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An Integrative Critical Incident Approach to Quality Management in the Smartphone Market: Product, Service, and Content

스마트폰 시장에서의 통합적 품질관리: 제품, 서비스, 컨텐츠

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오윤선의 경영학석사 학위논문을 인준함

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Abstract

The explosive growth of the smartphone market and furious competition among global IT (Information Technology) leaders necessitate a better understanding of consumers' quality perceptions of smartphones, their related services, and contents. In this study, a critical incident approach to quality perception and management is utilized to investigate how the quality of a smartphone device, product-related services, telecommunications services, and application contents influences owner intentions of future purchases. Specifically, critical incidents that smartphone owners may confront are hypothesized to engage in forming their satisfaction level or quality perceptions of smartphones, affecting their likelihood of future purchases with regard to the three major smartphone supply chain parties: the mobile device manufacturer, the telecommunications carrier and the application content provider. The proposed model was empirically examined by regression analyses of 795 smartphone users' responses. The results can be summarized as follows: Smartphone owners are affected by the critical incidents associated with their smartphones which they experienced during the ownership cycle; the owners' overall quality perceptions of smartphones are influenced by the critical incidents related to phone device, product-related services, telecommunication services, and application contents; the specific critical incident categories that significantly

have an effect on each smartphone supply chain party differ with each other. Additionally, quality management through monitoring and managing critical incidents during the ownership period is verified to applicable in smartphone market in order to enhance quality perceptions of customers, leading to business prosperity as well as better quality design of smartphone products and services.

Keywords: Critical Incident; Quality Management; Integrative Approach; Supply Chain Management; Smartphone

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Table of Contents

1. Introduction

In this era of convergence, the products which provide various values at the same time become prevalent in marketplace. For example, “smart” devices are increasingly getting more popular and are likely to corner the market in the very near future. Accordingly, quality management considering the “convergence” attribute of current products becomes necessary. In other words, integrative approach to quality management that evaluate and control how various aspects of a certain product such as a hardware device, service, and content have a combined effect on customers’ overall quality perception of the product. This study develops one possible framework for integrative quality management and examines the model in smartphone market which is representative of the convergence era.

In the smartphone market of rapid growth and dynamic competition, it seems essential for smartphone manufacturers to manage their product quality efficiently and effectively in order to enhance their competitiveness and to corner the market eventually. Meanwhile, a smartphone, which is representative of smart devices, possesses distinct features compared to other ordinary product. In other words, it is sort of combination of a hardware device, product-related services, network services, and application contents. Therefore, a special

approach to quality management which considers this conspicuous property of smartphones seems indispensible; moreover, supply chain coordination efforts of the smartphone supply chain parties to bring about high quality smartphones seem to be needed. Despite the necessity of special approach to quality management of smartphones, or a composite product made up of several important components at large, few academic literatures have addressed this task explicitly to date. Though there have been numerous articles, surveys and consumer reports that monitor and address the smartphone quality, major focal points are on network quality or call quality of smartphones (comScore, 2011; Korea Communications Commission, 2011.) However, due to the idiosyncratic feature of smartphones, as stated above, a smartphone owner's quality perception is affected not only by its network service performance but also by various other factors such as its hardware performance, product-related services including after service, and application contents availability and usefulness. For example, even with sub-par network service performance, superior hardware performance and ample supply of useful application contents might compensate and lead to the enhanced overall positive quality perception on the smartphone usage. Most of the extant surveys and reports, however, lack an integrative approach to the smartphone quality management issue which takes into account of multiple pertinent factors affecting the smartphone quality perception. Furthermore, there

has been even fewer academic treatment of the smartphone quality management issue from this integrative viewpoint.

The purpose of this paper is to provide a reference for integrative quality management of the product made up of hardware device, related services, and contents, using ‘critical incident’ approach. More specifically, one objective of this paper is to reveal the combined effects of recalled ‘critical incidents’ regarding the quality of hardware devices, product-related services, telecommunication services, and application contents on the customers’ overall quality perceptions, affecting the customers’ eventual likelihood of future purchases in the case of the smartphone market. In doing so, we examined how the owners’ quality perceptions of hardware device, product-related services, network services, and contents are adjusted by the related critical incidents and finally affect the owners’ behavioral intentions of future purchases, by looking at the influence of critical incidents faced by the owners on their future intentions as implemented by Archer and Wesolowsky (1996). Another objective of this study is to identify relative sizes of the impact of critical incident categories related to the product (smartphone device) quality, product-related service quality, network service quality, and content quality on the major smartphone supply chain entities.

Data were collected from a mailed questionnaire survey of smartphone users

in Korea, in which the number of smartphone users have grown explosively in recent years (KISDI, 2010). We've undergone two subsequent survey processes: the first questionnaires were designed to identify types of critical incidents that a smartphone owner might encounter during their ownership period of the smartphone. Here, the owners were asked to enumerate any experience of both positive and negative critical incidents related to the quality of smartphone devices, product-related services, telecommunications services, and application contents. Based on the results of the first survey, retrospective information on the number of both positive and negative critical incidents that the owners experienced and the owners' future intentions was collected in the second survey. Information on the owners' future intentions includes their likelihood of re-purchase, which apparently influences the three major smartphone supply chain parties: the smartphone device manufacturer, the telecommunications carriers, and the application content providers.

The following section offers a brief overview of the smartphone market environment, followed by a section of literature review. A framework is then proposed within which critical incidents regarding various attributes of the smartphone related to quality perceptions of the owners are considered. In the analysis of critical incidents recounted by smartphone owners, the incidents are classified into thirteen categories related to the product (phone device), product-

related services, network services, and application contents, both in positive and negative. The impact of critical incidents related to devices, product-related services, telecommunications services and contents on the owner intentions of loyalty is regarding the major smartphone supply chain parties including the mobile device manufacturer, the telecommunications carrier, and the application content provider. The proposed model is then empirically examined with regression analyses.

2. Smartphone market

A smartphone is a high-end mobile phone that offers advanced computing ability and connectivity than a contemporary feature phone (i.e. a modern low-end phone) (Nusca, 2009; Phone Scoop, 2011). In addition to their built-in functions, smartphones can run myriads of applications, turning the once single-minded cellphone into a mobile computer (PC Magazine, 2010).

