266	.001	
	Price	.132	.056	.143	2.362	.019	
OS DBMSs only R <sup>2</sup> =0.295	(constant)	1.839	.374		4.921	.000	Reject
	Reputation	.287	.093	.347	3.092	.003	
	Experience	.247	.100	.278	2.470	.016	
	Price	-.095	.067	-.134	-1.404	.164	

Dependent variable: Expectancy, Significant level: < 0.05

Table 3. Regression analysis for the pre-implementation factors.

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 showed following: Chi-Square=3443.672, d.f. = 248, p-value=0.0000.

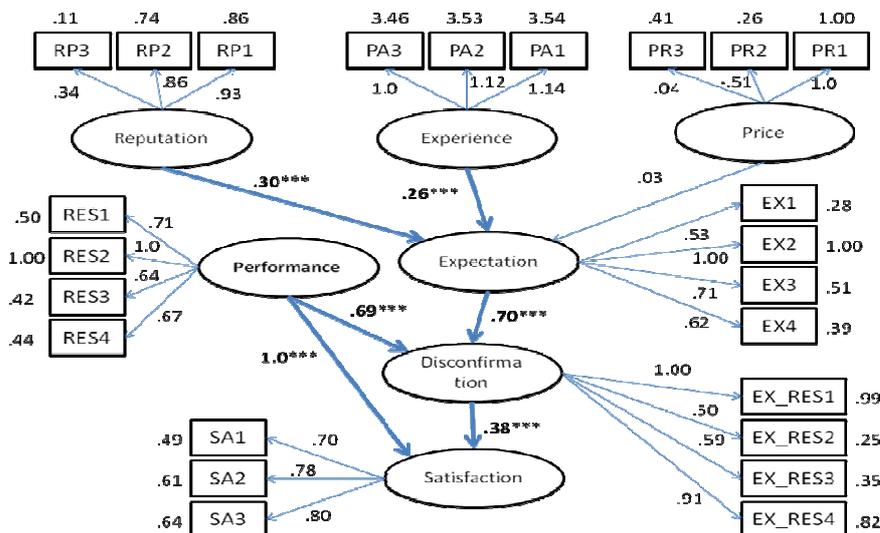


Figure 2. Path analysis results: standardized estimates.

The goodness-of-fit statistics revealed that the research model and collected data do not fit each other. CMIN/DF, value was 13.886 which is larger than 3 RMSEA=0.24 (smaller than threshold value 0.05)

NFI=0.478 (smaller than threshold value 0.9)

However, it is well known that Chi-square test is not appropriate for the fitness test between a proposed research model and collected data when the number of collected data is larger than 200 (Kaplan, 1995). As the number of collected data is 283, this study has taken only the path coefficient and the causal relationships between the measurement variables and latent variables have been tested via the regression analysis result at 5% of significance level. The result is shown in table 4.

Dependent variable	Direction	Indep. variable	Estimate	S.E.	C.R.	P	Decision
Expectancy	←	Price	0.023	0.025	0.92	0.358	Reject
Expectancy	←	Reputation	0.439	0.123	3.581	***	
Expectancy	←	Experience	0.25	0.059	4.24	***	
Disconfirmation	←	Performance	0.408	0.047	8.613	***	
Disconfirmation	←	Expectancy	-0.487	0.063	-7.703	***	
Satisfaction	←	Disconfirmation	-0.655	0.114	-5.757	***	
Satisfaction	←	Performance	1.068	0.087	12.332	***	

Table 4. Path analysis results: regression weights.

Table 4 shows the same result with table 3. That is, the price of DBMSs does not significantly affect users' expectancy. On the other hand, the reputation and experience have significant impact on the user expectancy. Also, table 4 shows that the performance and the expectancy of the users make significant impact on the expectance disconfirmation. Also, the expectance disconfirmation and DBMS performance significantly affect the user satisfaction.

Average group analysis and one-way ANOVA have been employed to see the difference on the relationships between expectance disconfirmation and user satisfaction. For this, the user groups have been divided into four difference groups: large disconfirmation group (LDG, performance – expectance > 4), confirmation group (CG, performance – expectance = 3), positive disconfirmation group (PDG, performance – expectance > 3), and negative disconfirmation group (NDG, performance – expectance < 3). It was turned out that LDG had the lower expectance and the higher performance and satisfaction than those of CG. Also, PDG showed higher satisfaction than that of NDG. According to above analysis, hypotheses H4 – H5 have been accepted.

