**Is There a Dichotomy of Critical Success Factors**

**in Influencing Satisfaction and Post-Adoption Usage of IT-enabled Service?**

**ABSTRACT**

Most IS research presumes that the effect of critical success factors (CSFs) of IT-enabled service (or simply IT service) on user satisfaction/usage is one-dimensional: the higher (or lower) the influence of a CSF, the higher (or lower) the level of satisfaction/usage. However, sporadic arguments have been made that user reactions cannot be adequately predicted when research is grounded on such a linear premise. The theoretical position of this study posits that the influence of a CSF on IT service can be either linear (or symmetric) or non-linear (or asymmetric) that reflects a gap in directional influences. The hypotheses are therefore derived to examine the directional gap of influences CSFs have on consequence variables. This line of reasoning sets this study apart from previous research that viewed the asymmetry through the lens of statistical significance in “each” direction (i.e., statistically significant in one direction, but not in the other direction). To test the validity of this theoretical position, data were gathered on the post-adoption usage of digital data services offered by mobilecarriers, the most prevalent form of IT service. Two sets of empirical data were gathered (self-report-based cross-sectional data and usage-based longitudinal data) and analyzed separately using structural equation modeling. The results confirmed that some CSFs have divergent and thus asymmetric influences on measured outcomes. This study reinforces the utility and efficacy of the non-linear perspective in theorizing dynamics between study factors of IT service.

Keywords: Duality Theory, Critical Success Factors, Satisfiers, Motivators

**INTRODUCTION**

Most IS studies take the position that the effect of critical success factors (CSFs) of advanced IT service (e.g., data service on mobile devices, IPTV service) on the outcome is one-dimensional or linear: the higher the influence of a CSF, the higher the level of measured performance (e.g., service satisfaction, adoption, and/or usage). Most theories and research models adopted by IS researchers, such as the theory of reasoned action and the technology acceptance model, are grounded on this paradigm in which unidimensionality is presumed implicitly or explicitly. However, sporadic arguments have been made that adequate prediction of user perceptions and behaviors is difficult when research is grounded on such a one-dimensional premise (Ahuja and Thatcher, 2005; Cenfetelli, 2004; Lee et al., 2009; Mittal et al., 1998). These studies took the dichotomy position in which an explanatory variable can become a motivator or a de-motivator in using a service/product. For instance, a motivator can improve user satisfaction if fulfilled, but its absence may not necessarily result in a proportional growth of user dissatisfaction. Likewise, a de-motivator of a service may increase user dissatisfaction, but its alleviation may not necessarily enhance satisfaction with the service proportionally. Nonetheless, empirical studies that examine the directional discrepancy of influences on the success of IT service are scarce, making it difficult to judge the theoretical integrity of the ‘dichotomy’ view. The important theoretical and practical (e.g., market strategy for service providers) implications of the dichotomy perspective warrant further investigation. This study is intended to fill the void.

In adopting the duality perspective, *we take the position that the influence of a CSF on the consequence variable(s) of IT service can be either symmetric (i.e., linear) or asymmetric (i.e., non-linear).* In other words, *a CSF has both positive and negative effects on measured outcomes, but there may be a gap in directional influence.* This line of reasoning sets this study apart from the short list of previous works that viewed the potential asymmetry through the lens of statistical significance in each direction (i.e., significance in one direction, but not in the other direction). To test our theoretical position, the commonly agreed CSFs of IT service are applied to a study model and their expected influence on outcomes is delineated. There is little disagreement that system quality, information quality, and personal attributes are key factors (e.g., DeLone and McLean, 1992, 2003) shaping user attitudes (e.g., satisfaction) and behaviors (e.g., system usage) toward IT service. As for personal attributes, perceptions of *self-efficacy* and *monetary value* are particularly germane. Then, we examined the possible asymmetry of influences the four CSFs (i.e., system quality, information quality, self-efficacy, and monetary value) have on measured outcomes (i.e., satisfaction and usage) of IT service. From the symmetric viewpoint, the association between a CSF and an outcome remains proportionately uniform: a higher-level of CSF results in improved outcome. However, if the influence of a CSF is asymmetric, there is a directional gap it has on the measured outcome.

To test the validity of our hybrid theoretical position in which both symmetric and asymmetric roles of CSFs are employed, data were gathered on post-adoption usage of data services for mobile devices (shortly DSM), the most prevalent form of IT service. With the launch of high-speed mobile networks running 3G and 4G technologies, there has been a surge of digital data consumption for social networking, video conferencing, streaming of movies anduser-created content, and online gaming among others. For this study, two sets of empirical data (a purely self-report-based, cross-sectional dataset and an actual usage-based, longitudinal dataset) were gathered and analyzed separately with structural equation modeling. The two datasets complement each other’s weaknesses, offering more generalization of our empirical findings.

**Theories**

Most studies of information systems success have been based on the linearity presumption outlined earlier. This literature review section, therefore, focuses on introducing the duality-oriented views that accept the non-linear influence of antecedent variables on consequence variables. The theorization began as early as Herzberg et al. (1959), who separated personal and organizational elements influencing employee job satisfaction into two categories: motivators and de-motivators. Motivators boost job satisfaction and employee performance, but their absence or insufficiency does not necessarily increase job dissatisfaction. According to the two-factor theory, motivators are internally-generated drivers rather than externally-stimulated incentives (Bassett-Jones and Lloyd, 2005). They are mainly task-related, intrinsic to job content, employee-administered, and closely related to a person’s sense of internal growth. By contrast, de-motivators result in employee dissatisfaction if not alleviated; however, their alleviation may not result in higher job satisfaction. They tend to be extrinsic, environmental, and controlled by someone other than the employee herself. For instance, the motivational effect of financial rewards may decrease past a certain threshold level; however, their paucity can steadily de-motivate employees (Bassett-Jones and Lloyd, 2005).

The two-factor theory has been applied to the domain of product/service satisfaction. For example, Mittal and Lassar (1998) divided service quality into technical quality and function quality, and demonstrated their opposite influences on clients’ service satisfaction. Chowdhary and Prakash (2005) discussed motivators and de-motivators in terms of *vantage* factors that differentiate a service and *qualifying* factors that clients take for granted in subscribing to the service. Swan and Combs (1976) derived the concept of *instrumental* variables that represent product performance and *expressive* variables that embody the psychological performance of the product. According to them, customer satisfaction tends to improve when a product’s expressive values are higher, but low expressive values do not necessarily translate into higher dissatisfaction with the product. However, dissatisfaction with the product increases when instrumental values fall below a certain psychological anticipation level.

Some IS studies have embraced a similar line of reasoning. Most notably, Cenfetelli (2004) theorized an influential duality (i.e., *enablers* and *inhibitors*) of explanatory IT features on a measured outcome (e.g., adoption). In his duality theory, the inhibiting and enabling perceptions are mutually independent. For instance, an enabler exerts a positive force on the decision to adopt a system, but its absence may or may not contribute to system rejection. An inhibitor may be a positive predictor of system rejection, but its absence may or may not enhance system adoption. The dual theoretical argument can be extended into a nomological network in which inhibitors are triggered by a set of causal factors different from those of enablers. Inhibitors also differ from enablers in their effect on consequence variables. In determining the psychological significance of IS attributes (e.g., inhibitors vs. enablers), norms and expectations play a key role. For instance, if an attribute is normative, users take it for granted and notice its effect only when it is missing (or weak), thus triggering their negative reactions. The argument goes that instead of focusing on the enabling or facilitating aspects of system issues, IT may be designed to curtail inhibiting forces in order to prevent system rejection by IS users.

A few IS studies have embraced reasoning similar to that of Cenfetelli (2004). For instance, Lee et al. (2009) showed that information quality (as a motivator) was positively associated with significant increases in usage of mobile data services, but system quality (as a de-motivator) was not. System quality was also negatively associated with usage decrease, but information quality was not.Speier et al.’s (2003) study indicated that inhibitors have asymmetric effects on IT usage. For example, the reduction of such system interruptions as web browser pop-ups did not necessarily increase system usage. In addition, studies of IT innovation adoption by Parthasarathy and Bhattacherjee (1998) and Venkatesh and Brown (2001) implied that factors promoting adoption differ from inhibiting forces. Despite the potential lack of symmetry of an attribute’s impact on measured consequences, empirical efforts to examine this phenomenon have not gained much traction in the IS field.