The explosive growth of the smartphone market has triggered a furious competition within the market. McKinsey & Company (2011) reported that approximately 600 million smartphones were already in use as of 2010. According to IDC (Internet Data Center) (2011), the world-wide smartphone

market grew by 79.7% from the first quarter of 2010 to that of 2011 and it is anticipated to grow at 50 percent in total in 2011. Moreover, Strategic Analytics (2011) indicated that the portion of smartphones in total mobile phone market accounted for about 22% as of 2010 and is projected to reach about 40% of the total mobile phone sales in 2013.

Smartphone device manufacturers produce smartphone devices based on various hardware components and software platforms from mobile OS (operating system) providers. They also perform tasks of promotion, sales and after-services of their devices in the market. Major device manufacturers of this market include Nokia, Apple, RIM (Research In Motion) and Samsung. During the first quarter in 2011, Nokia ranked the first with 24.3% market share, followed by Apple with 18.7%, RIM with 14.0% and Samsung with 10.8%. However, the industry has witnessed a dramatic change in the market share ranking during the second quarter of 2011, in which Apple and Samsung rose to the close first and second places with 18.5% and 17.5% market shares in the smartphone market, followed by Nokia with 15.2% and RIM with 12% (Strategic Analytics, 2011).

Although device manufacturers represent a significant force behind the smartphone market dynamics and evolution, there are also other significant players. The most representative of these include telecommunications (or network) carriers and application content providers (or application developers).

Telecommunications carriers provide network services via which voice calls, text messages and data transmission are delivered. Application content providers offer mobile application contents through digital distribution platforms provided by the mobile OS providers and adopted by the smartphone manufacturers. They are involved in various maintenance services such as application content updates and after service.

Based on this overview of the industry, we have identified the device manufacturer, the telecommunications carrier and the application content provider to be the major entities along the smartphone supply chain in studying the consumers' quality perception on the smartphone experience. Even though component manufacturers and mobile OS providers (which mostly coincide with the digital distribution platform providers) are also major forces of the industry, they are not explicitly considered in our framework. From the smartphone owners' perspectives, the components, the mobile OS or the digital distribution platform are coupled with the hardware device to yield a unique product quality perception. In this regard, they are all considered to be part of the device manufacturers' domain. Therefore, smartphone device manufacturers, telecommunications carriers, and application content providers are only regarded as major smartphone supply chain parties in this study.

3. Literature review

Quality management has become a prevalent management philosophy, which has been defined as a philosophy or an approach to management made up of a set of mutually reinforcing principles, each of which is supported by a set of practices and techniques (Dean and Bowen, 1994; Rui Sousa, Christopher A. Voss, 2002). As the impact of quality performance as well as quality management practices on business performance was identified, quality management has become pivotal for the success in most sectors of business (Capon et al., 1990; Maani et al., 1994; Madu et al., 1995; Sluti et al., 1995; White, 1996).

Juran (1951) proposed a straightforward definition of quality: fitness for use. In other words, quality is related to product performance that brings about customer satisfaction and to freedom from product deficiencies. The American National Standards Institute (ANSI) defined quality as "the totality of features and characteristics of a product or service that bears on its ability to satisfy given needs (ANSI/ASQC, 1978)," thereby linking quality to customer satisfaction as well. Such tie between quality and customer satisfaction is also bolstered by 'user-based approach' to quality, one of five major approaches to the definition of product quality distinguished by Garvin (1984.) The user-based approach

recognizes satisfaction of individual consumer preferences as a measure of product quality. In addition, the relationship between product quality and customer satisfaction was also investigated by many including Anderson et al. (1994), Narasimhan et al. (1993), Selnes (1993) and Zeithaml (1988.)

Specific properties of the service quality were researched by the famous SEVQUAL model (Prarsuraman et al., 1985), which identified relevant determinants of service quality and their relationship to the quality perception. In particular, it was hypothesized that service quality is evaluated as a gap between customer expectations and the actual perceptions of the service.

Along with the studies exclusively focused on either product or service quality, there have been some endeavors to integrate quality management frameworks in product and service markets (Gummesson, 1988; Muller, 1991; Ritchken etl al., 1989; Saraph et al., 1989.) Furthermore, Archer and Wesolowsky (1996) conducted a study on integrated quality management involving both product and supporting service quality, which considers not only ‘critical incidents’ related to products and services, but also the owner’s future behavioral intentions as estimates of overall quality perception or satisfaction.

The rise and probable dominance of the smart and/or mobile environment, however, calls for an integrative quality management framework in which product, service and content quality are considered at the same time. Of course,

there are some attempts to follow the market changes into smart age. A research focusing on individual mobile content quality, which is different from product and service quality in that it has quality roots in basic information quality characteristics, was conducted (Landor, 2003). Additionally, though studies on mobile phone and smartphone industries have been carried out (Ka-shing Woo and Henry K.Y. Fock, 1999; Peter W. Turnbull Sheena Leek and Grace Ying, 2000). most of these efforts have been exerted from the technological perspective. Nevertheless, since the "evolving" supply chain (Hau L. Lee, 2002) of smartphones is still under early development and are rapidly changing in terms of manufacturing process and the underlying technology, there have been and will be quality management and responsibility issues that should be effectively coped with. Therefore, in order to obtain and maintain competitive position in the smartphone market, it is essential to manage smartphone users' quality perceptions based on an integrative quality framework of product, service, and content.

4. A framework for evaluating owner perceptions of smartphone quality

Following the quality perspective of Juran, this paper relates quality to

product performance that triggers customer satisfaction and to freedom from product deficiencies. From this viewpoint, critical incident technique is utilized to assess quality perception: that is, critical incidents which might adjust customers' satisfaction level with a certain product of interest are utilized as proxy for quality perception. A *critical incident* is an event associated with the product of interest and that is outside the normal expectations of the owner of the product (Archer and Wesolowsky, 1996; Flanagan, 1954). Critical incidents play a very significant role in quality perception formation of a given product due to the fact that they lead to positive or negative emotion, which in turn, affect customer satisfaction (Archer and Wesolowsky, 1996; Edvardsson, B., Strandivik, T., 2000). More specifically, a critical incident may bring about a positive or negative adjustment of the owner's previous opinion about the quality of the product (Archer and Wesolowsky, 1996). Since critical incidents are often easier to recall than everyday ordinary incidents, they can be used in retrospective analyses of owner experience (Archer and Wesolowsky, 1996; Flanagan, 1954; Butterfield et al., 2005). In his introductory work on critical incident approach, Flanagan (1954) mentioned that the critical incident methodology does not consist of a single rigid set of rules governing data collection. Rather, it should be thought of as a flexible set of principles that must be modified and adapted to meet the specific situation at hand. The flexibility enabled utilization of critical