Finally, ANOVA has been employed to test if there are any differences on the perceived expectance, performance and pre-implementation factors between commercial DBMS and OS DBMS users. It has been turned out that there is significant difference on price (at 5% of significance) and reputation (at 10%) but no difference on previous experience between the two groups. Also, there is significant difference on the expectancy on DBMSs and disconfirmation between the two groups at 5% of significance level but no difference on performance. As a result, H8 and H10 are accepted at 5% and 10% of significance level. However, H9 is rejected.

## 6 DISCUSSION

The results in this research reveal that reputation and past experience are significant pre-implementation factors of DBMSs user expectancy while price only affects user expectancy of commercial DBMSs. In particular, reputation has been identified as the strongest pre-implementation factor of the user expectancy on commercial DBMS. Also, the reputation made stronger impact to the user expectancy of commercial DBMSs than that of OS DBMSs. Conversely, price made a significant impact to only the user expectancy on commercial DBMSs but not on OS DBMSs. This implies that users do not consider price in shaping expectancy on OS DBMSs despite of maintenance cost, and reputation and past experience are the major factors that determine the level of the user expectancy. Finally, the respondents had overall positive past experiences on both types of DBMS, and this made a

positive impact to the user expectancy of both types of DBMS. Also, there was no significant difference on the level of impact to the user expectancy between the two types of DBMSs.

Also the user expectancy and perceived performance significantly affected the expectancy disconfirmation which in order affected the user satisfaction. In particular, the expectancy and satisfaction on commercial DBMSs were higher than those of OS DBMSs. This was because higher price of commercial DBMSs led to higher expectancy on the performance, and the reputation and past experiences of commercial DBMSs were higher than those of OS DBMSs. On the other hand, there was no significant difference on the perceived performance between OS and commercial DBMSs. This led to higher positive expectancy disconfirmation of OS DBMSs than that of commercial DBMSs. According to the expectancy disconfirmation theory, the perceived satisfaction of OS DBMSs should have been higher than that of commercial DBMS but oppositional results were derived.

The contribution of this study is as follows. Firstly, to the authors' knowledge this paper is the first effort to explain the user satisfaction process of OSS. The results show that expectancy disconfirmation model can be used to explain user satisfaction on OSSs. OSSs are usually considered to provide inferior functionality as well as less maintenance support than commercial software whose users can expect intensive after service from the software providers. In spite of this inferior competition environment, open source software is increasing its share in software market. Low price seems not to be the only reason of such trend as the literature reveals many evidences that price is not the only factor in making purchase decisions. The results in this paper reveal that users have lower expectation on an OSS than commercial software and they can be satisfied with the lower performance of the OSS as their expectation was low in the beginning. Secondly, this research proposes an integrated model that combines a pre-implementation factors model for user expectancy with an EDM. One of the major critics on the EDM was the difficulty of measuring user expectancy (Yüksel and Yüksel, 2001). This paper identified pre-implementation factors of user expectancy on DBMSs and linked it to the EDM through verification of the pre-implementation factors model. Thirdly, this research compares user satisfaction processes of two different and competing types of IS (OSS and commercial software) within one framework. This allows direct comparison between user satisfaction processes of two alternative ISs. In this research, the positive disconfirmation level of OS DBMSs was bigger than that of commercial DBMSs but the overall satisfaction level of the former was smaller than the latter. This implies a non-linear relationship between the disconfirmation level and user satisfaction.

