Measurement of a Customer Satisfaction Index for Improvement of Mobile RFID Services in Korea

Yong-Jae Park, Pil-Sun Heo, and Myung-Hwan Rim

One of the ubiquitous technology fields that have received the most attention recently from technology communities worldwide is mobile radio frequency identification (RFID). Mobile handsets loaded with RFID readers enable the identification and retrieval of information on RFID tagged objects. In Korea, a variety of mobile RFID services are currently being piloted, and their commercial roll-out looks imminent. The goal of this study is to propose, ahead of the commercial launch of mobile RFID services, a customer satisfaction index (CSI) model for this service category and to then measure the CSI to derive practical implications for their providers and pointers related to the improvement of service. A web survey was conducted on Korean mobile phone subscribers who had participated in a mobile RFID pilot program. Using the results of this survey, we tested the CSI model and its hypotheses by employing a partial least-squares-based structural equation model analysis and calculated the index. We further conducted an importance-performance analysis in order to provide insights that may be useful for improving the quality of mobile RFID services.

Keywords: Radio frequency identification (RFID), mobile RFID services, customer satisfaction index (CSI), partial least squares (PLS), structural equation model analysis, importance-performance analysis.

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I. Introduction

As the radio frequency identification (RFID)-enabled mobile phone has been earning increasing recognition as a convergence solution with the potential to accelerate the transition toward a ubiquitously-networked society, efforts are currently under way in many parts of the world to develop and commercialize related technologies. RFID is a wireless sensor technology which is based on the detection of electromagnetic signals [1] and provides various communication services using RFID tags [2], [3]. In the US, RFID technology has been successfully integrated into government led U-Health projects, and a variety of services bundling mobile RFID and wireless Internet access are successively being launched. In Europe, 13.55 MHz-band portable units based on mobile RFID technology are under development at companies such as Nokia [4]. In Japan, a prototype RFID reader-enabled mobile phone was released by KDDI in 2005. In October 2006, a commercial mobile RFID reader was rolled out as well, through a joint project involving Hitachi [5].

In Korea, convergence technology has been studied with a view to mounting miniature RFID readers on cellular phones. The research has been conducted by the Mobile RFID Forum established in February 2005 by the Ministry of Information and Communication and the relevant organizations. Recently, the leading providers of mobile telecommunications in Korea, SKT and KTF, have been providing mobile RFID trial services, and as a result, the commercialization of these services is imminent. In Korea, these trial services include the following: genuine ginseng verification, uPortal service, genuine drug verification, safe taxi service, indoor navigation service, shopping guide service, Korean premium beef verification, touch book service, and McDonald's touch order service [6]-[8].

Table 1. Prior studies on customer satisfaction index models.

CSI Model	Construct dimensions	Related studies
ACSI	Perceived quality, customer expectations, perceived value, overall customer satisfaction, customer complaints, customer loyalty	Fornell et al. [9]
ECSI	Image, customer expectations, perceived hardware quality/perceived software quality, perceived value, customer satisfaction, customer loyalty	ECSI [10]
ECSI for portal service	Image, customer expectations, product hardware quality, customer service human-ware quality, perceived value, customer satisfaction, customer loyalty	O'Loughlin and Coenders [11]
SWICS	Customer satisfaction, customer dialogue, customer loyalty	Bruhn and Grund [12]
Canadian CSI for mobile services	Perceived quality, customer expectations, perceived value, customer satisfaction, customer complaints, price tolerance, repurchase likelihood	Turel and Serenko [13]

It is important for service providers to measure the level of satisfaction among customers who have tried out mobile RFID services through pilot programs ahead of their commercial roll-out in Korea, as this could assist providers in identifying and reforming the areas that may need improvement. Meanwhile, investigative issues related to the improvement of customer satisfaction have long been a major area of research in the service marketing subfield of business management. The American Customer Satisfaction Index (ACSI), developed in the mid-1990s, for instance, has provided a basic framework for many other index models created elsewhere in the world [9]. However, the related studies have been mostly focused on measuring customer satisfaction indices for entire industry sectors, and the rankings produced have been used for the purposes of advertising the concerned sectors and marketing. Few of the previous studies in this field explored perceived quality factors that have an actual impact on customer satisfaction or sought to develop strategies for quality improvement.