incident methodology in various studies including examining effective and ineffective ways of doing something, looking at helpful and obstructive factors, collecting functional or behavioral descriptions of events or problems, examining successes and failures, and determining characteristics that are critical to important aspects of an activity or event (Flanagan, 1954.) Furthermore, the flexibility of the methodology leads to its adoption across diverse applications including job analysis (Kanyangale and MacLachlan, 1995; Stitt-Gohdes et al., 2000), education and teaching (LeMare and Sohbat, 2002; Parker, 1995), marketing (Derbaix and Vanhamme, 2003; Keaveney, 1995), performance appraisal (Evans, 1994; Schwab et al., 1975), quality assessment of hospital discharge procedures (Pryce-Jones, 1992), and quality breakdown in airline travel services (Edvardsson, 1992.)

Based on these considerations, the framework of Fig. 1 for consumers' quality perceptions on the smartphone, which is sort of combination of product, service and mobile content quality, is constructed. This framework is fundamentally based on the model of Archer and Wesolowsky (1996) but is extended in a way that considers product, services, and contents simultaneously. It is partially based on the quality concept of Juran (1951), SERVQUAL work of Parasuraman et al. (1985), the mobile content quality evaluation model developed by Landor (2003), and the critical incident methodology and its

application exemplified in Archer and Wesolowsky (1996.) To be more specific in detail, a customer has a certain level of satisfaction or quality perception when he or she purchases a product; however, a critical incident that he or she might confront during the ownership period of the product may trigger a positive or negative adjustment of the owner's previous opinion about the quality of the product (Archer and Wesolowsky, 1996). And, in the case of a product which combines product (hardware device), product-related service, network service and contents aspects, the critical incidents related to each aspect modify the satisfaction level or quality perception regarding product (hardware device), product-related services, network services, and contents respectively. These four main quality perceptions have combined influence on the owner's overall quality perception of the product in the end, finally affecting the owner's likelihood of future purchases.

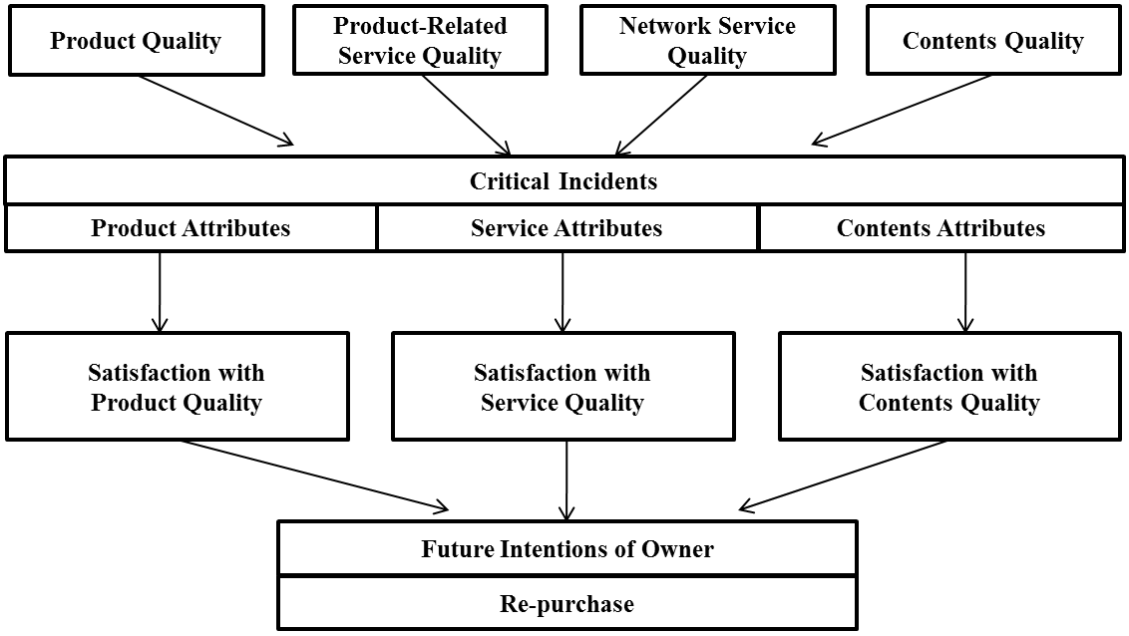

Fig. 1. Framework for evaluating owner perceptions of smartphone quality made up of product, service, and content quality

When applying the above logic and framework in the smartphone market, at the beginning of the smartphone ownership cycle, the owner has a certain satisfaction level with the quality of the smartphone device, product-related services, telecommunications services and its available application contents. As the owner experiences the actual performance of the device, product-supporting services, network services, and application contents, he or she would face positive and/or negative critical incidents which are out of the owner's normal

expectation, as shown in Fig. 1. These incidents could be classified into categories of product, service or content attributes, according to respective sources of incidents. Upon their encounters, the critical incidents alter the owner's quality perceptions of the product, service and contents, by affecting the owner's satisfaction level which is dependent on the gap between the owner's expectation and the actual performance. Finally, the modified satisfaction level or quality perception leads to the owner's behavioral intention for the future purchase (Anderson et al., 1994; Rogerson, 1983).

Within the proposed framework for assessing the owner perception over smartphone quality, the following hypotheses have been proposed for verification.

H1) Smartphone owners' overall quality perceptions of their smartphones will be influenced by critical incidents during the ownership life cycle; therefore, quality management approach by monitoring and controlling critical incidents seems to be also applicable in the smartphone market. Insufficient network coverage, prompt after service, fabulous user interface of a phone device, and easy and timely updates of contents could be some examples of critical incidents in this study.

H1-1) Critical incidents related to smartphone device affect the overall quality perception.

H1-2) The incidents related to phone-related services affect the overall quality perception.

H1-3) The incidents related to telecommunications services affect the perception.

H1-4) The incidents related to application contents affect the quality perception.

H2) The critical incident category which triggers loyalty to each of smartphone supply chain party may be different from each other.

In the following sections, regression analyses for verifying the proposed hypotheses are discussed.