## 7 CONCLUSION

This paper has proposed an integrated EDM to explain user satisfaction of OSS and tested it through an empirical study on DBMS users. The proposed model integrated a pre-implementation factor model for user expectancy with the EDM to trace a process in which users 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 OS and commercial DBMS users to find any differences on the process and factors that shape user satisfaction. The results confirmed significant relationship between expectancy disconfirmation and user satisfaction on both types of DBMS. Reputation and past experience have been proved to be the major determinants of user expectancy on both types of DBMS but price has turned out to be a significant factor only for commercial DBMS. Performance and disconfirmation between user expectancy and performance of DBMS turned out to be the major factors determining the level of user satisfaction on both OS and commercial DBMSs. This confirms the proposition that users have lower expectancy on OSS than commercial software and that leads to reasonable degree of user satisfaction due to a positive expectancy disconfirmation. However, the higher degree of positive disconfirmation in OS DBMS than that of commercial DBMS did not lead to higher degree of user satisfaction by OS DBMS users and this need to be further investigated in future studies.

## 8 REFERENCES

- Ågerfalk, P. and Fitzgerald, B., "Outsourcing to an Unknown Workforce: Exploring Opensourcing as a Global Sourcing Strategy," *MIS Quarterly* (32:2), 2008, pp. 385 – 409.
- Anderson, E. W. and Sullivan, M.W. "The Antecedents and Consequences of Customer Satisfaction for Firms", *Marketing Science* 12 (Spring), 1993, pp.125–43.
- Au, N., Ngai, E.W.T. and Cheng, T.C.E., "A critical review of end-user information system satisfaction research and a new research framework," *Omega: The International Journal of Management Science* (30), 2002, pp. 451 – 478.
- Bernadette, S. and Scamell, R.W., "The Effects of Information System User Expectations on Their Performance and Perceptions," *MIS Quarterly* (17:4), 1993, pp 493 – 516.
- Bhattacharjee, A. "Understanding Information Systems Continuance: An Expectation-Confirmation Model," *MIS Quarterly* (25:3), 2001, pp.351 – 370.
- Bhattacharjee, A. and Premkumar, G., "Understanding Changes in Belief and Attitude toward Information Technology Usage: A Theoretical model and longitudinal Test," *MIS Quarterly* (28:2), 2004, pp.229 – 254.
- Bitner, M.J., "Evaluating Service Encounters: The Effects of Physical Surroundings and Employee Responses," *Journal of Marketing Research* (54), April, 1990, pp. 69-82.
- Bolton, R. and Drew, J., "A Longitudinal Analysis of the Impact of Service Changes on Customer Attitudes," *Journal of Marketing* (55), January, 1991, pp. 1-9.
- Cardozo, R.N., "An Experimental Study of Consumer Effort, Expectation and Satisfaction," *Journal of Marketing Research*, August, 1965, pp. 244-249.
- Churchill, G.A. and Suprenant, C., "An Investigation into the Determinants of Customer Satisfaction," *Journal of Marketing Research*, 1983, pp.60-65.
- Clow, K. E., Krutz, D.L. and Ozment, J., "How Consumers form Expectations of Service Quality Prior to a First Time Purchase," in Darden, V., R. Lusch, B. Mason(eds.), 1991.
- Clow, K.E. and Krutz, D.L., "The Antecedents of Consumer Expectations of Services: An Empirical Study Across Four Industries," *The Journal of Services Marketing* (11:4), 1997, pp. 230-248.
- Crowston, K., Annabi, H. and Howison, J., "Defining Open Source Software Project Success," In *Proceedings of 24<sup>th</sup> International Conference on Information Systems*, Seattle, Washington, 2003.
- Erevelles, S. and Leavitt, C. A. "Comparison of Current Models of Consumer Satisfaction/Dissatisfaction". *Journal of Consumer Satisfaction, Dissatisfaction, and Complaining Behavior*, 1992, 5, pp.104–14.
- Festinger, L., "A theory of cognitive dissonance," Evanston, IL: Row, Peterson, 1957.
- Fitzgerald, B., "The Transformation of Open Source Software," *MIS Quarterly* (30:3), 2006, pp. 587 – 598.
- Ginzberg, M.J., "Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions," *Management Science* (27), 1981, pp. 459 – 498.
- Grönroos, C., *Service Management and Marketing: Managing the Moments of Truth in Service Competition*, Lexington Books, Lexington, MA, 1990.
- Hahn, J., Moon, J.Y., and Zhang, C., "Emergence of New Project Teams from Open Source Software Developer Networks: Impact of Prior Collaboration Ties," *Information Systems Research* (19:3), 2008, pp. 369 – 391.
- Holbrook, B., "Situation-specific Ideal Points and Usage of Multiple Dissimilar Brands," in Sheth, J. (ed), *Research in Marketing* (7), JAI Press, Greenwich, CT, 1984, pp. 93 – 112.
- Kim, J.W., Shin, S.K., Kim, B.G., "An Empirical Study on the impact of Information Systems Expectation, Perceived Performance and Disconfirmation to User Satisfaction (in Korean)," *Information Systems Review* (14:1), 2004, pp. 101 – 123.
- Koo, S.E., "The impact of Service Ambiguity to User Satisfaction (in Korean)," *Korean Marketing Journal* (1:4), 1999, pp. 75 – 103.
- Lee, S.Y.T., Kim, H.W. and Gupta, S., "Measuring open source software success," *Omega: The International Journal of Management Science* (37), 2009, pp. 426 – 438.