**RESEARCH MODEL**

Prior studies agree that *system quality*, *information quality*, and *personal attributes* are primary success conditions of IT service (e.g., Lee et al., 2009). Although *service quality* may be counted as well (Cenfetelli, 2004; DeLone and McLean, 2003), its conceptual domain overlaps with those of information and system quality factors (Jamal and Anastasiadou, 2009). This may be especially true when service providers and users do not share common goals, but are loosely tied by their own vested interests. Due to this conceptual overlap, the service quality construct is not separately defined in our research model. The *information quality* and *system quality* constructs are inherently multidimensional and accordingly positioned as second-order constructs manifested by the first-order indicator variables (Cenfetelli, 2004; DeLone and McLean, 1992).

Information quality is the perceived quality of information content available on mobile devices and can be manifested by various theoretical dimensions, including accuracy, precision, relevance, currency, completeness, sufficiency, comparability, timeliness, reliability, understandability, and scope (Bharati and Chaudhury, 2006; DeLone and McLean, 1992; Miller, 1996; Redman, 1996; Strong et al., 1997). In a review of current studies, *relevance*, *timeliness*, *reliability*, and *scope* were determined as highly salient elements to DSM users (Lee et al., 2009; McKinney et al., 2002). As success conditions, they are conceptually divergent and cover important domains of information quality in the context of DSM (refer to Table 1 for definitions).

The system quality construct embraces highly complementary but interactive conceptual dimensions including access convenience, flexibility, integration, response time, sophistication, reliability, accessibility, stability, system speed, usability, ease of use, navigation, and network speed (Bharati and Chaudhury, 2006; DeLone and McLean, 1992; Kim and Kim, 2002; Liao and Cheung, 2001; Wilkerson et al., 1997). Among these various possibilities, *access*, *usability*, *navigation*, and *interactivity* were determined to be especially salient system issues for individual users of DSM (Lee et al., 2009; McKinney et al., 2002) (refer to Table 1 for definitions). These factors advance user experience in terms of the ubiquity, flexibility, and contextuality of DSM, moderating the effects of the physical limitations of a mobile device (e.g., small screen size and keypad) on usage (Jarvenpaa et al., 2003; Lee and Benbasat, 2003).

Among the many possible personal attributes, perceptions of *self-efficacy* and *monetary value* are particularly germane to the context of DSM, in which user behaviors are less influenced by organizational-level forces and more individually determined (Cenfetelli, 2004; Hong and Tam, 2006; Venkatesh and Brown, 2001). The question may arise as to whether the perception of *monetary value* should be regarded as a personal attribute. Although this may not be a pivotal issue, the classification is justified based on the following assumption of relativism: people perceive the same price of DSM differently depending on their circumstances, which include such factors as personality, affordability, service utility, importance to the individual, peer pressure, and pricing level.

Using these three groups of explanatory variables, a conceptual model is proposed delineating relationships among the study factors from both the duality perspective and the traditional unidimensional perspective. In the model, the effects of certain antecedent variables on dependent variables may be more symmetric than asymmetric, and vice versa. The potential dual nature of these effects also implies that user satisfaction and dissatisfaction may not follow in a linear fashion. For instance, equating weaker satisfaction with stronger dissatisfaction (and vice versa) may be logically flawed, as these concepts represent two discrete semantic dimensions of human cognition (Anderson and Sullivan, 1993; Oliver, 1993). In addition, Mittal et al. (1998) suggested that customers can experience mixed feelings toward a product/service, and that capturing this ambiguity using a traditional measurement approach is difficult. For instance, customers may be satisfied with the intended functionality and design of an IT device, but at the same time, they may be dissatisfied with the operational or usage complexity and flaws (e.g., software bugs) of its embedded functions. To capture the possible influential dichotomy of the antecedent variables, therefore, satisfaction and dissatisfaction are treated as disparate notions. Then, behavioral changes in DSM usage (i.e., increase vs. decrease) are regarded as direct or indirect consequences of the exogenous variables. This approach is in line with that of many previous studies demonstrating a close association between the level of user satisfaction and system usage (e.g., DeLone and McLean, 1992; Seddon, 1997; Venkatesh et al., 2003; Wixom and Todd, 2005). The resulting research model is presented in Figure 1.

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Figure 1 about here

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In embracing the idea that the role of each explanatory variable may be either symmetric or asymmetric, we make several assumptions. First, a relatively steady state of DSM usage after adoption is assumed as a function of the user’s unique personal needs. Secondly, substantial variations in the level of usage exist even among users who are equally satisfied or dissatisfied with DSM, again for personal and/or circumstantial reasons unique to each subscriber. Thirdly, users have implicit or explicit levels of expectation about information quality, system quality, and pricing of DSM which vary from person to person. Based on these assumptions, this study investigates what triggers changes from the established individual norm of DSM satisfaction and usage.

**HYPotheses**

**Information Quality**

This explanatory variable primarily represents the characteristics of information at the semantic level (DeLone and McLean, 1992). In DSM, content may be available in text, sound, image, or other multimedia format; richness of content depends largely on the presentation method. The quality of information is *intrinsic* in the sense that its consumption is the primary reason for subscribing to DSM. Not surprisingly, information quality is known to affect system adoption and usage (Bharati and Chaudhury, 2006; Cenfetelli, 2004; Davis et al., 1989) and therefore has been a key criterion in determining IT success in many studies.

From the duality perspective, information quality is a motivator that drives satisfaction with DSM, influences usage, is closely tied to user experience, and engages individuals in a personal way (McKeen and Smith, 2009). Information is the reason most people use a mobile device. Information quality is therefore considered a *vantage* factor that differentiates IT services rather than a *qualifying* factor that any IT service provider should offer or any user takes for granted (Chowdhary and Prakash, 2005). When high-quality information is offered that strikes a balance between passive and active absorption and passive and active immersion (Pine and Gilmore, 1999), DSM users are expected to be more engaged in the service and more satisfied with their experience. In the early stages, interaction with an IT service may be more relational than transactional (McKeen and Smith, 2009). By enriching user tasks and therefore user experience, high-quality information is expected to result in greater satisfaction with DSM.

By contrast, when information quality does not meet the standards that the user implicitly or explicitly expects, dissatisfaction may result. As finding and using information is fundamental to DSM use, it can be discouraging when information is irrelevant, inadequate in scope and range, not timely or improperly updated, and unreliable. Nonetheless, from the duality theory perspective, because information quality is a *differentiator* rather than a *qualifier* of a service, perceived weakness in this area may not necessarily lead to service rejection. Users may not have a transcended, relational experience with their DSM, but may simply maintain a transactional relationship with it (McKeen and Smith, 2009). From a slightly different perspective, a certain quality of information is required when a user adopts DSM in order to meet his/her hedonic or utilitarian needs. Psychological compromise on the part of the user may be necessary, but its discouraging effects may not be as strong as its encouraging effects. From the perspective of relativism, therefore, it is proposed that:

H1: *Perceived information quality has a stronger effect on satisfaction with DSM than on dissatisfaction with DSM.*

**System Quality**

System quality can be defined as the general perception of a system’s software and hardware performance. System quality has been considered a crucial indicator of the success of an IT service (DeLone and McLean, 1992, 2003). The components of DSM systems include bandwidth and accessibility, operational support systems, terminals such as cellular phones, user applications, and interface design. User perceptions of system quality are formed by the integrity of system elements as a whole in effectively fulfilling user expectations and providing positive experiences. System quality reflects a general impression of the DSM platform on which information content is offered, the *extrinsic* or *supportive* conditions under which a user uses the service. The platform is in this sense *contextual* or *instrumental,* andis a qualifying condition for DSM subscribers.