4.1. Data collection

The sample of our study consists of Korean smartphone owners. According to the Korea Communications Commission (KCC) (2011), there are 10.02 million

smartphone users in Korea as of 23rd of March, 2011. This number is projected to grow to reach 20 million by the end of 2011, which will be equivalent to 40% of total Korean population. Also, the smartphone penetrations rate in Korea is reported to be the highest in the world (Joong-ang Newspaper Co., 2011). Moreover, mobile data traffic per user in Korea is estimated to be the highest in the world (Informa Telecoms & Media, 2010). Based on the above facts, Korea seems to be the perfect place to study smartphone quality, in which there are sufficient number of people who are sensitive enough to various features of smartphones.

A two-stage survey and corresponding data analysis were conducted in this study. Overall, the surveys were devised based on the study of Archer and Wesolowsky (1996). The first survey gathered responses from 144 Korean smartphone owners to identify and categorize critical incidents. The second survey sampled 651 responses for subsequent analysis to evaluate the proposed model introduced in the previous section. The response rates of both surveys were 100%. There were 512 male respondents and 283 female respondents among the 795 total respondents throughout two stages of survey. Approximately 91.4% of the respondents of the survey were in their 20s and 30s who have been proactive and vocal during the early phases of smartphone adoption in Korea.

In the first stage survey, smartphone users were asked to list positive or

negative experiences with regard to the quality of their smartphones. They were asked to write down up to five critical incidents along with the level of significance (very, moderate, somewhat, and not significant) of each incident and whether each incident resulted in positive or negative feeling. Only the reported incidents that were either very significant or moderate significant were considered to qualify as critical incidents and were utilized during the second survey. Some part of two surveys is presented in Appendix.

The critical events revealed by the first survey data could be grouped into thirteen categories with the help of the literatures on quality management of product, service and content quality as follows.

1. Product design (e.g. user interface, embedded device performance)
2. Durability/Reliability of the product (e.g. breakdown)
3. Software(OS) (e.g. speed, updates of OS)
4. Service (product-related service) (e.g. after service)
5. Service charges (e.g. high/low charges)
6. Network coverage (e.g. network indoor/outdoor coverage)
7. Network transmission quality (e.g. transmission quality in underground)
8. Network charges (e.g. high/low charges)
9. Content accessibility (e.g. easy access, customized interest)
10. Content easiness-to-use (e.g. easiness-to-read, easiness-to-interpret)
11. Content updates (e.g. easiness of updates, proper frequency of updates)
12. Content charges (e.g. high/low usage costs of application contents)

13. Security (e.g. privacy invasion)

Critical incidents in categories of 1 through 3 are related to the smartphone device itself. Categories 4 and 5 are clearly associated with the product-related services. Categories 6, 7, and 8 are regarding network services. In the remaining five groups are contents-related.

The design of the second survey and the subsequent analysis on critical incidents were conducted based on the analysis of the first survey results. More specifically, thirteen categories of critical incidents regarding the phone device, product-related services, network services and application contents were presented in the survey. Respondents were asked to report the number of incidents they experienced for each of critical incident category. In addition, future behavioral intentions of loyalty were questioned.

4.2. Independent and dependent variables

Positive and negative critical incidents identified during the first survey correspond to the independent variables. To be more specific, they are measured by the number of critical incidents regarding each of thirteen categories in both positive and negative.

The followings are the dependent variables regarding the owners' overall quality perception of their smartphones and their likelihood of future purchases. I asked the owners to evaluate the overall quality of smartphones in five scale (Good, Somewhat good, Neutral, Somewhat bad or Bad). And the owners' future intentions were measured by corresponding yes or no dichotomous questions about their loyalty.

- OQ (Overall Quality) : the owners' evaluation of their smartphones' overall quality
- ML (Manufacturer Loyalty): whether the owner would purchase another smartphone produced by the mobile device manufacturer of the current smartphone,
- TL (Telecommunications carrier Loyalty): whether the owner would purchase another smartphone utilizing the network of the current telecommunications carrier,
- CL (application Content provider Loyalty): whether the owner would purchase another smartphone which enables an access to the same set of application contents in use.

OQ reflects the smartphone owner' overall quality perception of the smartphone in use. ML indicates more general perceived quality of smartphones

and supporting services offered by the device manufacturer. TL is the owner's perception of the telecommunications carrier's service quality, or the network service quality. And lastly, CL reflects the smartphone user's quality perceptions over the set of application content that they use.

5. Data analysis

Data were analyzed in two ways. First of all, multiple regression analysis was conducted to verify whether the overall smartphone quality which the owners perceive are really affected by the critical incidents that the owners experienced during the ownership period. Subsequently, the multiple regression analysis was also conducted to examine the significant influence of each critical incident categories related to smartphone device, product-related services, telecommunications services, and application contents, respectively. And finally, a logit regression model was utilized to examine how each smartphone supply chain party, namely the smartphone manufacturer, the telecommunications carrier, and the application content provider is affected by specific critical incidents categories of those significant critical incidents. All the regression analyses were conducted by means of STATA SE 11.0.

5.1. The impact of critical incidents on the smartphone's overall quality

Multiple regression analysis was conducted in order to identify whether the critical incidents the smartphone owners confronted during the ownership period really affect their overall quality perception of their smartphones. The result of the regression analysis is presented in Table 1.

Critical Incident	Coef	Std. Err.	t	p > |t|	95% Conf.	Interval
Positive Critical Incidents	0.015**	0.002	8.15	0.000	0.011	0.018
Negative Critical Incidents	-0.012**	0.002	-5.58	0.000	-0.015	-0.007

Overall Fit: R squared: 0.07 Adjusted R squared: 0.07
Note:
Significance of estimated coefficients: if not indicated, p>0.05 (Fisher's Criterion); * 0.01<p<=0.05; ** p<=0.01

Table 1. The impact of critical incidents on the overall smartphone quality perceptions

The significant main effects shown in Table 1 support the hypotheses stated earlier. As the significant influence of critical incidents on the overall quality perception of smartphones is verified by the above result, the subsequent regression analysis was conducted to examine whether the each critical incident category of phone device, product-related services, network services, and

application contents significantly affects the overall quality perception, respectively. The results are shown as follows.