In this study, we propose a new customer satisfaction index (CSI) model which is adapted to the field of the mobile RFID service. By calculating the index, this study can offer the providers of this service practical tips which will result in an improvement in service quality ahead of the commercial roll-out.

II. Theoretical Background and Hypotheses

1. Theoretical Background

A. Customer Satisfaction Index Models

The ACSI model, elaborated during the mid-1990s by US service marketing researchers, has served as the basis for other CSI models developed in many countries around the world. The ACSI model is composed of six factors: perceived quality, customer expectations, perceived value, overall customer satisfaction, customer complaints, and customer loyalty. Each factor is linked to the others through a causal relationship [9]. This is to say, the higher the customer expectations, the higher the perceived quality; the higher the customer expectations and the higher the perceived quality, then the higher the perceived value, which finally results in higher customer satisfaction. Likewise, a high level of customer satisfaction tends to reduce customer complaints and increase customer loyalty. Thus, the causal model explains the inversely proportional relationship between customer complaints and customer loyalty.

The European Customer Satisfaction Index (ECSI) model uses six constructs, namely, image, customer expectations, perceived quality of hardware and software, perceived value, customer satisfaction, and customer loyalty. These six factors are also linked through a causal relationship. Image has a determining influence on customer expectations, and customer expectations, in turn, affect the perceived quality of hardware or software. The European model eliminates the category of "customer complaints" present in the original ACSI model [10]. As for the ECSI model for portal services proposed by a follow-up study, it consists of seven factors, namely, image, hardware quality, customer service, quality of human-ware, perceived value, customer satisfaction, and customer complaints, all of which are causally interrelated [11].

The Swiss Index of Customer Satisfaction (SWICS) measures three factors: customer satisfaction, customer dialogue, and customer loyalty. The three factors exist in a causal relationship in which customer satisfaction affects customer dialogue and customer loyalty, and customer dialogue affects customer loyalty [12].

The Canadian Customer Satisfaction Index model for mobile services modifies the ACSI by adding the category "price tolerance" and replacing "customer loyalty" with "repurchase likelihood" [13].

These CSI models, summarized in Table 1, reveal that most of them could be improved through the use of more detailed

perceived quality factors. The obvious reason for this is that, as has been pointed out by many studies, a high level of customer satisfaction reduces customer complaints and increases customer loyalty; therefore, it is of paramount importance to improve customer satisfaction, which can be achieved by enhancing the level of perceived quality. Quality-related factors are especially important with regard to services in the pilot stage, such as mobile RFID services in Korea. By determining which quality factors are capable of increasing customer satisfaction and developing strategies for quality improvement, service providers can improve the odds of the successful commercialization of these services. In the following subsection, we explore the quality factors that may be pertinent to mobile RFID services through a review of prior studies.

B. Quality Factors in Mobile RFID Services

One of the most important perceived quality factors for customers of mobile RFID services is the device's recognition capability. This is because the basic shared functions of all mobile RFID services are the identification of RFID tagged objects and the retrieval of information through the RFID reader-integrated mobile handset. The reading speed, accuracy, and range of RFID tags and the rate of recognition are the key quality factors having a determining influence on the satisfaction felt by customers. SKT, for instance, one of the Korean mobile operators scheduled to provide commercial mobile RFID services, uses recognition capability as the chief criterion in its assessment of the pilot results [6].

Another important quality factor is the quality of the wireless Internet connection because information on objects recognized through mobile phone RFID readers is transmitted over wireless communications networks. Prior studies on this topic report that the stability of a wireless Internet content system and download speed are the two connection quality related factors that most decisively affect the degree of satisfaction felt by customers [14].

The third quality factor is interaction with customers. Mobile RFID service systems retrieve information from RFID tagged objects and transmit content which is relevant to the information collected. In [14], it was empirically demonstrated that the quality of interaction between a wireless Internet content system and its users had a measurable influence on the level of customer satisfaction. In [15], "interactivity" was reported to be one of the system quality factors affecting satisfaction with a web-based customer support system.