Because system quality is a *qualifying* condition (Chowdhary and Prakash, 2005), service users consciously or unconsciously develop certain performance expectations toward the service platform. If the expectations are met, that is, if the platform does not hamper users’ information needs, they may not care much about its performance any more. For instance, if a webpage downloads slightly faster than normal, it may not make much difference to or have a lasting psychological impact on the user. Thus, the effect of system quality as a motivator in facilitating user satisfaction and subsequent usage increase may be limited. However, when the quality of an IT platform system is perceived to be below a certain acceptable level or weaker than what is implicitly or explicitly taken for granted, the user may become more conscious of the fact that the system is not supporting his/her needs effectively. Poor system quality may therefore become a major inhibitor of sustained DSM usage, resulting in more negative user reactions (Cenfetelli, 2004; Lee et al., 2009). Thus, system quality may be a necessary condition to, but not a sufficient condition of, DSM success (Chowdhary and Prakash, 2005). We therefore hypothesize that:

H2: *Perceived system quality has a stronger effect on dissatisfaction with DSM than on satisfaction with DSM.*

**Monetary Value**

Many studies have demonstrated the close tie between the positive perception of a service’s value and its usage level (Cronin et al., 2000; Hong and Tam, 2006; Zeithaml, 1988). Value is an economic concept that explains why people engage in business relationships. It is viewed in terms of trade-offs between benefits and sacrifices, such as the ratio of price to quality. A formal breakdown of value yields the concepts of perceived use value, exchange value, and consumer surplus (Bowman and Ambrosini, 2000). Perceived use value is a subjective value assessed by customers, which can be translated into monetary terms as how much they are prepared to pay for an IT service. A price for a service may be selected subjectively based on previous experience and used as a yardstick for purchase decision-making. The exchange value is the actual price paid by buyers. The gap between perceived use value and exchange value is the *consumer surplus* (or *deficit*). Customers generally opt for the service that offers the largest consumer surplus. In addition, consumer surplus may influence user attitudes and post-adoption behaviors.

User satisfaction strongly correlates with the perceived value of an IT service. It is a function of service quality and pricing (Athanassopoulos, 2000). Thus, if the service quality of DSM adequately reflects pricing, then a positive (*surplus*)perception should enhance the level of user satisfaction. However, if users perceive that the price does not match overall service quality, then the perception of *consumer surplus* turns negative, and the DSM becomes unsatisfactory. This value perception may also be associated with the idea of usefulness, that is, the perception of the extent to which the DSM fulfills user needs. The monetary value of DSM, therefore, may not be as intrinsic as its information quality, which is the primary reason for paying for the service. To a certain degree, it may be classified as an environmental aspect of service usage (Hertzberg, 1959).

Many studies have detected a special sensitivity toward pricing and economic considerations affecting user perceptions and behaviors (Hong and Tam, 2006; Lim et al., 2006). This sensitivity may make the monetary value a *vantage* factor rather than simply a *qualifying* factor. If a user already maintains a certain usage level, and the service fee goes up but the level of information/system quality remains unchanged, the perception of less value in exchange for financial investment may result, and may be followed by service dissatisfaction and usage decline. By contrast, lower fees for the same level of information/system quality have a positive effect on perception of the value of a service, leading to higher satisfaction and increased service usage. If service fees are tied to usage, as presumed in this study, the degree of satisfaction/dissatisfaction and usage may be a direct function of monetary value. Due to individual differences in sensitivity to value perceptions, monetary value is expected to affect usage changes both directly and indirectly (i.e., via enhanced satisfaction/dissatisfaction). Presuming that the cost of DSM is proportionate to its usage (e.g., number of packets exchanged), and given that this study focuses on personal usage of DSM for hedonic and utilitarian gains, we hypothesize that:

H3: *The association between the perceived monetary value of DSM and satisfaction/dissatisfaction with DSM is symmetrical*.

H4: *The association between the perceived monetary value of DSM and changes in DSM usage is symmetrical*.

**Self-efficacy**

Self-efficacy from the perspective of social cognitive theory is a person’s confidence in successfully undertaking intended tasks (Bandura, 1977). Personal IT adoption and usage is heavily affected by individual attributes such as personal confidence. Some researchers have noted the particular roles of self-efficacy and personal innovativeness in use of technology (Agarwal and Prasad, 1998; Lewis et al., 2003). Personal innovativeness, an individual’s tendency to try new technologies, is not included in this research, as it plays a more critical role in the adoption of DSM rather than its post-adoption usage. However, self-efficacy continuously shapes a person’s perceptions of DSM (Lewis et al., 2003) and thus is expected to affect usage behavior during the post-adoption period.

Self-efficacy in the context of DSM is closely associated with the user’s perceptions of its ease of use and usefulness. A more confident user may naturally perceive the service as easy to use and useful, and may therefore continue using it (Agarwal et al., 2000; Lewis et al., 2003; Venkatesh and Davis, 1996). However, confidence in one’s ability to use technology may not necessarily result in an increase in usage beyond what is necessary. Conversely, a lack of confidence or sense of clumsiness in using DSM can become a significant inhibitor to increased usage (Cenfetelli, 2004). Rapid changes in technology may erode a sense of self-efficacy and discourage DSM usage (Venkatesh and Brown, 2001). To a certain degree, the effects of self-efficacy on an DSM user may resemble those of system quality, as greater confidence in one’s ability to use technology should lead to the perception that DSM is easier to use, thereby providing a positive link between perceived ease of use and enhanced system quality. However, usability is a necessary condition that makes it easier to realize the ultimate goal of DSM usage: information acquisition. Thus, we propose that self-efficacy has a greater tendency to reduce DSM usage than to increase it.

H5: *A user’s perception of self-efficacy in using DSM has a stronger effect on reducing than increasing its usage*.

**(Dis)satisfaction vs. Usage Change**

McKinney et al. (2002) proposed satisfaction and dissatisfaction as two opposite extremes in measuring overall user satisfaction with a web service. However, low satisfaction may not necessarily equate to dissatisfaction and, conversely, a lower level of dissatisfaction may not be equivalent to satisfaction (Anderson and Sullivan, 1993; Oliver, 1993). Accordingly, satisfaction and dissatisfaction toward a particular service/product may be treated as separate notions. Satisfaction and dissatisfaction may result in different affective consequences and intentions to continue service/product subscription (Oliver, 1993). Studies have also repeatedly shown that satisfaction positively influences service/product continuation, while dissatisfaction reduces service/product usage and increases tendency to discontinue (DeLone and McLean, 2003; LaBarbera and Mazursky, 1983; Mittal et al., 1998). Users satisfied with an information system form attitudes compatible with sustained usage, while dissatisfied users have a greater chance of suspending usage (Bhattacherjee, 2001). Thus, we hypothesize that:

H6: *Satisfaction and* *dissatisfaction with DSM are associated with DSM usage increase and decrease, respectively.*

**RESEARCH METHODS**

**Survey Design**

Indicators of study variables were derived from current research in order to reflect the study context. For the self-report surveys, a detailed definition of DSM including many popular applications was provided at the beginning of the questionnaire. Definitions of study variables, their survey indicators, and literature sources of survey items are summarized in Table 1. Customized surveys were designed for the *usage increase group* and the *usage decrease group* separately. The items for *DSM* *satisfaction* and *DSM increase* were included in the survey for the usage increase group, and those for *DSM* *dissatisfaction* and *DSM decrease* were contained in the survey for the usage decrease group (Appendix 1 lists items for both surveys). As stated earlier, satisfaction and dissatisfaction were treated as separate variables with distinct semantic dimensions. All self-report survey questions were scored on a 7-point Likert scale in which 1, 4, and 7 mean “strongly disagree”, “neutral”, and “strongly agree”, respectively. As for the dependent variable, *usage increase/decrease*, two different datasets (i.e., survey data alone and actual usage data) were utilized. Two separate empirical studies were performed using the two different datasets. In the first study, question items were derived from Seddon (1997) to obtain information on *usage increase/decrease* based on self-reports. In the second empirical study, actual DSM usage data in terms of ARPU (average revenue per use) during a six-month period were utilized.