Critical Incident Category	Coef	Std. Err.	t	p > |t|	95% Conf.	Interval
Smartphone device (Positive)	0.02**	0.00	3.17	0.00	0.01	0.02
Product-related services (Positive)	-0.03	0.02	-1.84	0.07	-0.07	0.00
Network services (Positive)	0.03*	0.01	2.72	0.01	0.01	0.06
Application contents (Positive)	0.02**	0.00	4.28	0.00	0.01	0.03
Smartphone device (Negative)	-0.02**	0.01	-3.14	0.00	-0.03	-0.01
Product-related services (Negative)	-0.06**	0.02	-3.68	0.00	-0.09	-0.03
Network services (Negative)	0.00	0.01	0.61	0.54	-0.01	0.01
Application contents (Negative)	-0.02*	0.01	-2.12	0.04	-0.04	0.00

Overall Fit: R squared: 0.14 Adjusted R squared: 0.13
Note:
Significance of estimated coefficients: if not indicated, p>0.05 (Fisher's Criterion); * 0.01<p<=0.05; ** p<=0.01

Table 2. The influence of each critical incident category

Critical incident category	Sub-items	Factor Loading
Product (Phone device) (POSITIVE)	Product design	0.838
	Durability/Reliability	0.719
	OS (software)	0.773
Product-related services (POSITIVE)	Service	0.704
	Service charge	0.904
Network services (POSITIVE)	Network coverage	0.784
	Network transmission quality	0.795
	Network charges	0.741
Application contents	Content availability	0.669

(POSITIVE)	Content easiness-to-use	0.727
	Content updates	0.845
	Content charges	0.686
	Security	0.516
Product (Phone device) (NEGATIVE)	Product design	0.686
	Durability/Reliability	0.478
	OS (software)	0.622
Product-related services (NEGATIVE)	Service	0.750
	Service charge	0.595
Network services (NEGATIVE)	Network coverage	0.765
	Network transmission quality	0.766
	Network charges	0.373
Application contents (NEGATIVE)	Content availability	0.619
	Content easiness-to-use	0.621
	Content updates	0.575
	Content charges	0.563
	Security	0.424

Note: Degrees of freedom = 271, Probability level = 0.000, Chi-square = 2270.764 (AMOS 18.0)

Table 3. Confirmatory factor analysis

According to the results presented in Table 2, the influence of positive critical incidents related to phone device, network services, and application contents is significant among the positive critical incident categories; negative critical incidents associated with phone device, product-related services, and application contents significantly affect the overall quality perception among the negative.

To sum it up, the owner perceptions of the overall quality of their smartphones

are affected by critical incidents during the ownership life cycle; therefore, quality management approach by monitoring and controlling critical incidents seems to be also applicable in the smartphone market. For significant positive or negative critical incidents, the coefficients are positive or negative respectively, which shows that the model is internally consistent. While owners usually begin their ownership cycles with positive quality perceptions of the product, their perceptions are changed in negative direction during the ownership period, especially if they experience negative events. Thus, applicability of critical incident technique in quality management is supported, which was suggested by Pryce-Jones (1992), Edvardsson (1992), and Archer and Wesolovsky (1996). Additionally, it is proved that the smartphone owners' overall quality perceptions of their smartphones are affected by all the product, product-related service, network and contents quality even though the impact of product-related service and network services is only significant in case of negative and positive incidents respectively; therefore, it is reasonable to conclude that the integrative approach to quality management is necessary in the smartphone market. And this result is in line with the claim about integrative approach to quality management in the study of Archer and Wesolovsky (1996).

5.2. The impact of critical incidents on the owner's future intentions

Then, the combined effects of critical incidents related to product, product-related service, network service, and contents on the owners' likelihood of future purchases were investigated. Since the dependent variables regarding the owner's future behavioral intentions (i.e. ML, TL, and CL which were explicated in the preceding sections) are dichotomous random variables, ordinary regression analysis is not appropriate. Hence, a logit regression model was utilized to examine how each specific category of critical incidents has influence on the owners' likelihood of future purchases with respect to the three major smartphone supply chain parties (i.e. the smartphone device manufacturer, the telecommunications carrier, and the application content provider). The independent variable coefficients and their significance for the logit model fits to the three dependent variables are summarized in Table 4, along with the statistics for the overall fits. Fig. 2, 3, and 4 depict the significant impact of critical incident categories on ML (Manufacturer Loyalty), TL (Telecommunications carrier Loyalty), and CL (Content provider Loyalty) respectively.

Additionally, the table for the logit regression analysis results is followed by Table 5, 6 and 7 which present the marginal effects after logit with respect to the mobile device manufacturer, the telecommunications carrier, and the application content provider respectively.

Critical incident	Owner's likelihood of future purchases		
Category	ML	TL	CL
Product design (Positive)	0.18*	0.06	0.00
Durability/Reliability (Positive)	-0.09	-0.01	0.07
Software (OS) (Positive)	0.08	0.03	-0.02
Product-related service (Positive)	0.12	0.07	0.09
Service charge (Positive)	0.03	0.14	-0.11
Network coverage (Positive)	0.29**	0.18	0.19*
Network transmission quality (Positive)	0.14	0.06	0.09
Network charges (Positive)	-0.17	0.06	0.06
Content accessibility (Positive)	0.10	0.00	0.11
Content easiness-to-use (Positive)	0.17*	-0.02	-0.01
Content updates (Positive)	0.15	0.07	0.03
Content charges (Positive)	-0.10	-0.04	-0.04
Security (Positive)	-0.02	-0.02	-0.01
Product design (Negative)	-0.19**	-0.09	0.08
Durability/Reliability (Negative)	-0.10	-0.08	-0.13
Software (OS) (Negative)	-0.20**	0.06	0.00
Product-related service (Negative)	0.09	0.02	0.24**
Service charge (Negative)	-0.09	-0.16	-0.19*
Network coverage (Negative)	0.04	-0.01	-0.01
Network transmission quality (Negative)	0.04	-0.03	-0.04
Network charges (Negative)	-0.13	0.03	0.04
Content accessibility (Negative)	-0.02	0.01	0.09
Content easiness-to-use (Negative)	0.04	-0.03	0.03
Content updates (Negative)	-0.06	0.10	0.04
Content charges (Negative)	-0.26**	-0.23**	-0.07
Security (Negative)	-0.09	0.03	-0.03
Constant	0.07	-0.65	-0.63

Overall fit			
$\chi 2$ (D.F. = 26)	114.11**	51.50**	58.28**

Notes:

