Asymmetric Impact of IS Quality on User Satisfaction: Development of Resource Allocation Strategy of e-Government in Agriculture

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Abstract Information System (IS) Success Model proposed by DeLone and McLean is applied as a successful operation tool of information system, with its basic assumption of symmetric relationship between independent variables and dependent variables of the structural equation modeling. However, because previous studies have proved asymmetry of quality factors' influence structure on dependent variable by applying three-factor analysis, this study examined asymmetry of impact structure of quality factors introduced in IS Success Model on user satisfaction. Also the study applies structure equation modeling (SEM), three-factor analysis and importance and performance analysis (IPA) to develop resource allocation strategy for IS success. The study is able to provide IS practitioners with strategic implications for allocating and managing limited resources more effectively.

Keywords IS Success, Asymmetric, Resource Allocation, User Satisfaction, System Quality, Information Quality, Service Quality

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1 Introduction

DeLone and McLean proposed IS(Information System) Success Models in 1992 and 2003 respectively (DeLone and McLean 1992; Delone and McLean 2003). Many studies based on the IS Success Model applied structural equation modeling (SEM) presuming symmetric relationships between independent variables and dependent variables to identify relationship between them (Chin 1998;Tenenhaus and Vinzi 2005). As a result, most IS Success Model-based studies suggested achievement of goals (dependent variables) by increasing independent variables with high correlation coefficient (Dolinsky 1991;Wittink and Bayer 1994). However, some recent studies on service marketing and service quality argue that such symmetric assumption should be reconsidered. Therefore, it is necessary to improve usability of the model by clarifying the asymmetric structure of each quality attribute.

Furthermore, IS Success Model's independent variables - system quality, information quality and service quality - are composed of indicators on quality of the IS. Therefore, for a successful operation of IS, such indicators need to be assigned resources. For example, convenience of use, stability of system and excellence of security – indicators of system quality proposed by DeLone and McLean - are identical measurements of system quality, but need distinctly different resources to be achieved. Therefore, in applying the result of structural equation analysis of IS Success Model in practice, it is hard to find specific answers for the question of which resources to increase or to decrease.

Importance-performance analysis (IPA) method is heavily used in practice to determine the priority of limited resources (Martilla and James 1977). It presumes that performance and importance for each quality attribute are independent from each other and performance for each attribute and overall satisfaction are in symmetric relations. Thus, it is necessary to consider the asymmetric structure of each quality attributes as well as to combine with IPA as a tool for strengthening IS Success Model explanatory power

and determine to practical priority among quality factors.

As a method of developing a successful IS management strategy, this study will figure out the impact structure of system quality, information quality and service quality on the customer satisfaction. Then the study, based on three-factor analysis, will identify asymmetric relationships between independent and dependent variables, assigning IS quality factors to three quality dimensions: attractive quality, one-dimensional quality and must-be quality. IPA analysis will be followed, analyzing importance and performance of quality factors. Finally this study will integrate results and develop a strategic, practical decision-making method for a successful IS.

The findings of this study will contribute to academia that understanding each quality attribute's asymmetry is an important start for operation strategy and resource-allocation decision. Furthermore the study may be able to provide strategic implications to allocate and manage limited resources more effectively to IS practitioners.

2 Research Framework

The foundation of our research framework comprises of 3 parts: SEM, three-factor analysis, and IPA. SEM is used to analyze impact of the quality factors based on Delone and McLean's IS Success Model on user satisfaction. Three-factor analysis is conducted for assigning those quality factors to three-factor quality dimension. Then we conducted IPA based on importance and performance of quality factors. Finally by integrating the results from those, we developed new decision making strategy for resource allocation of IT (Figure 1).

2.1 IS Success Model

DeLone and McLean introduced an integrated model for IS success and argued that system quality (SQ) and information quality (IQ) influence use and user satisfaction leading to individual impact and, in turn, organizational impact (DeLone and McLean 1992). In the study, they systematically classified IS success factors into six categories and review the causality among the factors. The IS Success Model provided guidance for future researchers.

In 2003, DeLone and McLean analyzed the result of studies referencing their model during the period from 1993 to 2002, and updated the model by adding service quality to the quality dimension of the model (Delone and McLean 2003). Service quality in the study refers not to the quality of overall information service, but to interaction between users and IS operating divisions, such as support and education for user.

Since a causal model postulates that A causes B, the IS success model is used to reach to IS success by analyzing the effects of quality dimensions on user satisfaction (Delone and McLean 2003). Structural equation model (SEM) using PLS is one of the most common methods to analyze the effects. This method assumes symmetric relationships between high and low satisfaction groups. For example, higher system quality, in the Delone and McLean's IS Success Model, is expected to lead to higher user satisfaction and use, leading to positive impacts on individual productivity and organizational productivity (Delone and McLean 2003).