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Table 1 about here

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**Data Gathering**

By conducting two independent and complementary empirical studies and comparing their results, possible bias due to methodological weaknesses should reduce. For the first study based on the self-report data, 2500 potential respondents were randomly identified from among registered members of the online survey company [www.wsurvey.com](http://www.wsurvey.com). The sample included a similar number of subscribers from each of the three Korean mobile service carriers: Sunkyoung Telecom (SKT), Korea Telecom Freetel (KTF), and LG Telecom (LGT). Stratified random selection was possible because each carrier is assigned a unique initial three-digit code for mobile phone numbers (e.g., 011, 016, and 019 for SKT, KTF, and LGT, respectively). Then, the selected subscribers were contacted via email and invited to visit the survey site. Visitors were first asked if their DSM usage habits had changed (i.e., increased or decreased) during the previous six-month period. Then, depending on the response to this initial question, a customized survey form was presented.

For data gathering, the submission process was controlled so that a maximum of 200 responses (100 increases and 100 decreases) from each of the three mobile carriers could be submitted within the one-month survey period, resulting in 600 total submissions (300 in the increase group and 300 in the decrease group). This control was necessary because of the possible skewness resulting from random responses that could heavily favor usage increase and cause a subsequent bias in the data analysis. During the one month-long survey period, 576 responses were submitted (23% response rate). Of these 576 responses, 15 were incomplete and were thus excluded, resulting in a final sample of 561 responses (300 increase and 261 decrease) for analysis. The fact that the number of respondents in the decrease group did not reach the target of 300 within the data-gathering period confirmed our suspicion that the number of users who decreased DSM usage in the previous six months was considerably smaller than the number of users who increased usage.

Self-estimation in assessing DSM usage is highly subjective. Therefore, a second empirical study was conducted based on actual DSM usage data obtained from SKT, the largest mobile carrier in Korea. Obtaining this (ARPU) data from all three carriers was practically impossible due to their concerns about violation of the Korean law protecting individual privacy. The dataset was therefore based on SKT’s clients who had been subscribing to their DSM for more than a year. DSM users were identified using the stratified sample method in which increases and decreases in ARPU formed two different strata of the sampling. ARPU data represents the monthly spending of a subscriber on a data service during the past six-month period, excluding voice and text messaging (see Figure 2). To quantify the change, first and second three-month periods of DSM usage were compared for each user, after which the rate of increase (ARPU = (A − B)/A) or decrease (ARPU = (B − A)/A) was decided depending on the direction of change. For identification of eligible subjects, SKT queried its large-scale data warehouse. Ten thousand (10,000) people that met the search criteria were identified from the vast pool of the company’s client records.

Then, in order to conform to Korea’s privacy protection law, SKT directly emailed the self-report survey to the selected people and compiled their responses. SKT matched each returned survey response with the respondent’s ARPU data to complete each individual record. Matching was based on the email address and the cellular phone number. This process resulted in 301 records with 145 increases and 156 decreases in DSM usage. Due to incompleteness, 17 were dropped, making 284 records (138 increases and 146 decreases) available for data analysis. The comparison of the two groups in terms of average ARPU during the six-month period is shown in Figure 2. The second empirical study compensated for the weakness of the pure self-report-based empirical method of the first study. However, response bias may still be present because all replies were based on DSM offered by a particular carrier (i.e., SKT). In addition, the response rate of 3% was substantially lower than that in the first survey.

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Further explanation of the response gap between the two surveys is warranted. The response was better for the first online survey because the respondents were selected from a pool of people who voluntarily joined the survey panel to receive benefits such as cyber money offered by the survey company. By contrast, the second SKT survey had a fairly low response rate (301/10,000) for several reasons. First, when target subjects are randomly selected and given little incentive to complete the survey, the result is often a low response rate (Kaplowitz et al., 2004). In fact, SKT’s marketing department reported that its own surveys generally have a 3–4% response rate even with incentives such as product coupons. Second, the low response rate can be partially attributed to the inaccurate email list. Emails were sent to people who had registered their email addresses on SKT’s customer portal site (www.t-mobile.com) and accessed it at least once during the past year. However, SKT stated that many emails bounced back due to address inaccuracy or unavailability. In addition, many people provided information for their secondary email accounts rather than their primary ones, which further weakened the chance of obtaining a good survey response. Finally, the survey itself was designed to solicit further responses only when the initial self-report matched the actual usage pattern recorded in the six-month ARPU data; therefore the response pool was narrowed again.

**Comparison of Response Groups**

The two response groups (self-report group and ARPU group) were compared in terms of demographics, usage-related attributes, and DSM applications. Table 2 shows the general demographic similarity between respondents in the two datasets.

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Table 2 about here

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**Validity Testing**

Validity testing was conducted separately for the usage increase and decrease groups in both samples, as the survey items differed slightly between groups. All studied constructs had composite scale reliability index (CSRI) and average variance extracted (AVE) values greater than 0.7 and 0.5, respectively, confirming their reliability (Liang et al., 2007). Comparison between factor loadings and cross-loadings, and between the values of squared AVE and the squared values of correlation coefficients, indicated appropriate discrimination between the study variables (Chin, 1998; Gefen et al., 2000). Finally, the two sample groups showed similitude in their means, standard deviations, CSRI values, and AVE values (see Appendices 2 and 3).

The reliability of self-reported survey responses can be tainted by common method bias (CMB) (Podsakoff et al., 2003). The relatively high correlations (> 0.70) between study variables in both tests raise multicollinearity concerns despite the fact that their values are lower than the associated squared AVE values. However, the high correlations may not constitute a significant hazard in this study because they are assumed to exist between the first-order variables of a reflective second-order construct. Nonetheless, a CMB test was conducted to examine the possibility of systematic measurement errors.

First, Harman’s one-factor test was conducted to determine any common factor that would explain the majority of common variance (Podsakoff et al., 2003). The test showed that the amount of variance explained by the identified factors was relatively evenly distributed in both the increase group (Test 1: mean = 8.38%, S.D. = 2.14; Test 2: mean = 8.38%, S.D. = 2.14) and the decrease group (Test 1: mean = 8.38%, S.D. = 2.14; Test 2: mean = 8.41%, S.D. = 1.96). Second, the highest factor identified through the principal component analysis was added to the partial least squares (PLS) model as a control variable to examine its effect on the dependent variable (Podsakoff et al., 2003). The significance of the control factor is an indication of CMB (Podsakoff and Organ, 1986). Overall, a weak contribution of the control variable to *R2* was observed. In Test 1, *R2* improved very little. The results were as follows: 0.011 (satisfaction), 0.007 (dissatisfaction), DSM increase (0.015), and DSM decrease (0.003). The same outcome was observed in Test 2, in which the values were 0.009 (satisfaction), 0.003 (dissatisfaction), DSM increase (0.022), and DSM decrease (0.001). Based on these test results, we concluded that CMB was not an issue in this study.

**RESULTS**

PLS with bootstrapping was used to estimate the structural models and to test the significance of the proposed hypotheses. Figures 3 and4 summarize the path coefficients of the usage increase and decrease groups based on two different datasets (i.e., self-report-based only and ARPU-based).

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**Comparative Analysis**

For hypotheses testing, the statistical differences between corresponding path coefficients of the two models (e.g., Figure 3a and 3b) are compared for each dataset (except H6) relying on the following test statistics:



where PC1 and PC2 are path coefficients, N1 and N2 are sample size, and SE21 and SE22 represent standard errors of path coefficients (Keil et al., 2000; Teo et al., 2003). To compare the magnitude of the coefficients irrespective of changes in direction, their absolute values were utilized. The results are summarized in Table 3. Comparative tests confirmed that the influence of information quality on satisfaction was greater in the increase group than that on dissatisfaction in the decrease group (H1 supported). In addition, the influence of system quality on dissatisfaction was greater in the decrease group than that on satisfaction in the increase group (H2 supported).

In both usage increase groups, perceived monetary value positively affected satisfaction. In both usage decrease groups, weak monetary value was associated with higher user dissatisfaction. When the comparative formula (Keil et al., 2003; Teo et al., 2003) was applied for the testing of H3, both the self-report response data and the ARPU data indicated that monetary value had a larger effect on growing satisfaction than dissatisfaction (H3 not supported).