The fourth quality factor is the content itself. Mobile RFID services are essentially targeted content delivery services, enabled by a remote recognition technology. Therefore, the quality of the content delivered can have a major impact on the level of customer satisfaction. In [16], a study on the success of information systems, it was found that the quality of the content was one of the principal factors. Similar conclusions were reached in [15] and [17]. In [14], it was also confirmed that content quality had an influence on the satisfaction felt by users. Wang and Liao [18] proposed content quality as one of the parameters by which to measure the degree of satisfaction felt by users of mobile commerce.

Finally, the fifth factor is related to the quality of the provided service. Lai [19] conducted an empirical study to verify whether service quality indeed influenced the customer satisfaction with short message services (SMS). In [18], a study on mobile commerce, customer satisfaction was measured using service quality as one of the parameters. The quality factors affecting customer satisfaction in mobile services as proposed by previous studies are summarized in Table 2.

Table 2. Related prior studies on quality factors.

Researcher	Tag recognition quality	Connection quality	Interaction quality	Content quality	Service quality
Chae et al. [14]		●	●	●	
DeLone and McLean [16]				●	●
Jung [6]	●				
Lai [19]					●
Negash et al. [15]			●	●	●
Seddon [17]				●	
Wang & Liao [18]				●	●

2. Customer Satisfaction Index Model for Mobile RFID Services and Hypotheses

To increase the level of satisfaction felt by customers of mobile RFID services, reduce complaints, and thereby enhance their loyalty to the service provider, we identified a series of perceived quality factors that influence customer satisfaction and proposed a CSI model as described in Fig. 1. The quality factors deemed in this model to positively influence customer satisfaction are the following: tag recognition quality, connection quality, interaction quality, content quality, and service quality. Customer satisfaction, customer complaints, and customer loyalty form a causal chain of relationships. In other words, a high level of customer satisfaction decreases customer complaints, and the decrease of customer complaints, in turn, results in enhanced customer loyalty.

As suggested in [9] and [13], perceived quality has a positive

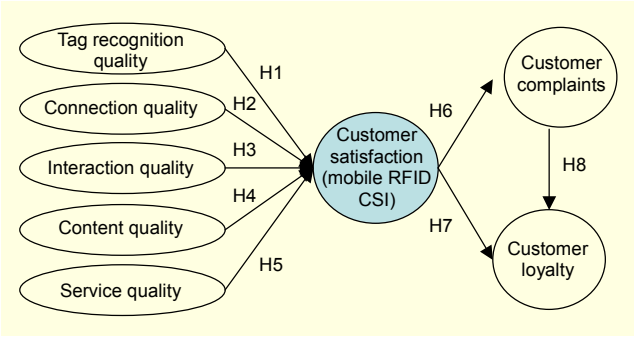

Fig. 1. Customer satisfaction index model for mobile RFID services.

influence on the level of customer satisfaction. The quality of tag recognition, the most essential perceived quality factor for mobile RFID services, breaks down into reading speed, accuracy, distance, and recognition rate. It has a major impact on the level of customer satisfaction [6]. In this study, we assumed that the quality of tag recognition positively affects customer satisfaction; therefore, we formed the following hypothesis:

Hypothesis 1. Tag recognition quality has a positive effect on customer satisfaction with mobile RFID services.

Chae and others [14], in their empirical investigation of factors that influence customer satisfaction with wireless content systems, reported that the stability of a wireless content system and download speed are two quality factors related to connection quality. Also, in a case study on the e-commerce system of ME Electronics [16], it was found that the speed of download has an effect on the level of satisfaction felt by customers. Kim and others [20] empirically demonstrated that the speed of download and upload influenced the level of satisfaction, especially by customers using high-speed Internet services. As mobile RFID services use wireless networks to transmit the information collected from RFID tagged objects, the quality of connection to the wireless Internet is likely to have a positive impact on customer satisfaction. Therefore, we formed the following hypothesis:

Hypothesis 2. Connection quality has a positive effect on customer satisfaction with mobile RFID services.