- Lee, S., Suh, N.K. and Song, N.K. Determinants of public satisfaction with the National Health Insurance in South Korea, *International Journal of Health Planning and Management*, 2007, DOI: 10.1002/hpm.917
- Leichty, M. and Churchill, G.A. Jr., "Conceptual Insights into Consumer Satisfaction with Services," in Beckwith, N. et al. (ed), *Educator's Conference Proceedings Series 94*, 1979, American Marketing Association, pp. 509 – 515.
- Maish, M. "A user's behaviour toward his MIS", *MIS Quarterly* 3(1): 1979, pp. 39–52.
- McKinney, V., Yoon, K. and Zahedi, F.M., "The Measurement of Web-Customer Satisfaction: An Expectation and Disconfirmation Approach," *Information Systems Research* (13:3), September 2002, pp. 296 – 315.
- Miller, J.A., "Studying Satisfaction, Modifying Models, Eliciting Expectations, Posing Problems and Making Meaningful Measurements in Conceptualization and Measurement of Consumer Satisfaction and Dissatisfaction," *Marketing Science Institute*, 1977, pp. 72 – 91.
- Oliver, R. L., "A Cognitive Model of the Antecedents and Consequences of Satisfaction Decisions," *Journal of Marketing Research* (17:4), 1980, pp. 460-469.
- Oliver, R. L. "Satisfaction: A Behavioural Perspective on the Consumer", New York: Irwin McGraw-Hill, 1997.
- Oliver, R. L. and DeSabo, W.S., "Response Determinants in Satisfaction Judgment," *Journal of Customer Research* (14), 1988, pp. 405-507.
- Olson, J.C. and Dover, P., "Disconfirmation of consumer expectation through product trial," *Journal of Applied Psychology* (64), 1979, pp. 179 – 189.
- Raghu, T.S., Sinha, R., Vinze, A. and Burton, O., "Willingness to Pay in an Open Source Software Environment," *Information Systems Research* (online version ahead of print), August 2008, pp. 1 – 20.
- Staples, D.S., Wong, I. and Seddon, P.B., "Having expectations of information systems benefits that match received benefits: does it really matter?" *Information & Management* (40), 2002, pp. 115 – 131.
- Stewart, K.J., Ammeter, A.P., and Maruping, L.M., "Impacts of License Choice and Organizational Sponsorship on User Interest and Development Activity in Open Source Software Projects," *Information Systems Research* (17:2), 2006, pp. 126 – 144.
- Szajna, B. and Scamell, R.W., "The Effects of Information System User Expectations on Their Performance," *MIS Quarterly* (17:4), 1993, pp. 493-516.
- Van Ryzin, G. G. "Expectations, Performance, and Citizen Satisfaction with Urban Services", *Journal of Policy Analysis and Management* 23(3), 2004, pp. 433–48.
- Woodruff, R.B., "Expectations and Norms in Models of Consumer Satisfaction," *Journal of Marketing Research* (24), 1987, pp. 305 – 314.
- Yi, Y. "A critical Review of Customer Satisfaction. In *Review of Marketing*" (Eds.) V. A. Zeithaml, pp. 68–123. Chicago: American Marketing Association, 1990.
- Yüksel, A. and Yüksel, F., "The Expectancy Disconfirmation Paradigm: A critique," *Journal of Hospitality & Tourism Research* (25), 2001, pp. 107 – 131.