Significance of estimated coefficients: if not indicated, p>0.05 (Fisher's Criterion); * 0.01<p<=0.05; ** p<=0.01

Table 4. Logit model results

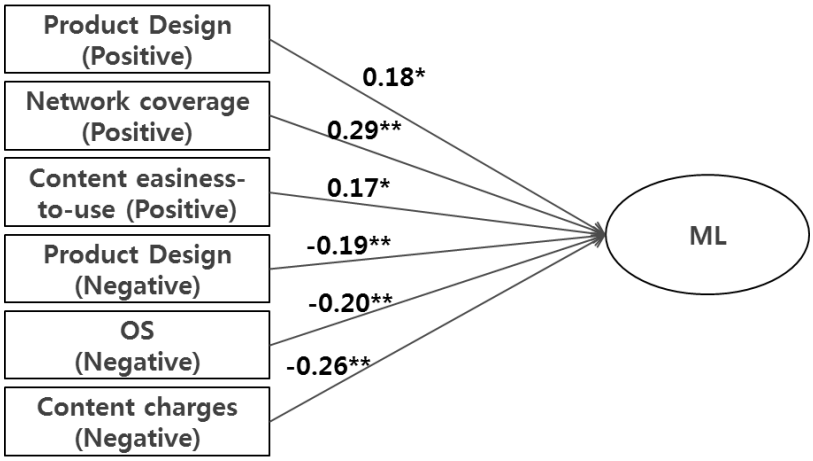

Fig 2. Significant effects of critical incident categories on loyalty to mobile device manufacturer

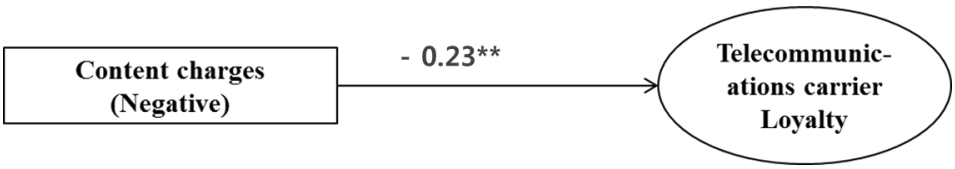

Fig 3. Significant effects of critical incident categories on

loyalty to telecommunications carrier

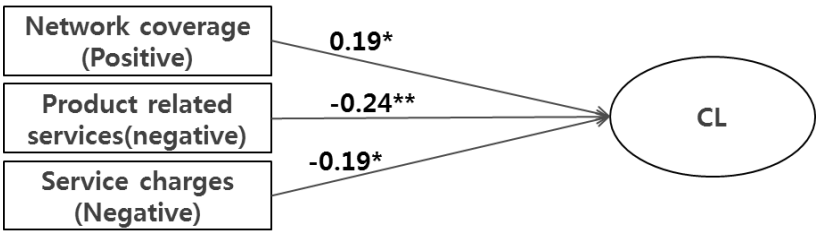

Fig 4. Significant effects of critical incident categories on loyalty to application content provider

Positive critical events related to product design, network coverage, and content easiness-to-use are significant in improving Manufacturer Loyalty, whereas negative critical incidents related to product design, operating system (OS) software and content charges significantly harm Manufacturer Loyalty. As for the likelihood of future purchases regarding telecommunications carrier, only the negative content-related incidents are influential; more specifically, negative incidents related to content charges matter. And lastly, for the loyalty to content providers, positive critical incidents related to network coverage and negative events related to product-supporting services and the charges for the services are significantly influential. And the marginal effects after logit for each dependent

variable were investigated as follows.

Variable	dy/dx	P>|z|	X
Product design (Positive)	0.04**	0.01	2.37
Durability/Reliability (Positive)	-0.02	0.37	1.12
Software (OS) (Positive)	0.02	0.30	1.66
Product-related service (Positive)	0.03	0.31	0.78
Service charge (Positive)	0.01	0.85	0.66
Network coverage (Positive)	0.06**	0.01	1.13
Network transmission quality (Positive)	0.03	0.23	0.93
Network charges (Positive)	-0.04	0.12	0.81
Content accessibility (Positive)	0.02	0.19	2.23
Content easiness-to-use (Positive)	0.04*	0.03	2.28
Content updates (Positive)	0.03	0.09	1.84
Content charges (Positive)	-0.02	0.08	1.38
Security (Positive)	0.00	0.88	0.68
Product design (Negative)	-0.04**	0.01	0.96
Durability/Reliability (Negative)	-0.02	0.23	0.85
Software (OS) (Negative)	-0.04**	0.00	1.29
Product-related service (Negative)	0.02	0.31	0.89
Service charge (Negative)	-0.02	0.33	0.90
Network coverage (Negative)	0.01	0.56	1.21
Network transmission quality (Negative)	0.01	0.55	2.08
Network charges (Negative)	-0.03	0.14	1.07
Content accessibility (Negative)	0.00	0.83	0.80
Content easiness-to-use (Negative)	0.01	0.71	0.67
Content updates (Negative)	-0.01	0.53	0.72
Content charges (Negative)	-0.06**	0.00	0.96
Security (Negative)	-0.02	0.28	0.75

Note:
Significance of estimated coefficients: if not indicated, p>0.05 (Fisher's Criterion); * 0.01<p<=0.05; ** p<=0.01

Table 5. Marginal effects after logit for ML

Table 5 indicates that when other variables being fixed at their mean values which are presented in the last column of the table, one more positive critical incident related to product design improves Manufacturer Loyalty by approximately 4%. In the same way, one more positive event related to network coverage and content easiness-to-use enhances ML by about 6% and 4% respectively. On the other hand, one more negative critical incident related to product design, operating system (OS) software, and network charges decreases ML by 4% or so. And, when one more negative critical incident occurs with respect to content charges, ML declines by approximately 6%.