The quality of interaction between the users of a mobile RFID service and RFID-enabled mobile handsets may be another factor that exerts an important influence on customer satisfaction. In [14], it was found that the quality of interaction between a wireless content system and its customers had a verifiable influence on customer satisfaction. In a similar vein, [15] proposed interactivity as a system quality factor that affects customers satisfaction with a web-based customer support system. Therefore, we formed the following hypothesis:

Hypothesis 3. Interaction quality has a positive effect on customer satisfaction with mobile RFID services.

Numerous studies have verified that content quality has a positive effect on customer satisfaction [16], [17]. In [15], the positive influence of information quality on satisfaction was empirically tested. In [14], a study on mobile content systems, empirical evidence was also obtained that content quality had a positive influence on customer satisfaction. In [21], the positive impact of content quality on customer satisfaction in the digital content industry was also confirmed. Therefore, we formed the following hypothesis:

Hypothesis 4. Content quality has a positive effect on customer satisfaction with mobile RFID services.

The causal relationship between service quality and customer satisfaction has been suggested and demonstrated by several studies [16], [19]. Therefore, we formed the following hypothesis:

Hypothesis 5. Service quality has a positive effect on customer satisfaction with mobile RFID services.

As suggested by the ACSI model, customer satisfaction has a negative influence on customer complaints and a positive influence on customer loyalty. Furthermore, customer complaints, according to the ACSI model, still have a negative influence on customer loyalty. The above causal relationships have been empirically confirmed in [13] and [21]. Therefore, we propose the three following hypotheses:

Hypothesis 6. Customer satisfaction has a negative effect on customer complaints about mobile RFID services.

Hypothesis 7. Customer satisfaction has a positive effect on customer loyalty toward mobile RFID services.

Hypothesis 8. Customer complaints have a negative effect on customer loyalty toward mobile RFID services.

III. Research Methodology

1. Research Variables and Sample

Variables were chosen largely based on prior research, and measured variables and measurement items were defined by appropriately modifying them to suit the purposes of this study. The questionnaire items used in the survey were tested through a preliminary survey, which was conducted with technological experts and business professionals involved in the mobile RFID field. After the necessary modifications, the 23 questionnaire items shown in Table 3 were finally selected. All of the items were measured using a 10-point scale (1: very low,

Table 3. Research variables and measurement items.

Variables	Measurement items	
Tag recognition quality [6]	Tg1	Speed of tag reading
	Tg2	Accuracy of tag reading
	Tg3	Distance of tag reading
	Tg4	Degree rate of tag recognition
Connection quality [14]	Cn1	The mobile RFID service system is stable, and errors are few and infrequent.
	Cn2	Quick response to RFID tags and short download time
Interaction quality [14]	In1	The mobile RFID service menu/interface is clear, and the organization of the contents is easy to understand.
	In2	The content provided is consistently represented, and the screen design is harmonious.
	In3	The navigation structure is simple to follow, and going back to a previously visited page is easy.
Content quality [15], [18]	Co1	The content delivered is accurate.
	Co2	The content delivered is up to date.
	Co3	The content is useful.
	Co4	The content is clear and understandable
Service quality [18]	Se1	The response time to customer requests is reasonably fast.
	Se2	Solutions provided to customer requests are pertinent and helpful.
	Se3	Adequate FAQs
	Se4	Satisfactory after-sales services
Customer satisfaction [9], [13], [21]	Cs1	Overall satisfaction with the mobile RFID service
	Cs2	Degree of expectancy disconfirmation
	Cs3	Performance versus ideal mobile RFID services
Customer complaints	CC1	Degree of complaints about the mobile RFID service
Customer loyalty	CL1	Intention to reuse the mobile RFID service
	CL2	Intention to recommend the mobile RFID service

Note. Variables are evaluated using a 10-point Likert scale.

10: very high) [13].

The sample selected in this study consisted of mobile subscribers who had tried mobile RFID services in the context of a pilot program. The survey was conducted over the web. Of the 209 responses returned, 202 were retained, after discarding incomplete or otherwise invalid responses. To test the model and hypotheses proposed by this study, a partial least squares (PLS 3.0)-based structural modeling approach was employed. The number of men exceeded that of women in this sample, with males accounting for 62.4% and females 37.6%. The ages of the majority of the respondents ranged between 20 and 40.