2.2 Asymmetry Quality Attributes

Several studies on service marketing and service quality suggest that the assumption of linearity and symmetry in such causality should be reconsidered. For example, Ting and Chen verified asymmetry and non-linearity of the cor-

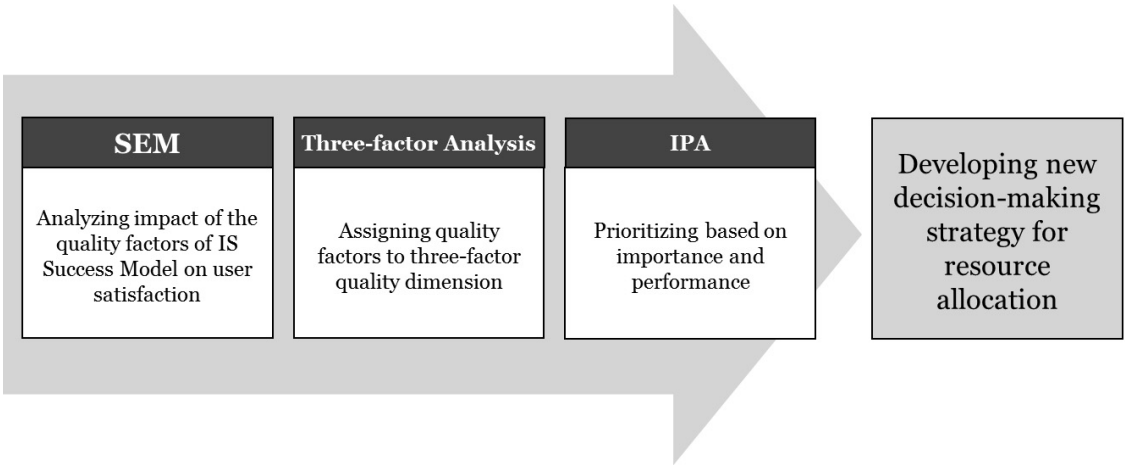

Fig. 1 Research Framework

relation between quality of a product and customer satisfaction; while car brakes have bigger impact in unsatisfied group than in satisfied group, car interiors have significant impact only in satisfied group (Ting and Chen 2002).

Studies on the asymmetry of quality attributes on customer satisfaction have begun since Herzberg, based on two-factor theory, distinguished motivation factors from hygiene factors for job satisfaction (Cadotte and Turgeon 1988;Maddox 1981;Swan and Combs 1976). Herzberg et al identified factors influencing job satisfaction by in-depth interviews and classify them into motivation factors and hygiene factors (Herzberg et al. 1993).

Motivation factors are those which themselves are the goals of work such as recognition from others or achievement of work and achieving such factors improves job satisfaction. Hygiene factors included physical work environment, company policies or job stability and very similar to hygiene factors in medical field. For example, garbage leads to higher chance of disease if not properly handled but do not cure individuals' disease even if properly handled.

The motivation-hygiene theory is highly related to the expectation-disconfirmation theory proposed by Oliver (Oliver 1977;Oliver 1980). Oliver argued that discrepancy between customers' pre-purchase expectation of the attributes of goods or service and post-use perceived performance leads to disconfirmation, in turn influence customer satisfaction. Applying the argument to the IS success model, researchers claims that each quality attribute's impact on customer satisfaction be influenced by the customers' prior expectation of quality of the IS (Oliver 1980).

Furthermore, Kano et al. clarified that the impact of quality attributes on satisfaction has non-linear based on characteristics of quality attributes, refining the motivation-hygiene theory and the expectation-disconfirmation theory (Kano et al. 1984). Also they classified the quality attribute factors into attractive factors, one-dimensional factors, must-have factors, indifferent factors and reverse factors.

Attractive quality factors create higher customer satisfaction when provided but create dissatisfaction in absent of it, namely that by providing services exceeding customer's expectations (potential needs), they enhanced customer satisfaction, which is a differentiating factor from competitors. One-dimensional quality factors - attributes which contribute to satisfaction when quality performance is high and lead to dissatisfaction when quality performance is low - are linear, symmetric factors. That is, they reflected needs expected by the customers and occurred in general competition structure. Must-be quality factors are those which expand customer dissatisfaction when their levels are low but do not create customer satisfaction even if their levels are high. That is, customers take them for granted regarding goods or services (basic needs) and are basic quality elements which, if not met, make market entry difficult. Indifferent quality factors are those which do not have impact on satisfaction or dissatisfaction whether provided or not and are either unnecessary for customers' use of goods or services or have low causality with satisfaction. Reverse quality factors are those which cause dissatisfaction when provided and include excessive kindness in customer services or excessive features in electronic products.

Many studies applied the Kano model in several areas, including classification of quality attributes (Huiskonen and Pirttila 1998;Nilsson-Witell and Fundin 2005). Also, Fuller and Matzler applied Kano model to study the customers' market classification (Fuller and Matzler 2008).

2.3 IPA (Importance-Performance Analysis) to Decide Priority of Strategic Resource Allocation

To a corporation, allocation of limited resources in achieving its goals is an important decision-making criterion. As a tool to support such decision-making, Martilla and James proposed the importance-performance analysis (IPA) method which determines strategic priority after measuring each quality attribute's importance and performance decided by customers (Martilla and James 1977).

In IPA method, importance (Axis X) is defined as customer's perception of the impact of each service attribute on the final goals of the service, and performance (Axis Y) is defined as customer's satisfaction with individual attributes of the provided service (Slack 1994). Measuring of importance is performed by directly inquiring customers of the importance of each quality attribute (self-stated) and measuring the impact (correlation coefficient) of each quality attribute on customer satisfaction (Matzler et al. 2004).