Variable	dy/dx	P>|z|	X
Product design (Positive)	0.01	0.29	2.37
Durability/Reliability (Positive)	0.00	0.89	1.12
Software (OS) (Positive)	0.01	0.63	1.66
Product-related service (Positive)	0.02	0.52	0.78
Service charge (Positive)	0.03	0.23	0.66
Network coverage (Positive)	0.04	0.06	1.13
Network transmission quality (Positive)	0.01	0.56	0.93
Network charges (Positive)	0.01	0.52	0.81
Content accessibility (Positive)	0.00	1.00	2.23
Content easiness-to-use (Positive)	-0.01	0.66	2.28
Content updates (Positive)	0.02	0.23	1.84
Content charges (Positive)	-0.01	0.41	1.38

Security (Positive)	0.00	0.79	0.68
Product design (Negative)	-0.02	0.17	0.96
Durability/Reliability (Negative)	-0.02	0.29	0.85
Software (OS) (Negative)	0.01	0.10	1.29
Product-related service (Negative)	0.00	0.85	0.89
Service charge (Negative)	-0.04	0.08	0.90
Network coverage (Negative)	0.00	0.90	1.21
Network transmission quality (Negative)	-0.01	0.28	2.08
Network charges (Negative)	0.01	0.73	1.07
Content accessibility (Negative)	0.00	0.90	0.80
Content easiness-to-use (Negative)	-0.01	0.77	0.67
Content updates (Negative)	0.02	0.30	0.72
Content charges (Negative)	-0.06**	0.01	0.96
Security (Negative)	0.01	0.73	0.75

Note:
Significance of estimated coefficients: if not indicated, p>0.05 (Fisher's Criterion); * 0.01<p<=0.05; ** p<=0.01

Table 6. Marginal effects after logit for TL

According to Table 4, when other variables being fixed at their mean values, one more negative critical incident with respect to content charges diminishes Telecommunications carrier Loyalty by approximately 6%.

Variable	dy/dx	P>|z|	X
Product design (Positive)	0.00	0.98	2.37
Durability/Reliability (Positive)	0.02	0.33	1.12
Software (OS) (Positive)	0.00	0.77	1.66

Product-related service (Positive)	0.02	0.40	0.78
Service charge (Positive)	-0.03	0.33	0.66
Network coverage (Positive)	0.05*	0.04	1.13
Network transmission quality (Positive)	0.02	0.39	0.93
Network charges (Positive)	0.02	0.52	0.81
Content accessibility (Positive)	0.03	0.06	2.23
Content easiness-to-use (Positive)	0.00	0.83	2.28
Content updates (Positive)	0.01	0.66	1.84
Content charges (Positive)	-0.01	0.45	1.38
Security (Positive)	0.00	0.93	0.68
Product design (Negative)	0.02	0.13	0.96
Durability/Reliability (Negative)	-0.03	0.07	0.85
Software (OS) (Negative)	0.00	0.96	1.29
Product-related service (Negative)	0.06**	0.01	0.89
Service charge (Negative)	-0.05*	0.03	0.90
Network coverage (Negative)	0.00	0.93	1.21
Network transmission quality (Negative)	-0.01	0.19	2.08
Network charges (Negative)	0.01	0.57	1.07
Content accessibility (Negative)	0.02	0.31	0.80
Content easiness-to-use (Negative)	0.01	0.78	0.67
Content updates (Negative)	0.01	0.69	0.72
Content charges (Negative)	-0.02	0.41	0.96
Security (Negative)	-0.01	0.67	0.75

Note:
Significance of estimated coefficients: if not indicated, p>0.05 (Fisher's Criterion); * 0.01<p<=0.05; ** p<=0.01

Table 7. Marginal effects after logit for CL

Finally, Table 5 indicates that when other variables being fixed at their mean

values, one more positive critical incident related to network coverage increases the loyalty to application content provider by approximately 5%. Whereas, when one more negative critical incident regarding product-related service charges takes place, CL decreases by 5% or so. And, notably, one more negative event related to product-related services increases CL by about 6%.

5.3. Implication

When examining the findings from the analysis above, we can derive some managerial implication that is useful to real business world. Based on the results of the analysis, it is possible to conclude that critical incidents affect the owners' quality perceptions and likelihood of future purchases in the case of the smartphone market. In other words, the critical incident technique is verified to be applicable in the smartphone market. Therefore, it could be suggested that the critical incident approach to quality management which monitors and controls critical incidents regarding smartphones that may occur during the smartphone ownership lifecycle is to be adopted by smartphone supply chain parties as one possible quality management method. And, cooperative efforts within the smartphone supply chain to bring about more positive critical incidents and

prevent negative critical events seem to be essential for better quality smartphones and for better performances of the entities along the smartphone supply chain. To be more specific in detail, there should be some coordinated efforts to create more positive critical incidents with respect to smartphone devices, network services, and application contents; however, negative critical incidents regarding phone devices, product-related services, and application contents should be reduced for better quality perceptions of smartphones. It is notable that network services should be taken care of to increase positive critical incidents with them and that product-related services only matter only if they trigger negative incidents.

Moreover, the integrative approach to quality management is indeed necessary in the smartphone market based on the fact that the smartphone owners perceive their smartphone quality with consideration of all the relevant aspects of the smartphone device, product-related services, network services, and application contents. It motivates the smartphone supply chain parties to cooperate with each other further because their care about other relevant aspects beyond their original focus (e.g. phone device for the mobile device manufacturer) will lead to improved overall quality perception of smartphones which will ultimately help reinforce positive intentions toward future purchases for themselves.

What each smartphone supply chain party should care about is revealed through looking at the marginal effects of significantly influential category of critical incidents for each party: the mobile device manufacturer, the telecommunications carrier, and the application content provider. Based on the results explicated in the preceding section, mobile device manufacturers should pay attention to product design and operating system (OS) software which are originally considered within the traditional business boundary of them; however, beyond those aspects, they should also care about network coverage, contents' easiness-to-use, and content charges that are originally included in business boundary of telecommunications carriers and contents developers because those aspects also influential in the formation of loyalty to them.

More specifically, the device manufacturers are encouraged to bring about more positive critical incidents related to network coverage and user-friendly contents, and to prohibit the negative incidents related to product design, operating system (OS) software, and contents charges from the beginning of the manufacturing process of smartphones. Among the influential critical incident categories stated above, it should be noted that network coverage and content charges are the most important in the forming the loyalty to device manufacturers.

When it comes to the most significant critical incident category for

telecommunications carriers, the category of content charges matters most; especially, the negative critical incidents related to content charges are influential to them. Thus, it will be helpful for the telecommunications carrier in enhancing its customer loyalty to enable the customers to differentiate the content charges from the network charges in that the negative results from negative incidents related to content charges will not affect the, which is based on rather myopic perspectives. In the long run, however, for improved overall smartphone quality which will surely lead to enhanced loyalty to them, the telecommunications carriers are suggested to motivate the contents providers to reduce the content charges and to impose the favorable charges for the smartphone owners.