Most respondents were university graduates, and the vast majority of the respondents were employed. Finally, the monthly income of the majority of respondents was between $3,000 and $5,000.

2. Reliability and Validity of Variables

The reliability of the measured variables was tested by assessing the consistency of the variables using Cronbach's α. A Cronbach's α of 0.6 or higher is generally considered an acceptable level of reliability. The reliability of variables can be assessed under structural equation modeling by calculating their internal consistency coefficients, which use the formula provided in (1) [22]. A coefficient of 0.7 or higher is considered a satisfactory level of internal consistency.

$$IC = (\sum \lambda_i)^2 / [(\sum \lambda_i)^2 + \sum \mathrm{var}(\varepsilon_i)], \quad (1)$$

where λ_i is the loading value of each measurement item and $\mathrm{var}(\varepsilon_i) = 1-\lambda_i^2$.

Next, the measured variables were tested for factorial validity and discriminant validity. To test the factorial validity of the variables, a confirmatory factor analysis (loading value) was performed, and to test the discriminant validity, their average variance extracted (AVE) values were estimated, using the following formula [22], [23]:

$$AVE = (\sum \lambda_i^2 / [(\sum \lambda_i^2) + \sum \mathrm{var}(\varepsilon_i)]. \quad (2)$$

3. Analysis of Structural Equation Model and Measurement of CSI

To test both the CSI model for mobile RFID services proposed in this study and the related hypotheses, we performed structural equation modeling using the bootstrapping method provided in PLS-Graph 3.0. Bootstrapping is an inferential technique that generates *t*-values to assess the significance of a model's standardized path coefficients [24] and, at the same time, conducts a re-sampling procedure to assess the significance of PLS parameter estimates (that is, path coefficients) [13]. To calculate the CSI for mobile RFID services, we used the formula proposed in [9] and [25] as shown in (3). In this equation, $\bar{x}_i$ is the average value of measurement item i, w_i is the weight of measurement item i, and n is the number of measurement items. For the CSI for mobile RFID services, n=3 since there are three measurement items.

$$Mobile\ RFID\ CSI = \frac{\sum_{i=1}^{n} w_i \bar{x}_i - \sum_{i=1}^{n} w_i}{9\sum_{i=1}^{n} w_i} \times 100. \quad (3)$$

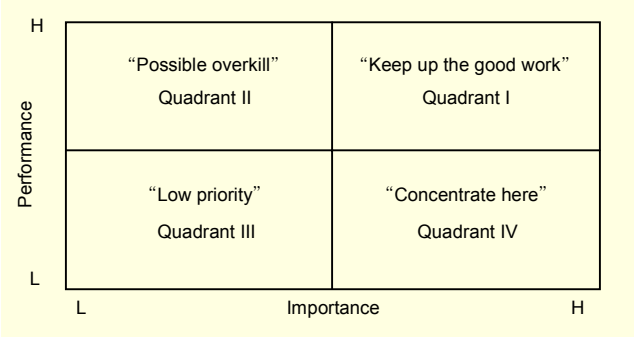

Fig. 2. I-P analysis framework.

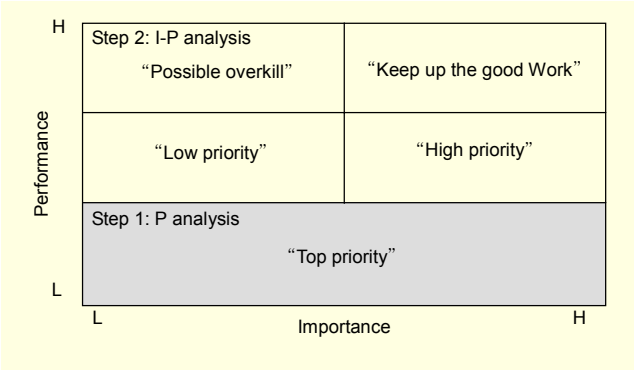

Fig. 3. Revised I-P analysis framework.