In both usage increase groups, perceived monetary value positively affected usage, although only the results in the ARPU group were statistically significant (0.105, *p* < 0.1 for self-report data and 0.189, *p* < 0.05 for ARPU data) at *p* = 0.05. In both usage decrease groups, monetary value negatively affected usage; both coefficients were statistically significant (−0.176, *p* < 0.05 for self-report data and −0.146, *p* < 0.05 for ARPU data). The statistical significance of the coefficients generally supports a functional relationship between monetary value and usage change. The comparative tests to validate H4, however, indicate conflicting results between the two datasets. The tests, therefore, fail to support the hypothesized effect of monetary value in changing a person’s DSM usage symmetrically (H4 not supported).

As for H5, the results are also contradictory between the two datasets. Self-efficacy was shown to have a larger impact on improving DSM usage in the self-report data, but this result was reversed with the ARPU dataset, in which self-efficacy played a greater role in suppressing DSM usage. Therefore, overall support for H5 was weak (H5 not supported). Finally, satisfaction (0.44, *p* < 0.001 and 0.39, *p* < 0.01) and dissatisfaction (0.28, *p* < 0.01 and 0.38, *p* < 0.01) with DSM were directly associated with its usage increase and decrease, respectively (H6 supported).

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Table 3 about here

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**DISCUSSION**

**Empirical Findings**

The majority of previous studies took the theoretical position that the influence of CSFs on measured performance is linear (or symmetric); only a relatively small group of studies argued that CSFs have asymmetric effects. This study took the hybrid position that the influence of an explanatory variable can be either unidirectional (or symmetric) or bi-directional (or asymmetric). Additionally, CSFs were presumed to have both positive and negative effects, and bi-directionality was suggested to be the reflection of the difference in influence. The hypotheses were therefore intended to compare the relative influence of CSFs on consequence variables. This line of reasoning sets this study apart from previous works that viewed asymmetry through the lens of statistical significance in each direction (e.g., Lee et al., 2009). Testing of this theoretical view involved examination of the relative effect of three groups of antecedent variables (i.e., information quality, system quality, and personal attributes) on the performance aspects of DSM based on both cross-sectional and longitudinal datasets. Several consistent patterns emerged.

First of all, information quality and system quality had clearly divergent strengths in influencing levels of user satisfaction and dissatisfaction. Information quality played a relatively larger role in shaping user satisfaction than dissatisfaction, but system quality had a greater influence on increasing user dissatisfaction than satisfaction. This is in line with the theoretical position of enablers (as satisfiers) and inhibitors (as dissatisfiers) as argued in previous studies (e.g., Cenfetelli, 2004; Lee et al., 2009; Parthasarathy and Bhattacherjee, 1998; Venkatesh and Brown, 2001).

The results further reveal that information quality is more influential than system quality in increasing user satisfaction and dissatisfaction. When the path coefficients between “information quality – satisfaction” and “system quality – satisfaction” were compared in the usage increase groups, information quality had a considerably higher impact than system quality on improving satisfaction with DSM. In addition, the effect of information quality in increasing dissatisfaction was also statistically significant in both decrease groups (−0.17, *p* < 0.05 for self-report data and −0.23, *p* < 0.01 for ARPU data), although the values were lower than those of system quality (i.e., −0.28 and −0.37). Overall, the results imply that the asymmetry of system quality tends to be more extreme than that of information quality. System quality becomes a pure inhibitor that only influences dissatisfaction when it falls short of the expectation level a user takes for granted (Cenfetelli, 2004).

The results also underscore a clear link between economic value and users’ cognitive and behavioral reactions. In fact, the perception of monetary value was statistically significant in 6 out of 8 path coefficients at *p* = 0.05. The remaining two path coefficients (i.e., 0.11 for the increase group and −0.11 for the decrease group) were strong enough to be significant at *p* = 0.1. This statistical consistency clearly reveals that people are sensitive to the economic value of DSM. At the same time, although a directional symmetry of influence was hypothesized, empirical testing reveals that this variable had a stronger effect as a satisfier than as a dissatisfier. The results imply that the financial factor becomes an intrinsic rather than external motivator, a vantage factor rather than a qualifying one with regard to user satisfaction (Chowdhary and Prakash, 2005). In addition, comparison of coefficients suggests that the influence of perceived monetary value on user satisfaction tends to be weaker than that of information quality, but stronger than that of system quality.

Examination of the role of self-efficacy in usage change shows mixed test results between the self-report- and ARPU-based datasets. Although the coefficients seem to imply a certain degree of positive contribution (0.24 and 0.02 in the increase group) and neutral or negative contribution (0.00 and −0.17 in the decrease group), the overall direct influence of this variable on usage change tends to be weaker than that of perceived monetary value. Additionally, its influence is either weaker or considerably weaker than those of other antecedents (i.e., information quality, system quality, and user satisfaction/dissatisfaction). This may be an indication that the overall change in personal behaviors is conditioned more by service provider-imposed factors than those inherent to the service user.

Finally, as might be expected, this study reaffirms that the level of satisfaction and dissatisfaction is decisive in either increasing or decreasing DSM usage. Our utilization of ARPU data over a six-month period was an attempt to reveal the longitudinal effect of satisfaction/dissatisfaction on DSM usage. Both the cross-sectional and longitudinal data analyses indicate a clear connection between the level of satisfaction/dissatisfaction and usage increase/decrease during the post-adoption period.

**Implications**

This study has several theoretical and practical implications. It was grounded on the presumption that both asymmetric bi-directionality and symmetric unidimensionality can explain how antecedent variables shape user attitudes and behaviors. As confirmed by the effects of information quality, system quality, and monetary value on the performance variables, the influence of CSFs on an IT service at the personal level may be approached from both dichotomous and non-dichotomous angles. Thus, researchers may begin with an open mind, realizing that satisfaction and dissatisfaction do not necessarily represent opposite concepts of a single dimension (Anderson and Sullivan, 1993), and that each could be more or less responsive to a particular group of variables (Chowdhary and Prakash, 2005).

Related to the first point, researchers may take the theoretical position that an explanatory factor is understood in terms of its *relative* influence on satisfaction versus dissatisfaction and on performance growth versus performance degradation. This position of *relativism* differs from that of previous duality studies in which the effect of a study variable is presumed to be statistically significant in one direction, but not in another (e.g., Lee et al., 2009). For example, our study reveals that while the inhibitor (i.e., system quality) furthered dissatisfaction and had a limited effect on satisfaction, the two variables (i.e., information quality and perceived monetary value) were statistically significant in both directions, but had a stronger influence as satisfiers.

The duality (or dichotomy) theory underlying this empirical work is a type of EP (explanation–prediction) theory that can contribute to the development and validation of IS research (Gregor, 2006). Among the conditions of a good EP theory are internal and external validities. The internal and external validity of duality theories has been demonstrated in marketing studies (e.g., Swan and Combs, 1976; Mittal and Lassar, 1998; Mittal et al., 1998) as well as in certain limited studies of IS (e.g., Lee et al., 2009; Speier et al., 2003). Thus, we suggest that the duality approach may be extended to the study of other variables (Cenfetelli, 2004). For example, recent studies (Benbasat et al., 2008; Charki and Josserand, 2008) emphasized the role of *distrust* as an independent conceptual dimension, rather than considering it as the opposite of trust. From the dichotomy perspective, low trust is not considered equivalent to high distrust, and vice versa. Future IS research may distinguish the effects of such negatively labeled variables (e.g., dissatisfaction, distrust) in understanding the dynamics of IT service usage.

Finally, this study has practical implications. Above all, the findings offer insights to IT service providers about how to develop effective marketing and promotional strategies for motivating service usage among satisfied customers, while at the same time preventing dissatisfied customers from defecting. For instance, given limited resources, if a firm’s strategic mix desires to minimize attrition of current subscribers rather than growing its customer base due to a saturated market situation, then it may pay more attention to sustaining the system quality its customers have come to expect. However, if the firm’s strategic goal is to grow its customer base or market share, then it may want to differentiate its service quality from that of the competition by enhancing customers’ perceptions of information quality or financial value. Our findings also suggest that practitioners should treat customer satisfaction and dissatisfaction as two divergent dimensions of business strategy in order to comprehend market dynamics better and improve the chance of business success. Executing a service strategy designed to increase user satisfaction may not have an equivalent effect on curtailing dissatisfaction.