And finally, application content providers seem to have some incentive to participate in bringing about more positive critical incidents related to network coverage and preventing negative critical incidents associated with charges for product-supporting service. This result is meaningful in current market circumstances where the telecommunications carriers fiercely compete with the application content developers who offer the application contents using the network in a way that harms the network condition. Since the positive critical incidents related to network coverage help improve the loyalty to application content providers as well, they need to support the favorable stance of network and endeavor to develop the application contents supportive to the network.

6. Conclusion

Witnessing the burgeoning smartphone market during the past several years, industry spectators have now begun to understand the importance of integrative and systematic approach to the smartphone market in which the product is sort of combination of hardware device, related services, and contents. Moreover, as smart devices are getting more popular these days, and are likely to corner the market in the very near future, the integrative approach to quality management seems to be needed. Yet, there have been very few academic literatures that share such integrative approach to the quality management of the product or service which is a composite of multiple significant components like a smartphone or a smart device at large. In this paper, based on the literatures on quality management, an integrative framework in which multiple dimensions of the smartphone functionalities are considered together is proposed and examined to assess the owners' quality perceptions. To be more specific in detail, the quality of a product, product-related services, network services and the application contents are hypothesized to be interrelated and all come together to mold the owner's overall quality perception of a smartphone product, affecting their likelihood of future purchases. And finally, this hypothesis was verified with

regression analyses.

To sum it up, the owner perceptions of the overall quality of their smartphones are affected by critical incidents during the ownership life cycle; therefore, quality management approach by monitoring and controlling critical incidents seems to be also applicable in the smartphone market. For significant positive or negative critical incidents, the coefficients are positive or negative respectively, which shows that the model is internally consistent. While owners usually begin their ownership cycles with positive quality perceptions of the product, their perceptions are changed in negative direction during the ownership period, especially if they experience negative events. Additionally, it is proved that the smartphone owners' overall quality perceptions of their smartphones are affected by all the product quality, product-related service quality, network quality and contents quality even though the impact of product-related service and network services is only significant in case of negative and positive incidents respectively; hence it is possible to conclude that the integrative approach to quality management is necessary in the smartphone market. And lastly, the specific categories of critical incidents which are especially significantly influential to the smartphone supply chain parties were investigated along with managerial implication based on the analysis result.

This research provides theoretical and practical guidelines of integrative

quality management which considers various aspects of a product including hardware, services, and contents altogether. The integrative approach to the quality management task is applicable in other markets in which the product and/or service of interest is a composite of multiple significant components as in the smartphone market. Most easily, the integrative quality management considering a device itself, related services, and contents could be applied in other smart device markets as well. Additionally, as the importance of IT in the automobile functionality is increasing, one might devise an integrative framework in which quality perceptions of traditional automobile functionalities and those of IT functionalities are considered together. Moreover, there could be some extension from our study by considering the various detailed components beyond product, product-related services, network services, and contents of newly developed goods and services which represent the era of convergence. The critical incident approach is particularly useful in this context since it allows analyses of customers' overall quality perception and subsequent behavioral intentions via normalization and synthesis of quality responses of customers to multiple dimensions of the product/service. Also, the critical incident approach to quality management in which positive and negative incidents beyond the normal expectations of customers are captured and managed has practical value in terms of ease of implementation and effectiveness.

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국 문 초 록

스마트폰 시장에서의 통합적 품질관리:
제품, 서비스, 그리고 컨텐츠

서울대학교 대학원
경영학과 생산관리전공
오 윤 션

스마트폰 시장이 폭발적으로 성공하고, 글로벌 IT 기업들간의 경쟁이 치열해지면서 고객이 스마트폰과 그와 연계된 서비스들, 그리고 컨텐츠에 대해 인지하는 품질에 대한 이해가 중요해졌다. 본 연구에서는 품질인식과 품질관리에서 '중요한 사건 (critical incident)'의 방법론을 활용하여 어떻게 스마트폰 기기의 품질과 스마트폰 기기 관련 서비스의 품질과 통신서비스의 품질과 어플리케이션 컨텐츠의 품질이 스마트폰 소지자의 미래 구매 의향에 영향을 미치는지에 대해 살펴보았다. 구체적으로 스마트폰 소지자가 마주하게 되는 '중요한 사건 (critical incidents)'이 소지자가 그자신의 스마트폰에 대해 가지는 만족도 또는 품질 인식에 영향을 미치

며 궁극적으로 그들의 미래 구매 성향에 영향을 미칠 것이라 가설이 세워졌다. 여기서 그들의 미래 구매 성향은 스마트폰 공급사슬의 주요 구성원인 모바일 기기 제조업체, 통신사업자, 그리고 컨텐츠 개발자에 영향을 미치는 것이다. 제안된 모델은 795명의 스마트폰 소지자의 설문 응답에 대한 회귀 분석을 통해 경험적으로 분석되었다. 그 분석 결과는 다음과 같이 요약될 수 있다: 스마트폰 소지자는 스마트폰을 소유하는 동안에 그들이 경험하는 그 자신의 스마트폰과 관계된 '중요한 사건 (critical incidents)'의 영향을 받는다; 스마트폰 소지자가 인식하는 자신의 스마트폰 전반에 대한 품질은 스마트폰 기기와 관련하여 발생하는 '중요한 사건 (critical incidents),' 스마트폰 기기 관련 서비스와 연결되어 발생하는 '중요한 사건 (critical incidents),' 네트워크 서비스와 관련하여 발생하는 '중요한 사건 (critical incidents),' 그리고 컨텐츠와 관련하여 발생하는 '중요한 사건 (critical incidents)'에 의한 영향을 받는다; 스마트폰 공급 사슬의 각 구성원에게 유의하게 영향을 미치는 구체적인 '중요한 사건 (critical incidents)'의 카테고리는 서로 다르다. 추가적으로, 제품의 소유기간동안 발생하는 '중요한 사건 (critical incidents)'을 관찰하고 관리하는 품질 관리 기법이 스마트폰 시장에 적용가능하며, 더 나은 품질의 스마트폰 기기/관련 서비스 디자인과 더 나은 고객의 품질 인식과 그에 따른 사업 번영을 위하여 필요하다는 사실이 검증되었다.

주요어: 중요한 사건 (critical incident); 품질 관리; 통합적 방법; 공급사슬관리; 스마트폰

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