4. Importance-Performance Analysis

The matrix between importance and performance can be expressed as four quadrants: "concentrate management here," "keep up the good work," "low priority for manager," and "possible overkill" as shown in Fig. 2 [26], [27]. Quadrant IV, corresponding to an area whose importance is high but whose performance is low, is a priority area for improvement. Efforts to improve performance must therefore be concentrated in this area. On the other hand, the strategy recommended for Quadrant II, corresponding to the area whose importance is comparatively low but whose performance is high, is that of maintaining the *status quo*.

The goal of an importance-performance (I-P) analysis, however, is to develop a strategy of selection and focus by comparing various quality factors that are somewhat independent so as to obtain the maximum results using a limited amount of input. The mobile RFID services with which this study is concerned are at a pilot stage and have not yet been commercially rolled out. Therefore, since the quality factors that influence the level of customer satisfaction are interdependent, we revised the I-P matrix.

As shown in Fig. 3, we divided the matrix into steps 1 and 2, with step 1 being the stage of performance analysis, in which the focus must be placed on quality factors with a low level of performance so as to raise the overall level of performance. Once the overall performance is deemed to have reached a certain level, the standard I-P matrix may then be used to identify the quality factors that require improvement in step 2, the I-P analysis.

IV. Results

1. Reliability and Validity Results of Variables

Cronbach's α, estimated for each of the measured variables in order to test their reliability, proved to be 0.8 or greater for all variables (threshold=0.6). This suggests a satisfactory level of consistency. The value of the consistency coefficient, calculated for all measured variables to test their internal consistency, was 0.9 or greater (threshold=0.7). This suggests a high level of internal consistency.

The confirmatory factor analysis, which was conducted to test the factorial validity of the measured variables, resulted in factor loadings of 0.8 and higher, which is well above the recommended value of 0.5. This suggests that all the measured variables used in this study were valid.

In Table 4, the bold numbers that form a diagonal line are the square roots of the AVE values of the variables. When the value of a square root exceeds those of the coefficients of the correlation between the variables to the left and in the bottom row, this indicates the existence of discriminant validity [22], [23]. The square roots of the AVE values proved to be greater than the rest of the values for all the measured variables used in this study, confirming the existence of discriminant validity. Detailed results of the reliability and validity testing of the measured variables are provided in Tables 4 and 5.

2. Analysis Results of the Structural Equation Model and CSI Measurement

The results of testing the model and its hypotheses are given in Fig. 4. All hypotheses were accepted with the exception of H2. Based on these results, the quality factors found to have an influence on customer satisfaction with mobile RFID services were service quality, content quality, tag recognition quality, and interaction quality.

The CSI for Korean mobile RFID services, obtained by calculating an index for each variable, using the CSI formula previously described, was 53.1, which is slightly lower than the corresponding values obtained in Canada for similar mobile service categories. Therefore, there is a need to enhance customer satisfaction with mobile RFID services ahead of their commercial launch. The detailed results of the CSI are provided in Table 6.

Table 4. Results of discriminant validity testing.

Variables	Tag	Connection	Interaction	Content	Service	Satisfaction	Loyalty
Tag	**0.872**						
Connection	0.651	**0.950**					
Interaction	0.768	0.680	**0.909**				
Content	0.710	0.724	0.702	**0.887**			
Service	0.731	0.683	0.795	0.735	**0.902**		
Satisfaction	0.748	0.676	0.789	0.706	0.837	**0.908**	
Loyalty	0.577	0.626	0.665	0.691	0.684	0.723	**0.973**

Table 5. Results of reliability and validity testing.

Variable	Item	Loading	α	IC
Tag recognition quality	Tg1	0.873	0.894	0.927
	Tg2	0.836		
	Tg3	0.879		
	Tg4	0.900		
Connection quality	Cn1	0.952	0.882	0.948
	Cn2	0.947		
Interaction quality	In1	0.905	0.885	0.934
	In2	0.931		
	In3	0.890		
Content quality	Co1	0.883	0.907	0.936
	Co2	0.893		
	Co3	0.894		
	Co4	0.877		
Service quality	Se1	0.926	0.921	0.946
	Se2	0.910		
	Se3	0.911		
	Se4	0.859		
Customer satisfaction	Cs1	0.910	0.893	0.936
	Cs2	0.938		
	Cs3	0.883		
Customer loyalty	CL1	0.971	0.942	0.973
	CL2	0.975		

Table 6. Results of customer satisfaction index.