**Limitations and Future Research**

This study has several limitations. The low response rate for the ARPU dataset is a limitation of our research, although it is to be expected when a sample is randomly chosen from a web portal’s registration list and a survey is conducted based on email solicitations (Kaplowitz et al., 2004). However, when PLS is used for data analysis, a sample size more than 10 times the number of study variables has been shown to suppress the chance of estimation bias (Chin et al., 2003; Goodhue et al., 2007).

Relating the service usage context to measured outcomes (i.e., satisfaction, usage change) is a topic for future research. This study focused on DSM use for the purpose of meeting utility and hedonic needs at the individual level. However, the characteristics of DSM usage at the organization level could differ considerably from those driven by individual needs. Important and interesting research remains to be done on how DSM utilization in a business context supports the duality (or non-duality) of CSFs. The patterns may turn out to be quite different when DSM usage is conditioned by organizational tasks, which allow a lesser degree of freedom in user behaviors. Future research may also investigate the roles of social, environmental, regulational, and cultural contexts (Lewis et al., 2003) in IT service usage. Future studies can accommodate these ideas to enrich our understanding of the possible duality of their antecedent variables, their dynamics, and the effects they might have on outcomes.

Other issues may also be addressed in future studies. First, the role of traditional factors, generally considered to be important in explaining the behaviors of IT service users, may be revisited from the perspective of their potentially divisive role. For example, as an important variable of the technology acceptance model, usability (or usefulness) may play a more significant role as a satisfier, while ease of use may be an inhibiting factor. Second, further studies can be conducted on increased usage despite user dissatisfaction, and decreased usage despite satisfaction. Finally, besides the variables selected in this study, other variables may play a pivotal role in determining the level of satisfaction/dissatisfaction and usage of IT services. Different combinations of first-order variables in the dimensions of information quality, system quality, and personal attributes may be tried to test the reliability of our dichotomy-related findings.

In conclusion, this study examined the possible asymmetric and symmetric nature of three antecedent dimensions (i.e., information quality, system quality, and individual attributes) in shaping the success of the advanced IT service. Directional effects of antecedents on outcome variables may or may not exist. The system quality variable showed a quite clear directionality of influence in increasing dissatisfaction, but not necessarily augmenting satisfaction. In addition, the dual roles of information quality and perceived monetary value in conditioning user satisfaction/dissatisfaction were recognized, but were relatively less evident than that of system quality. The statistical comparison between the increase and decrease groups indicated that both information quality and perceived monetary value were more effective as satisfiers than dissatisfiers. In sum, this study underscores that the hybrid duality perspective in theorizing dynamics between study factors can be highly rewarding.

**Appendix 1: Survey Items (Increase and Decrease Groups)**

**Relevance**

RL 1. Information is *applicable* to your purchase.

RL 2. Information is *related* to your purchase.

RL 3. In general, information is *relevant* to your purchase.

**Timeliness**

TI 1. Information is *current.*

TI 2. Information is *continuously updated.*

TI 3. In general, information is current.

**Reliability**

RI 1. Information is *trustworthy.*

RI 2. Information is *accurate.*

RI 3. In general, information is reliable for making your purchase decision.

**Scope**

SC 1. Information covers *a wide range*.

SC 2. Information contains *a wide variety of topics*.

SC 3. Information contains *a number of different subjects*.

**Access**

AC 1. The DSM is *responsive* to my request.

AC 2. The DSM *quickly* loads all the text and graphics.

AC 3. The DSM *assures* stable access.

AC 4. In general, the DSM provides *good access*.

**Usability**

US 1. The DSM has *a simple layout* for its contents.

US 2. The DSM is *easy to use.*

US 4. The DSM has *a clear design.*

US 4. In general, the DSM is *user-friendly.*

**Navigation**

NV 1. It is *easy to go back and forth* between pages.

NV 2. It is *easy* *to locate information*.

NV 3. In general, it is *easy to navigate*.

**Interactivity**

IN 1. The DSM provides the capability *to create a list of selected items.*

IN 2. The DSM provides the capability *to change items from a created list.*

IN 3. The DSM provides the capability *to create a customized product.*

IN 4. In general, the DSM enables me to participate actively in customizing the desired service.

**Self-efficacy**

I can complete the job using DSM…

CSE 1. …even if there is no one around to tell me what to do.

CSE 2. …even if I have never used it before.

CSE 3. …if I only have manuals for reference.

CSE 4. …if I see someone else using it before trying it myself.

**Perceived Monetary Value**

PMV1. The DSM is reasonably priced.

PMV2. The DSM offers good value for the money.

PMV3. At the current price, the DSM provides good value.

**Satisfaction**

SA1 I am satisfied with the DSM*.*

SA2 I am pleasedwith the DSM*.*

SA3 Using the DSM makes me content*.*

SA4 I will recommend the DSM to others.

**Dissatisfaction**

SA1 I am dissatisfied with the DSM*.*

SA2 I am displeasedwith the DSM*.*

SA3 Using the DSM makes me frustrated*.*

SA4 I will not recommend the DSM to others*.*

**DSM increase**

Over the past six months,

UI 1. …my overall usage of the DSM has increased.

UI 2. …my time using the DSM has increased.

UI 3. …DSM usage fees have increased.

**DSM decrease**

Over the past six months,

UD 1. …my overall usage of the DSM has decreased.

UD 2. …my time using the DSM has decreased.

UD 3. …DSM usage fees have decreased.

Note: Items for *satisfaction* and *DSM increase* were included in the survey for the usage increase group, and those for *dissatisfaction* and *DSM decrease* were included in the survey for the usage decrease group.