Figure 2 shows IPA matrix. In the axes of importance and performance, quadrant 1 (high importance, high performance) is classified as ‘Keep up the Good Work.’ Since attributes with high importance to customer and high quality performance currently provided are assigned therein, a strategy to maintain current dominance is necessary. Quadrant 2 (low importance, high performance) has attributes with high quality performance but low importance and classified as ‘Possible Overkill.' By deciding such excessively invested resources, an organization can perform efficient allocation of limited resources to higher-priority purposes. Quadrant 3 (low importance, low performance) is classified as ‘Low Priority.' Quadrant 4 (high importance, low performance) needs ‘Concentrate Here' strategy. When such quality attributes considered important by customers are provided in low level of performance, customer dissatisfaction and churn ensue. By moving efforts which are put into excessive resources and low-priority resources to the quality attributes of quadrant 4, corporations may achieve customer satisfaction (Martilla and James 1977).

IPA model is based on the basic premise that importance

and performance of each quality attribute are independent of each other and performance for each attribute and overall satisfaction has linear, symmetric relation. Thus many studies have proposed attempts of strengthening IPA's explanatory power by applying non-linearity of Kano's quality attributes (Matzler et al. 2004;Mikulic and Prebe ac 2008). Existing IPA recommends decision-making of resource allocation in which resources allocated to quality attributes in 'low priority' zone and 'excess' zone be moved to those in 'concentration' zone but studies applying Kano's three-factor analysis argued that different strategies have to be used depending on the must-have factors, one-dimensional factors and attractive factors of each quality attribute.

Considering the result of such preceding studies, IPA is a powerful tool to decide priority of resources to allocate for achieving strategic goals but it would be a more effective approach to derive strategic implications reflecting asymmetric impact relationship and the three-factor characteristics of each quality attribute by improving IPA's theoretical limitations (Kahneman and Tversky 1979;Kano et al. 1984;Mittal et al. 1998).

3 Research Methods and Data

3.1 Data Collection and Sampling

Agriculture Integrated Information Excellent System (hereinafter referred to as AgriX) was selected as the target system. AgriX is a system currently used by 13 thousand public servants in charge of agricultural projects and began its use in 2006. Since it is used by public servants in the government office in their everyday work, it is suitable to the study of public IS success model.

To collect data, online survey was performed from August 16 to September 15 of 2009 by AgriX's internal survey program and a total of 798 samples were collected. Regarding the characteristics of users, those in their 20s accounted for 22%, 30s did 44%, 40s did 27% and 50s did 6%, with 30s being the most. Males accounted for 72% while females did 28%.

Six questions were respectively assigned as indicators (quality factors) of system quality, information quality and service quality. Questionnaires were constructed by assigning two questions to customer satisfaction and six questions to net benefit. Likert's 7-point scale (1=not at all, 4=average, 7=very much so) was used to measure each question. Operational definitions and indicators of each variable are as shown in Table 1.

With respect to the analysis method to identify asymmetric quality attributes of quality factors, the scores are converted to the -3 ~ +3 range by subtracting each score by 4. As a result, the group who perceives the quality as high

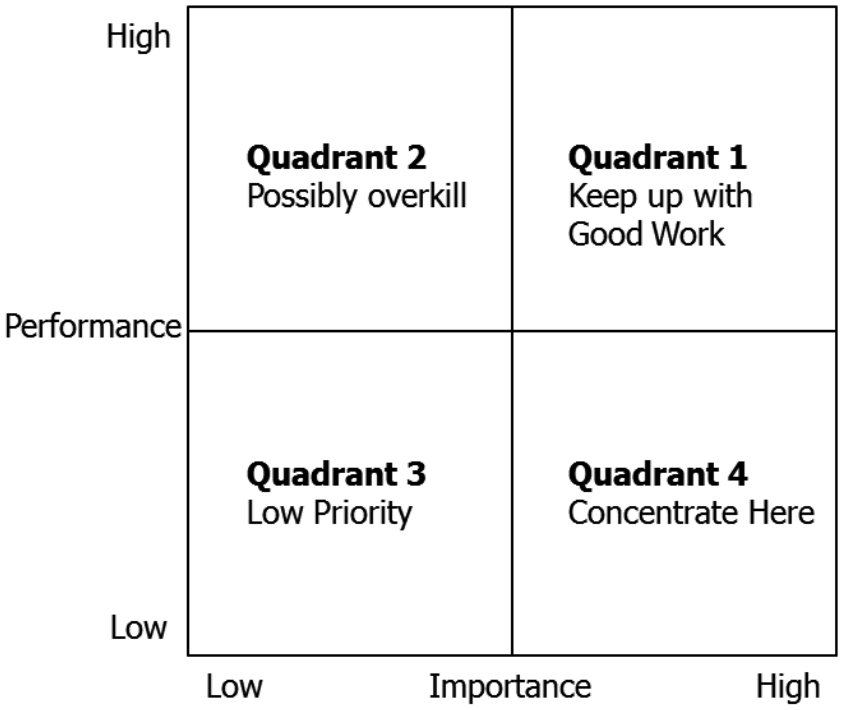

Fig. 2 IPA (Martilla and James, 1977)

(high group) is coded as (3, 0), (2, 0), (1, 0) according to each score. The group who perceive the quality as low (low group) was coded as (0, -1), (0, -2), (0, -3) and the group with response of 4 (average score) was coded as (0, 0). By doing so, impact of the quality factors on customer satisfaction can be divided by multiple regression equation according to high group and low group.