Sector	CSI
Mobile services (USA)*	65.0
Mobile services (Canada)*	55.0
Telecommunication (Switzerland)*	71.5
Mobile RFID services (Korea)	53.1

Note. * Data obtained from references [12], [13]

Table 7. I-P analysis of quality factors.

Quality factors	Importance	Performance
Tag recognition quality (Ta)	0.170	53.3
Connection quality (Cn)	0.049	50.9
Interaction quality (In)	0.156	54.2
Content quality (Co)	0.201	55.7
Service quality (Se)	0.388	54.6

3. Results of Importance-Performance Analysis

For the matrix analysis of quality factors that influence customer satisfaction with mobile RFID services, we used the path coefficients between the different factors as relative measures of importance. Regarding performance, we used the mobile RFID CSI formula. The performance indices of the quality factors thus calculated are provided in Table 7. The performance indices of these quality factors with a determinant influence on customer satisfaction were somewhat low, ranging from 51 to 56. This may be explained by the fact that the services studied are still in the pilot stage and need more fine-tuning. Therefore, providers of mobile RFID services need to adopt a strategy to improve the performance of the overall quality factors to enhance the level of customer satisfaction.

Of all the factors, the service quality factor proved to have the highest level of importance, including the provision of prompt responses to customer requests and the offer of pertinent and effectiveness solutions to customers.

The level of performance was also comparatively higher than that of the other factors. Connection quality and tag recognition quality were less important, and their performance was also somewhat lower than that of the other qualities.

The highest performance was shown in content quality. This result may mean that the novelty of this new category of IT service is eliciting high interest among potential users. The

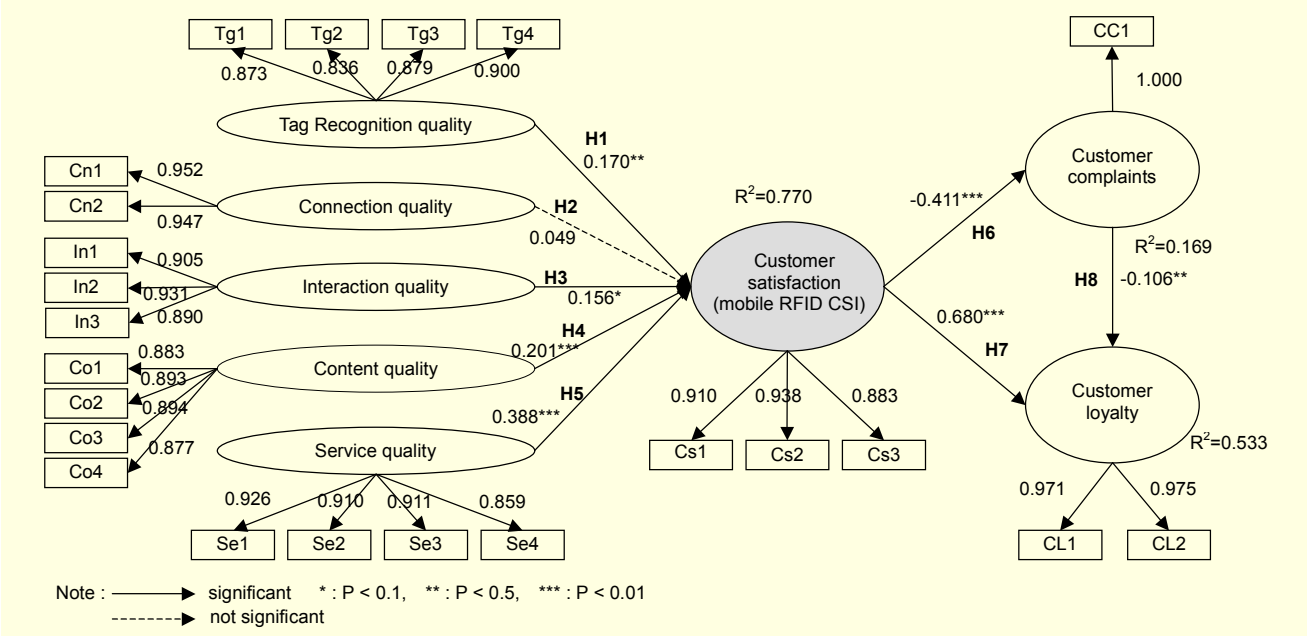

Fig. 4. Results of customer satisfaction index model and hypothesis testing.