**Appendix 2: Validity Testing of Self-report Survey (First Empirical Study)**

Discriminant and convergence validity test

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Increase Group | | | | | | | | | | | | | | | | |
|  | Mean | SD | CSRI | AVE | RL | TL | RI | SP | AC | US | NV | IR | SA | SE | PV | UI |
| RL | 5.087 | 1.004 | 0.922 | 0.799 | **0.894** |  |  |  |  |  |  |  |  |  |  |  |
| TL | 5.162 | 1.086 | 0.909 | 0.769 | 0.707 | **0.877** |  |  |  |  |  |  |  |  |  |  |
| RI | 5.009 | 1.056 | 0.941 | 0.842 | 0.693 | 0.724 | **0.918** |  |  |  |  |  |  |  |  |  |
| SP | 4.907 | 1.188 | 0.952 | 0.868 | 0.573 | 0.640 | 0.550 | **0.932** |  |  |  |  |  |  |  |  |
| AC | 4.571 | 1.297 | 0.935 | 0.781 | 0.516 | 0.532 | 0.657 | 0.602 | **0.884** |  |  |  |  |  |  |  |
| US | 4.724 | 1.133 | 0.930 | 0.768 | 0.652 | 0.628 | 0.692 | 0.663 | 0.758 | **0.876** |  |  |  |  |  |  |
| NV | 4.447 | 1.359 | 0.949 | 0.861 | 0.566 | 0.498 | 0.623 | 0.567 | 0.750 | 0.805 | **0.928** |  |  |  |  |  |
| IR | 4.530 | 1.267 | 0.949 | 0.822 | 0.630 | 0.594 | 0.663 | 0.636 | 0.748 | 0.803 | 0.841 | **0.907** |  |  |  |  |
| SA | 4.818 | 1.151 | 0.936 | 0.784 | 0.688 | 0.627 | 0.634 | 0.631 | 0.574 | 0.640 | 0.588 | 0.662 | **0.885** |  |  |  |
| SE | 5.057 | 1.214 | 0.957 | 0.848 | 0.509 | 0.556 | 0.497 | 0.471 | 0.412 | 0.583 | 0.442 | 0.514 | 0.456 | **0.921** |  |  |
| PV | 4.233 | 1.424 | 0.953 | 0.871 | 0.488 | 0.416 | 0.546 | 0.519 | 0.662 | 0.696 | 0.723 | 0.748 | 0.572 | 0.418 | **0.933** |  |
| UI | 5.108 | 1.043 | 0.920 | 0.794 | 0.622 | 0.603 | 0.571 | 0.471 | 0.477 | 0.529 | 0.469 | 0.544 | 0.604 | 0.484 | 0.453 | **0.891** |
|  | | | | | | | | | | | | | | | | |
| Decrease Group | | | | | | | | | | | | | | | | |
|  | Mean | SD | CSRI | AVE | RL | TL | RI | SP | AC | US | NV | IR | DS | SE | PV | UD |
| RL | 4.384 | 1.066 | 0.908 | 0.767 | **0.876** |  |  |  |  |  |  |  |  |  |  |  |
| TL | 4.419 | 1.221 | 0.914 | 0.78 | 0.528 | **0.883** |  |  |  |  |  |  |  |  |  |  |
| RI | 4.065 | 1.057 | 0.945 | 0.85 | 0.428 | 0.505 | **0.922** |  |  |  |  |  |  |  |  |  |
| SP | 4.249 | 1.166 | 0.936 | 0.831 | 0.401 | 0.593 | 0.494 | **0.912** |  |  |  |  |  |  |  |  |
| AC | 3.453 | 1.281 | 0.915 | 0.729 | 0.284 | 0.372 | 0.429 | 0.397 | **0.854** |  |  |  |  |  |  |  |
| US | 3.796 | 1.146 | 0.893 | 0.677 | 0.383 | 0.368 | 0.54 | 0.494 | 0.67 | **0.823** |  |  |  |  |  |  |
| NV | 3.436 | 1.229 | 0.942 | 0.845 | 0.277 | 0.243 | 0.44 | 0.377 | 0.676 | 0.747 | **0.919** |  |  |  |  |  |
| IR | 3.576 | 1.156 | 0.932 | 0.774 | 0.251 | 0.331 | 0.445 | 0.454 | 0.602 | 0.65 | 0.711 | **0.880** |  |  |  |  |
| DS | 4.258 | 1.278 | 0.926 | 0.757 | -0.244 | -0.231 | -0.358 | -0.286 | -0.387 | -0.367 | -0.37 | -0.418 | **0.870** |  |  |  |
| SE | 4.324 | 1.304 | 0.946 | 0.815 | 0.223 | 0.252 | 0.295 | 0.349 | 0.109 | 0.29 | 0.163 | 0.293 | -0.156 | **0.903** |  |  |
| PV | 3.384 | 1.298 | 0.919 | 0.792 | 0.082 | 0.216 | 0.36 | 0.244 | 0.548 | 0.482 | 0.553 | 0.594 | -0.333 | 0.134 | **0.890** |  |
| UD | 4.549 | 1.307 | 0.945 | 0.852 | 0.093 | 0.019 | -0.084 | -0.009 | -0.222 | -0.188 | -0.223 | -0.248 | 0.33 | -0.033 | -0.268 | **0.923** |

Note: RL: relevance, TL: timeliness, RI: reliability, SP: scope, AC: access, US: usability, NV: navigation, IR: interactivity, SA/DS: satisfaction/dissatisfaction, SE: self-efficacy, PV: perceived monetary value, UI/UD: usage increase/usage decrease.

Factor analysis (Usage increase group)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | RL | TL | RI | SP | AC | US | NV | IR | SA | SE | PV | UI |
| RL1 | 0.869 | 0.600 | 0.583 | 0.453 | 0.412 | 0.538 | 0.463 | 0.501 | 0.572 | 0.415 | 0.390 | 0.517 |
| RL2 | 0.898 | 0.669 | 0.661 | 0.552 | 0.498 | 0.598 | 0.503 | 0.577 | 0.626 | 0.483 | 0.447 | 0.587 |
| RL3 | 0.913 | 0.627 | 0.613 | 0.528 | 0.473 | 0.609 | 0.550 | 0.609 | 0.646 | 0.465 | 0.468 | 0.563 |
| TL1 | 0.679 | 0.893 | 0.680 | 0.565 | 0.493 | 0.601 | 0.503 | 0.594 | 0.582 | 0.492 | 0.427 | 0.517 |
| TL2 | 0.617 | 0.894 | 0.629 | 0.601 | 0.512 | 0.580 | 0.485 | 0.552 | 0.572 | 0.506 | 0.406 | 0.551 |
| TL3 | 0.561 | 0.842 | 0.593 | 0.515 | 0.391 | 0.466 | 0.315 | 0.412 | 0.493 | 0.464 | 0.256 | 0.518 |
| RI1 | 0.644 | 0.690 | 0.937 | 0.509 | 0.610 | 0.651 | 0.588 | 0.628 | 0.601 | 0.479 | 0.510 | 0.505 |
| RI2 | 0.642 | 0.658 | 0.921 | 0.528 | 0.609 | 0.632 | 0.555 | 0.585 | 0.594 | 0.474 | 0.501 | 0.502 |
| RI3 | 0.621 | 0.643 | 0.894 | 0.478 | 0.590 | 0.622 | 0.573 | 0.614 | 0.550 | 0.412 | 0.491 | 0.567 |
| SP1 | 0.561 | 0.605 | 0.511 | 0.910 | 0.563 | 0.608 | 0.519 | 0.593 | 0.612 | 0.474 | 0.514 | 0.474 |
| SP2 | 0.491 | 0.566 | 0.487 | 0.941 | 0.529 | 0.589 | 0.504 | 0.564 | 0.536 | 0.402 | 0.444 | 0.388 |
| SP3 | 0.549 | 0.618 | 0.540 | 0.943 | 0.592 | 0.656 | 0.562 | 0.621 | 0.617 | 0.441 | 0.492 | 0.455 |
| AC1 | 0.503 | 0.514 | 0.596 | 0.524 | 0.877 | 0.684 | 0.675 | 0.668 | 0.531 | 0.411 | 0.558 | 0.428 |
| AC2 | 0.490 | 0.518 | 0.602 | 0.542 | 0.915 | 0.688 | 0.695 | 0.681 | 0.523 | 0.420 | 0.617 | 0.470 |
| AC3 | 0.400 | 0.437 | 0.572 | 0.518 | 0.889 | 0.644 | 0.629 | 0.641 | 0.512 | 0.315 | 0.563 | 0.381 |
| AC4 | 0.431 | 0.409 | 0.552 | 0.547 | 0.853 | 0.665 | 0.650 | 0.655 | 0.462 | 0.309 | 0.604 | 0.406 |
| US1 | 0.594 | 0.542 | 0.604 | 0.515 | 0.628 | 0.880 | 0.711 | 0.688 | 0.546 | 0.517 | 0.616 | 0.495 |
| US2 | 0.541 | 0.562 | 0.608 | 0.656 | 0.683 | 0.829 | 0.646 | 0.662 | 0.574 | 0.564 | 0.543 | 0.475 |
| US3 | 0.606 | 0.564 | 0.628 | 0.578 | 0.688 | 0.908 | 0.732 | 0.731 | 0.573 | 0.499 | 0.622 | 0.471 |
| US4 | 0.543 | 0.534 | 0.587 | 0.581 | 0.660 | 0.887 | 0.731 | 0.732 | 0.551 | 0.470 | 0.655 | 0.414 |
| NV1 | 0.522 | 0.459 | 0.567 | 0.540 | 0.641 | 0.730 | 0.912 | 0.732 | 0.514 | 0.442 | 0.619 | 0.405 |
| NV2 | 0.518 | 0.416 | 0.566 | 0.506 | 0.714 | 0.747 | 0.930 | 0.786 | 0.558 | 0.353 | 0.715 | 0.432 |
| NV3 | 0.536 | 0.511 | 0.601 | 0.534 | 0.730 | 0.764 | 0.941 | 0.821 | 0.563 | 0.434 | 0.676 | 0.469 |
| IR1 | 0.583 | 0.568 | 0.634 | 0.569 | 0.683 | 0.727 | 0.784 | 0.897 | 0.621 | 0.465 | 0.684 | 0.476 |
| IR2 | 0.540 | 0.550 | 0.625 | 0.620 | 0.693 | 0.730 | 0.734 | 0.876 | 0.580 | 0.444 | 0.683 | 0.471 |
| IR3 | 0.583 | 0.522 | 0.569 | 0.558 | 0.662 | 0.722 | 0.767 | 0.926 | 0.608 | 0.480 | 0.667 | 0.502 |
| IR4 | 0.579 | 0.517 | 0.579 | 0.563 | 0.676 | 0.733 | 0.765 | 0.926 | 0.593 | 0.476 | 0.680 | 0.521 |
| SA1 | 0.663 | 0.613 | 0.597 | 0.568 | 0.472 | 0.558 | 0.493 | 0.587 | 0.867 | 0.453 | 0.501 | 0.554 |
| SA2 | 0.580 | 0.530 | 0.557 | 0.572 | 0.535 | 0.574 | 0.539 | 0.588 | 0.895 | 0.381 | 0.527 | 0.549 |
| SA3 | 0.642 | 0.597 | 0.569 | 0.591 | 0.542 | 0.588 | 0.560 | 0.623 | 0.918 | 0.439 | 0.491 | 0.537 |
| SA4 | 0.554 | 0.482 | 0.524 | 0.502 | 0.482 | 0.545 | 0.488 | 0.547 | 0.861 | 0.340 | 0.509 | 0.501 |
| SE1 | 0.478 | 0.520 | 0.459 | 0.446 | 0.359 | 0.507 | 0.386 | 0.490 | 0.411 | 0.918 | 0.363 | 0.422 |
| SE2 | 0.462 | 0.528 | 0.444 | 0.411 | 0.385 | 0.534 | 0.381 | 0.475 | 0.420 | 0.928 | 0.389 | 0.436 |
| SE3 | 0.457 | 0.484 | 0.453 | 0.424 | 0.390 | 0.577 | 0.438 | 0.474 | 0.421 | 0.932 | 0.409 | 0.477 |
| SE4 | 0.477 | 0.518 | 0.474 | 0.454 | 0.385 | 0.530 | 0.422 | 0.455 | 0.426 | 0.905 | 0.377 | 0.447 |
| PV1 | 0.415 | 0.363 | 0.482 | 0.425 | 0.608 | 0.635 | 0.670 | 0.666 | 0.512 | 0.342 | 0.930 | 0.390 |
| PV2 | 0.481 | 0.409 | 0.529 | 0.522 | 0.644 | 0.671 | 0.688 | 0.721 | 0.560 | 0.399 | 0.944 | 0.465 |
| PV3 | 0.468 | 0.392 | 0.517 | 0.505 | 0.603 | 0.642 | 0.665 | 0.707 | 0.530 | 0.428 | 0.926 | 0.412 |
| UI1 | 0.604 | 0.577 | 0.547 | 0.402 | 0.439 | 0.491 | 0.432 | 0.491 | 0.552 | 0.459 | 0.401 | 0.893 |
| UI2 | 0.571 | 0.543 | 0.529 | 0.447 | 0.463 | 0.498 | 0.442 | 0.501 | 0.589 | 0.442 | 0.462 | 0.899 |
| UI3 | 0.487 | 0.493 | 0.450 | 0.409 | 0.371 | 0.424 | 0.381 | 0.461 | 0.474 | 0.391 | 0.345 | 0.882 |