Table 1 Operational Definitions and Indicators

Latent Variable	Operational definitions	Quality		Related studies
System Quality (SQ)	IS performance perceived by customers	SQ1	convenience of use	DeLone and McLean (1992, 2003)
		SQ2	easy learnability of use	
		SQ3	system stability	
		SQ4	good overall security	
		SQ5	well-organized menu	
		SQ6	suitability to work	
Information Quality (IQ)	Level of information to satisfy customers' expectations and requirements (IS's output)	IQ1	accuracy of provided information	DeLone and McLean (1992, 2003)
		IQ2	reliability of provided information	
		IQ3	provision of outside information	
		IQ4	work connectivity of information	
		IQ5	utility of information	
		IQ6	recycling efficiency	
Service Quality (SerQ)	Level of satisfying customers' requirements in terms of service provided by IS	SerQ1	reliability of back office	Pitt et al. (1995), Molla and Licker (2001)
		SerQ2	sincerity of back office	
		SerQ3	quick response	
		SerQ4	skills of back office	
		SerQ5	continued improvement	
		SerQ6	proper training and support	
User Satisfaction (US)	Level of satisfaction felt by customers' use of system	US1	satisfaction of expectation	DeLone and McLean (1992, 2003)
		US2	overall satisfaction	
		US3	intention to expand	
		US4	intention to recommend	
Net Benefit (NB)	Benefit of individuals and organizations gained by customers' use of system	NB1	saving administrative cost	Delone and McLean (1992, 2003)
		NB2	saving visiting cost	
		NB3	saving administrative cost	
		NB4	reduction in document circulation time	
		NB5	reduction in reporting	
		NB6	reduction in conduct of work	

3.2 Data Analysis

3.2.1 Application of IS Success Model's Structural Equation

This study intended to apply Delone and McLean's IS Success Model in order to verify structural connectivity among independent variables, parameters and dependent variables involved in the success of public sector IS. System quality, information quality and service quality were selected as independent variables having impact on customer satisfaction, and net effect such as work saving, or administrative cost saving was set as the final goals of system success. In this study, intention to use is excluded because it was not our interest. Figure 3 shows our research model. Partial least squares (PLS) is chosen for data analysis.

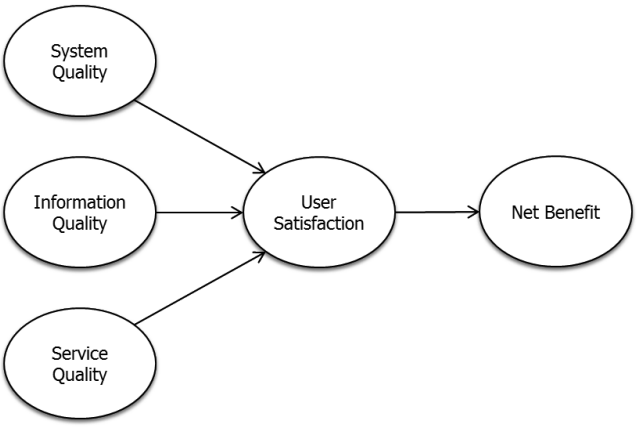

Fig. 3 Modified Research Model

3.2.2 Application of Three-factor Analysis

The core point of verification intended by this study is to prove that even indicators of the constructs may have different impact structures on user satisfaction by applying three-factor model to quality factors of IS Success Model's three independent variables, expanding IS Success Model's practical applicability. For that, this study verified that the impact structure of each indicator on user satisfaction is asymmetry according to quality performance. Verification of asymmetry of the impact is performed for each indicator by dividing into high (high quality perceived group) and low group (low quality perceived group). We would see the difference between the impact structures of these two groups on user satisfaction.

For deciding the impact of the indicators, three-factor analysis proposed by Matzler et al. was applied. Regression equation is shown below (equation (1)) (Matzler et al. 2004).

$$US = \beta_0 + \beta_{high}D_{high} + \beta_{low}D_{low} \ldots (1)$$

β_{high} represents coefficient of dummy variable of high group and β_{low} represents coefficient of dummy variable of low group. As written above, the high group is coded as (3,0), (2,0), (1,0) according to each score. The low group was coded as (0,-1), (0,-2), (0,-3) and the group with response of 4 (average score) was coded as (0,0). After that, we tested if the impact of high group and low group on user satisfaction is same ($\beta_{high} = \beta_{low}$), setting hypothesis is as below.

H_0: $\beta_{high} = \beta_{low}$
H_A: $\beta_{high} \neq \beta_{low}$

By using t-test, the hypothesis is tested. Equation (2) is used for t-test.

$$t = \frac{\beta_{high} - \beta_{low}}{\sqrt{var(\beta_{high}) + var(\beta_{low}) - 2cov(\beta_{low}\beta_{low})}} \ldots (2)$$

According to Matzler et al, if the ratio of the impact of high group (β_{high})to the impact of low group (β_{low}) is close to 1, than the quality factor is one-dimensional factor. If the ratio is larger than 1, the quality factor is attractive factor and if the ratio is smaller than 1, the quality factor is must-have factor (Matzler et al. 2004). In this study, if H_0 is accepted, we concluded that the quality factor is one-dimensional factor. If H_0 is rejected and if β_{high} is larger than β_{low}, we concluded the quality factor is attractive factor. Under the opposite condition, namely that if H_0 is rejected and if β_{low} is larger than β_{high}, we concluded that the quality factor is must-have factor.