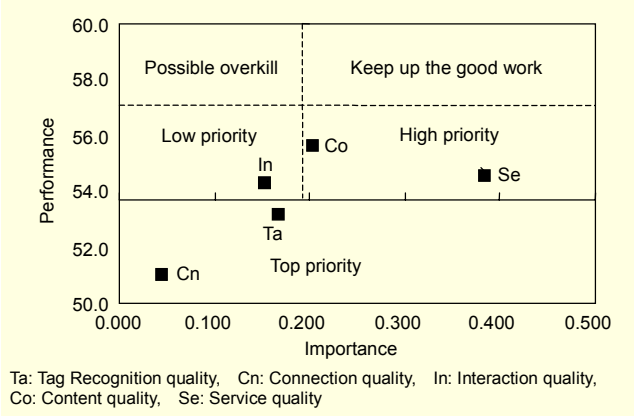

Fig. 5. Results of I-P analysis on mobile RFID quality factors.

'concentrate here' quadrant, corresponding to areas whose importance is relatively higher but whose performance is lower than that of other factors, constitutes the highest priority segment to which improvement efforts should be directed within the standard I-P analysis framework, but no quality factor of mobile RFID services fell into this category in this study.

Within step 1 of the revised I-P matrix, the top priority quality factors that needed to be targeted in an effort to improve performance were connection quality and the quality of tag recognition as shown in Fig. 5. This result suggests that it is essential that providers of mobile RFID services resolve any technical issues affecting the service, such as the reading speed, distance, and accuracy of the RFID tag, as well as the rate of recognition. There is also a need to address connectivity issues such as the stability of service systems and the speed of information download. Concerning step 2, that is, the stage of standard I-P analysis, when the overall performance is brought to a certain level and the services are commercially rolled out, there may or may not be changes in the hierarchy of relative importance between the various quality factors. Assuming that there are no major changes in the distribution of relative importance, the quality factors that significantly influence customer satisfaction at this stage are likely to be software-based issues such as service quality and content quality, rather than hardware-based issues such as the quality of tag recognition and interaction quality.

V. Conclusion and Implications

In this study, we proposed a customer satisfaction index model for mobile RFID services and calculated the index using the proposed model. Additionally, we discussed the direction of improvement for mobile RFID services through I-P analysis.

Our index indicated that the level of satisfaction with mobile RFID services among Korean customers was slightly lower than the estimated corresponding values for mobile services of a similar type in other countries. The performance indices of the quality factors liable to affect customer satisfaction with mobile RFID services were generally quite low, ranging below 60 points. These results indicate a need for the providers of mobile RFID services to concentrate their efforts on improving the performance of the overall quality factors in order to raise the level of customer satisfaction. Moreover, the I-P analysis

revealed that over the short term, the resolution of hardware-based service issues is urgently required. In other words, the focus of the short-term quality strategy should be the technical performance of mobile RFID services (the reading speed, distance and accuracy of RFID tags as well as the rate of recognition) and connectivity issues (stability of the service system and download speed). Over the medium and long term, the quality factors with the most significant influence on customer satisfaction appeared to be software-based, such as service quality and content quality, which need attention to be improved.

The significance of this study is that it offers practical guidance to the providers of the mobile RFID services currently under pilot testing in Korea. It measures the level of customer satisfaction with regard to these new services and identifies priorities within quality improvement strategies through I-P analysis. Future research may need to expand the scope of investigation, for instance, by analyzing the causal relationship between customer satisfaction and economic value, by estimating the perceived economic value of mobile RFID services, or by assessing their commercial potential as a business model by estimating the economic value related to these services.

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