3.3.3 Application of IPA

Decision of priority can be made by applying IPA. The impact of indicators on user satisfaction was used to represent importance, and average of the indicators' quality performance was used to represent performance. To derive impact to perform this IPA, multiple regression analysis was performed between six indicators of each construct and user satisfaction. Regression model is set as follow (equation (3)), with representing β_i coefficient of $_i{}^{th}$ indicator of the construct which means the impact of $_i{}^{th}$ indicator on user satisfaction.

$$US = \beta_0 + \sum_{i=1}^{n} \chi_i \beta_i \ldots (3)$$

Because user satisfaction is measured with two survey items, we conducted factor analysis and used factor scores as weight. Factor scores of two indicators were same, so that we weighed 0.5 to each indicator which consist user satisfaction. The standard of quality performance (Axis Y)

was calculated as average of all indicators' scores. The standard of importance is calculated as average of β coefficients of all indicators except indicators that are not significant.

3.3.4 Measurement Model Validation

Table 2 Correlations among Major Constructs

	SQ	IQ	SerQ	US	NB
SQ	**0.865***				
IQ	0.765	**0.884**			
SerQ	0.721	0.695	**0.854**		
US	0.601	0.583	0.513	**0.977**	
NB	0.668	0.614	0.553	0.553	**0.843**

AVEs are in Bold

Table 2 shows that discriminant validity is sufficient (Chin 1998). All of the reliability coefficients are greater than .729 and each AVE is above .710 (table 3), showing that the measurements model are reliable and the latent construct can account for at least 50 percent of variance in the items. Composite reliability and Cronbach α are added to make sure for reliability of the measurements model, resulting that the model is reliable. Also, the cross-loadings scores are in an acceptable range. Since the square root of the AVE is greater than all of the inter-construct correlations, it can be seen that each item loading in the table is much higher on its assigned construct than on the other constructs, supporting adequate convergent and discriminant validity.

Table 3 Validation and Cross Loading

Constructs	Indicators	System Quality (SQ)	Information Quality (IQ)	Service Quality (SerQ)	Customer Satisfaction (CS)	Net Benefit (NB)
SQ (CR*=0.947 CA**=0.931 AVE=0.749)	SQ1	0.872	0.646	0.629	0.686	0.610
	SQ2	0.858	0.649	0.601	0.610	0.533
	SQ3	0.821	0.607	0.599	0.622	0.574
	SQ4	0.847	0.652	0.617	0.588	0.543
	SQ5	0.905	0.712	0.651	0.643	0.588
	SQ6	0.884	0.702	0.644	0.675	0.618
IQ (CR=0.955 CA=0.943 AVE=0.781)	IQ1	0.633	0.810	0.557	0.560	0.511
	IQ2	0.661	0.880	0.612	0.596	0.517
	IQ3	0.629	0.894	0.574	0.542	0.528
	IQ4	0.681	0.906	0.621	0.611	0.548
	IQ5	0.717	0.916	0.660	0.642	0.571
	IQ6	0.734	0.894	0.660	0.646	0.581
SerQ (CR=0.942 CA=0.925 AVE=0.730)	SerQ1	0.676	0.658	0.871	0.641	0.528
	SerQ2	0.615	0.595	0.903	0.584	0.479
	SerQ3	0.582	0.585	0.891	0.578	0.466
	SerQ4	0.677	0.636	0.884	0.653	0.517
	SerQ5	0.595	0.568	0.836	0.603	0.434
	SerQ6	0.546	0.517	0.729	0.496	0.405
US (CR=0.977 CA=0.952 AVE=0.955)	US1	0.699	0.645	0.669	0.977	0.606
	US2	0.742	0.681	0.689	0.977	0.624
SQ (CR*=0.947 CA**=0.931 AVE=0.749)	NB1	0.554	0.505	0.435	0.510	0.843
	NB2	0.460	0.412	0.382	0.437	0.784
	NB3	0.581	0.537	0.484	0.558	0.900
	NB4	0.583	0.543	0.488	0.571	0.899
	NB5	0.591	0.541	0.491	0.534	0.833
	NB6	0.607	0.566	0.514	0.567	0.791

* CR=Composite Reliability
** CA=Cronbach Alpha

4 Results

4.1 Results from IS Success Model's Structure Equation

Analysis of the structural equation modeling showed that the model's explanatory power (R2) was 0.613 and customer satisfaction's impact on net effect was 0.639 (t=32.625), which is significant. With respect to independent variables' impact on customer satisfaction, service quality was the highest at 0.398 (t=11.763) and system quality was verified significant at 0.371 (t=11.005). Even though its impact was small, information quality was also verified significant at 0.151 (t=4.235). Supporting Delone and McLean's IS Success Model (1992), such result shows that improvement of service quality, system quality, and information quality is necessary to maximize this IS's net effect.

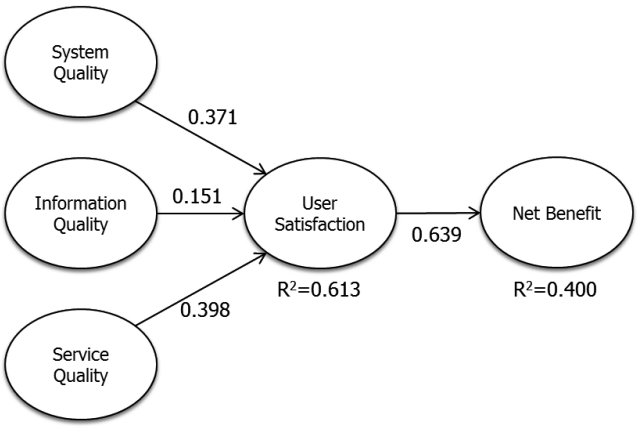

Fig. 4 Modified Research Model

4.2 Result From Three-factor Analysis

The result is shown in Table 4. Regression coefficients (impact) of high group and low group are presented and compared, showing asymmetry in the impact of two groups on customer satisfaction. The presence of such asymmetry proved different impact of independent variables' impact structure on dependent variables between two groups.

In the system quality, must-have factors included 'system stability' and every other than that were included in one-dimensional factors. In the information quality, must-have factors included 'accuracy of provided information' and 'reliability of provided information' and others else are confirmed to be one-dimensional factors. In the service quality, attractive factors included 'skills of back office', 'continuous improvement', and 'proper training and support'. Remaining three, including 'reliability of back office', sincerity of back office', and 'quick response' were included in one-dimensional factors.

Table 4 Three-factor Analysis Results

Constructs	Quality Factors (Indicators)		Coefficient		t-test ($\beta_{high} = \beta_{low}$)	3 factor
			β_{high}	β_{low}		
SQ	SQ1	convenience of use	.389	.466	-0.952	O
	SQ2	easy learnability of use	.375	.358	-0.513	O
	SQ3	system stability	.252	.524	-3.179**	M
	SQ4	good overall security	.377	.362	-0.258	O
	SQ5	well-organized menu	.403	.412	0.228	O
	SQ6	suitability to work	.415	.419	0.477	O
IQ	IQ1	accuracy of provided information	.271	.417	-1.654*	M
	IQ2	reliability of provided information	.331	.393	-1.896*	M
	IQ3	provision of outside information	.316	.370	-1.059	O
	IQ4	work connectivity of information	.392	.345	-0.064	O
	IQ5	utility of information	.431	.332	0.433	O
	IQ6	recycling efficiency	.420	.358	0.204	O
SerQ	SerQ1	reliability of back office	.447	.396	1.231	O
	SerQ2	sincerity of back office	.426	.354	0.438	O
	SerQ3	quick response	.394	.369	-0.147	O
	SerQ4	skills of back office	.474	.402	1.783*	A
	SerQ5	continued improvement	.439	.317	1.738*	A
	SerQ6	proper training and support	.357	.355	1.762*	A

4.3 Results from IPA

The mean value of total quality factors' performance score is 4.19. The average of significant quality factors' β coefficients was 0.124. We set four quadrants based on those two numbers. As the result of IPA analysis, there are two quality factors in the first quadrant, eight in the second, four in the third, and three in the fourth (table 5). 'Reliability of back office' is positioned on the line dividing the first quadrant and the fourth quadrant. There are 6 quality factors that did not have significant impact on user satisfaction, meaning that their importance is low.

Traditional IPA model recommended that low-priority zone be excluded from decision of priority because they have low importance. However considering three-factor characteristics, must-have factors such as SQ3 (system stability) have high importance in the low group but as they move to the high group, their importance becomes rapidly lower. On the other hand, attractive factors such as SerQ6 (proper training and support) have low importance in the low group but as they move to the high group, their importance increases exponentially. It is not that SerQ6 both lack priority as it belongs to quadrant III but that its quality is one whose importance grows with improvement thereof, so a high priority needs to be considered. Thus, a better decision-making becomes possible by considering the non-linearity of quality attributes even in the IPA analysis.

Table 5 IPA Results

	Quality Factors (Indicators)		**Importance (*β*)**	**Significance (p-value)**	**Perform ance**	**S.D.**	**3 factor**
SQ	SQ1	convenience of use	0.337	0.000	4.07	1.68	Ⅳ
	SQ2	easy learnability of use	-0.029	n/s*	4.39	1.51	Ⅱ
	SQ3	system stability	0.220	0.000	3.50	1.70	Ⅲ
	SQ4	good overall security	0.047	n/s	4.27	1.42	Ⅱ
	SQ5	well-organized menu	0.227	0.227	4.14	1.48	Ⅲ
	SQ6	suitability to work	0.227	0.000	4.12	1.53	Ⅳ
IQ	IQ1	accuracy of provided information	0.235	0.000	3.84	1.57	Ⅳ
	IQ2	reliability of provided information	0.105	0.038	4.26	1.46	Ⅱ
	IQ3	provision of outside information	-0.055	n/s	4.15	1.40	Ⅲ
	IQ4	work connectivity of information	0.115	0.039	4.42	1.41	Ⅱ
	IQ5	utility of information	0.102	n/s	4.54	1.40	Ⅱ
	IQ6	recycling efficiency	0.304	0.000	4.44	1.43	Ⅰ
SerQ	SerQ1	reliability of back office	0.294	0.000	4.19	1.47	Ⅰ, Ⅳ
	SerQ2	sincerity of back office	-0.042	n/s	4.36	1.44	Ⅱ
	SerQ3	quick response	0.038	n/s	4.20	1.45	Ⅱ
	SerQ4	skills of back office	0.368	0.000	4.25	1.51	Ⅱ
	SerQ5	continued improvement	0.089	0.009	4.41	1.47	Ⅰ
	SerQ6	proper training and support	0.174	0.000	3.90	1.41	Ⅲ(+)

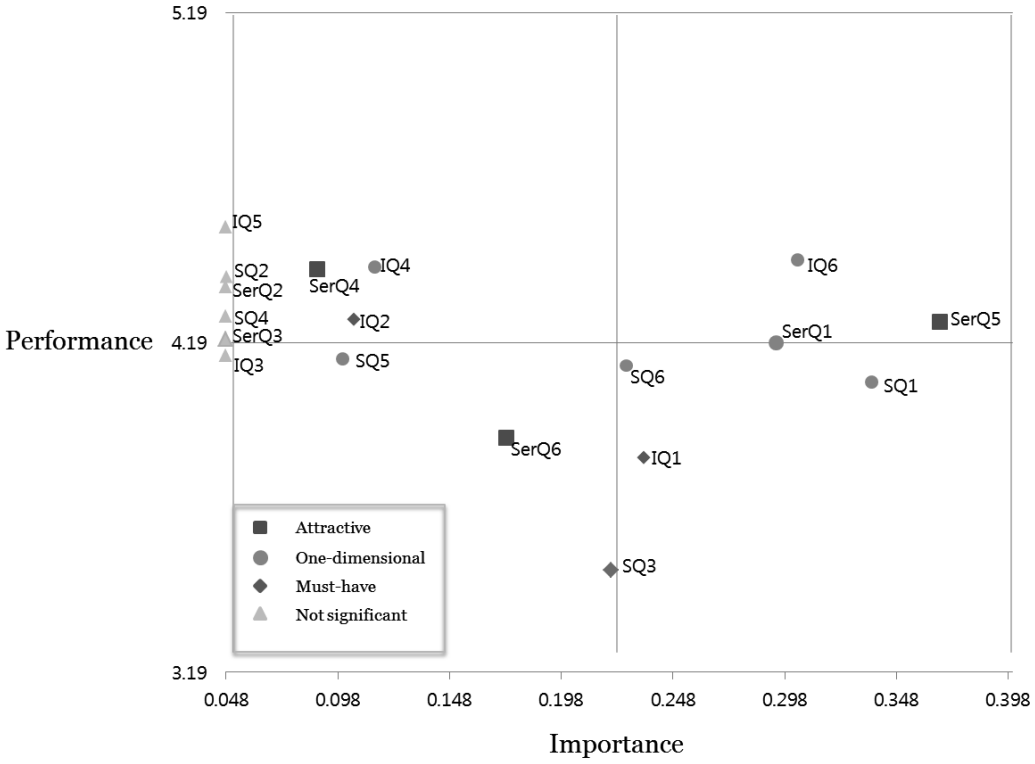

Fig. 5 Visualized IPA Results

4.4 Comprehensive Resource Allocation Strategy of IS

In this study, impact of the three quality dimensions of IS Success Model on customer satisfaction was first analyzed, and three-factor attributes were assigned to quality factors and then a priority matrix decision was made through importance-performance analysis. By combining such results, a score card to decide priority were made as in Table 6.

We note that the scoring method is not supported by any literatures and methods. The purpose of this paper is not suggesting which quality factors are more important than others, but developing new strategy for resource allocation of IS. Different organizations may have different idea about scoring. Thus we do not suggest practitioners in IS field to use our scoring method. The scoring method used in this paper is one possible example.

Finally, we sum up all points including the values of SEM, Three-factor and IPA. To decide the final priority of quality factors, we devide 3 levels which are set point 6~9 as the first, point 3~6 as the second, and point 0~3 as the third. Consequently, three first priority quality factors are included in system quality and those are 'convenience of use', 'system stability', and 'suitability to work'. In the information quality only one first priority factor – accuracy of provided information - is included. In the service quality, 'reliability of back office', 'skills of back office', and 'proper training and support' are first priority quality factors.

Our scoring method is as follows. First, with SEM results, we scored service qualities as 3 because the influence of service quality is largest (path coefficient is 0.398 and the largest). Other two constructs, system quality and information quality are given points considering relative size of their path coefficient. As a result, quality factors which belong to information quality are given 1.14 and those that belong to system quality are given 2.80.

Second, considering three-factor analysis, we gave 1 point if quality factors are included in one-dimensional qualities, 2 points if included in attractive qualities, and 3 points if included in must-have qualities. That is because, according to Kano and Matzler et al., if must-be quality were not fulfilled, user satisfaction cannot be made (Kano et al. 1984;Matzler et al. 2004). Also, in the case of putting same amount of resources to attractive quality and one-dimensional quality, we can have larger user satisfaction with attractive quality than with one-dimensional quality. Therefore, must-be quality is the first to be achieved, attractive quality the second and one-dimensional quality the last.

Third, based on IPA analysis, we gave 3 points to the quality factors positioned in the quadrant 4, 2 points to those in the quadrant 1, 1 point to those in the quadrant 3, and no point to those in the quadrant 2. Because quadrant 4 has attribute with high importance but low performance, we gave highest score to the quadrant 4. However, the quadrant

2 has attribute with low importance and low performance, managers should not put resources into quadrant 2. Since SerQ1, 'reliability of back office' is on the line between quadrant 4 and quadrant 1, we gave point 2.5 to SerQ1. For SerQ6, considering that its quality is one whose importance grows with improvement and thus it needs high priority, we gave 1 point more to SerQ6.

Table 6 Comprehensive Prioritizing Quality Factors

	Quality Factors (Indicators)		SEM	Three-factor	IPA	Score	Priority
SQ	SQ1	convenience of use	2.80 (0371)	1(O)	3(Ⅳ)	6.80	1st
	SQ2	easy learnability of use		1(O)	0(Ⅱ)	3.80	3rd
	SQ3	system stability		3(M)	1(Ⅲ)	6.80	1st
	SQ4	good overall security		1(O)	0(Ⅱ)	3.80	2nd
	SQ5	well-organized menu		1(O)	1(Ⅲ)	4.80	2nd
	SQ6	suitability to work		1(O)	3(Ⅳ)	6.80	1st
IQ	IQ1	accuracy of provided information	1.14 (0.151)	3(M)	3(Ⅳ)	7.14	1st
	IQ2	reliability of provided information		3(M)	0(Ⅱ)	4.14	2nd
	IQ3	provision of outside information		1(O)	1(Ⅲ)	3.14	2nd
	IQ4	work connectivity of information		1(O)	0(Ⅱ)	2.14	3rd
	IQ5	utility of information		1(O)	0(Ⅱ)	2.14	3rd
	IQ6	recycling efficiency		1(O)	2(Ⅰ)	4.14	2nd
SerQ	SerQ1	reliability of back office	3.00 (0.398)	1(O)	2.5(Ⅰ, Ⅳ)	6.50	1st
	SerQ2	sincerity of back office		1(O)	0(Ⅱ)	4.00	2nd
	SerQ3	quick response		1(O)	0(Ⅱ)	4.00	2nd
	SerQ4	skills of back office		2(A)	2(Ⅰ)	7.00	1st
	SerQ5	continued improvement		2(A)	0(Ⅱ)	5.00	2nd
	SerQ6	proper training and support		2(A)	2(Ⅲ+)	7.00	1st

5 Conclusion

Our interest in developing new strategy for resource allocation of IS was triggered by asymmetric relationship between quality and satisfaction. In this study, impact of the three quality dimensions of IS Success Model on customer satisfaction was first analyzed, and Kano's three-factor attributes were assigned to quality factors, and then a priority decision was made through IPA. By conducting one survey, this study integrated results from SEM, three-factor analysis, and IPA analysis, suggesting a method of deciding priority of resource allocation for maximize net benefit of IS.

5.1 Theoretical Contribution

Two key aspects of this study signify our contribution to the theory of IS quality and satisfaction. First focus on Delone and McLean's IS Success Model applicateed to the information system of public administration. While the ISs in public and private are different (Bretschneider 1990), this study shows that Delone and McLean's IS Success Model can be applied to public administration IS; namely PLS results show that system quality, information quality, and service quality positively affect user satisfaction and user satisfaction positively affect net benefit of IS. Even though we did not include variable 'intention to use,' the SEM results support not only Delone and McLean's research but also their follow-up research of IS success (Halawi et al. 2008;Leclercq 2007).

Second, this research proved that the quality factors of IS have asymmetric relationship with user satisfaction. Dividing users into high group and low group, the study showed that each quality factors has different influence structure on satisfaction, supporting Kano (1984). Previous researches on IS using SEM assumed linear relationship between independent variables and dependent variable, thus they also assumed symmetric relationship between variables (Chin 1998;Tenenhaus and Vinzi 2005). However, based on findings of this study, those that are using SEM can be reconsidered as variables are not symmetrically related.

5.2 Managerial Implication

Many of our findings provide guidance to management and IT practitioners. First, this study only use SEM based survey to conduct SEM analysis, three-factor analysis, and IPA, namely that the method is convenient to use. Three-factor analysis has been hard to be conducted because it needs complex survey. This research divides user group as high and low group, conducting regression analysis, so that practitioners may be able to determine quality factors' attribute. Also, the one source of survey data can also be applied to IPA.

Second, the proposed method provides determination of resource allocation priority. Organizations including private firms and public administration face the issue of performance maximization with their limited resource. Thus, how to appropriately allocate resource is important. With Delone and McLean's IS Success Model only addresses the relationship among qualities, user satisfaction, and net benefit. The method used in this research, combining three analyses, suggests a new strategy for resource allocation of IS and thus is an effective way for priority determination.

5.3 Limitation and Future Study

Despite the comprehensiveness of the proposed model and the empirical support for it, we acknowledge some theoretical limitations, which call for additional research.

First, although user satisfaction, perceived usefulness, intention to use are commonly used as mediators for Delone and McLean's IS success model in IS field, this study only utilizes user satisfaction. Large number of studies for IS success verify that intention to use has significant impact on net benefits in Delone and McLean's IS Success Model (Almutairi and Subramanian 2005;Burton-Jones and Straub 2006;Kositanurit et al. 2006). Therefore, further research is needed to figure out how quality attributes of IS have impact on perceived usefulness and intention to use.

Second, in this study we give points to each quality factors based on coefficients in SEM, three-factors in Kano, quadrant of the importance-quality performance, which is not tested statistically. Moreover, the formula for decision priority does not reflect weights from each of processes. Research environments, such as characteristics of industries and researchers, could have influence to compute the score and the weight, which needs further research for it.

Finally, the impacts of independent variables on dependent variables in IS field could be asymmetric as previous discussed. Thus, extant research models in IS field should be considering the asymmetry.

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