Factor analysis (Usage decrease group)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | RL | TL | RI | SP | AC | US | NV | IR | DS | SE | PV | UD |
| RL1 | 0.792 | 0.339 | 0.344 | 0.261 | 0.264 | 0.283 | 0.165 | 0.182 | -0.099 | 0.180 | 0.055 | 0.105 |
| RL2 | 0.934 | 0.529 | 0.396 | 0.405 | 0.231 | 0.355 | 0.278 | 0.213 | -0.235 | 0.233 | 0.073 | 0.077 |
| RL3 | 0.897 | 0.505 | 0.383 | 0.377 | 0.257 | 0.365 | 0.277 | 0.263 | -0.295 | 0.170 | 0.084 | 0.067 |
| TL1 | 0.486 | 0.918 | 0.448 | 0.559 | 0.324 | 0.308 | 0.186 | 0.266 | -0.194 | 0.231 | 0.150 | 0.034 |
| TL2 | 0.454 | 0.878 | 0.372 | 0.467 | 0.258 | 0.258 | 0.129 | 0.223 | -0.167 | 0.217 | 0.178 | -0.030 |
| TL3 | 0.459 | 0.852 | 0.520 | 0.545 | 0.406 | 0.411 | 0.333 | 0.393 | -0.254 | 0.219 | 0.249 | 0.047 |
| RI1 | 0.429 | 0.485 | 0.912 | 0.455 | 0.367 | 0.484 | 0.364 | 0.402 | -0.321 | 0.284 | 0.320 | -0.055 |
| RI2 | 0.404 | 0.473 | 0.942 | 0.486 | 0.411 | 0.508 | 0.404 | 0.408 | -0.344 | 0.278 | 0.326 | -0.081 |
| RI3 | 0.351 | 0.438 | 0.913 | 0.425 | 0.410 | 0.502 | 0.448 | 0.421 | -0.324 | 0.254 | 0.349 | -0.096 |
| SP1 | 0.360 | 0.584 | 0.502 | 0.889 | 0.365 | 0.468 | 0.364 | 0.445 | -0.282 | 0.353 | 0.244 | -0.036 |
| SP2 | 0.382 | 0.543 | 0.436 | 0.934 | 0.370 | 0.451 | 0.324 | 0.373 | -0.241 | 0.291 | 0.192 | 0.008 |
| SP3 | 0.353 | 0.495 | 0.415 | 0.912 | 0.352 | 0.434 | 0.342 | 0.425 | -0.261 | 0.313 | 0.234 | 0.003 |
| AC1 | 0.321 | 0.412 | 0.427 | 0.396 | 0.886 | 0.633 | 0.620 | 0.567 | -0.381 | 0.148 | 0.497 | -0.240 |
| AC2 | 0.288 | 0.371 | 0.414 | 0.424 | 0.872 | 0.617 | 0.648 | 0.581 | -0.354 | 0.163 | 0.507 | -0.216 |
| AC3 | 0.143 | 0.226 | 0.221 | 0.231 | 0.813 | 0.494 | 0.500 | 0.447 | -0.254 | 0.014 | 0.416 | -0.140 |
| AC4 | 0.211 | 0.252 | 0.395 | 0.297 | 0.841 | 0.539 | 0.536 | 0.455 | -0.328 | 0.038 | 0.448 | -0.156 |
| US1 | 0.352 | 0.303 | 0.436 | 0.365 | 0.579 | 0.841 | 0.632 | 0.503 | -0.256 | 0.163 | 0.368 | -0.147 |
| US2 | 0.322 | 0.459 | 0.467 | 0.564 | 0.404 | 0.700 | 0.457 | 0.502 | -0.306 | 0.306 | 0.303 | -0.064 |
| US3 | 0.331 | 0.299 | 0.467 | 0.428 | 0.640 | 0.898 | 0.709 | 0.556 | -0.329 | 0.274 | 0.448 | -0.217 |
| US4 | 0.261 | 0.179 | 0.415 | 0.301 | 0.561 | 0.838 | 0.636 | 0.579 | -0.320 | 0.223 | 0.453 | -0.173 |
| NV1 | 0.259 | 0.260 | 0.378 | 0.360 | 0.576 | 0.681 | 0.905 | 0.638 | -0.320 | 0.143 | 0.446 | -0.148 |
| NV2 | 0.217 | 0.194 | 0.439 | 0.326 | 0.656 | 0.678 | 0.916 | 0.660 | -0.362 | 0.152 | 0.529 | -0.204 |
| NV3 | 0.288 | 0.217 | 0.394 | 0.352 | 0.632 | 0.700 | 0.936 | 0.661 | -0.338 | 0.154 | 0.550 | -0.262 |
| IR1 | 0.292 | 0.340 | 0.433 | 0.436 | 0.502 | 0.572 | 0.580 | 0.819 | -0.343 | 0.278 | 0.552 | -0.220 |
| IR2 | 0.194 | 0.355 | 0.454 | 0.380 | 0.549 | 0.537 | 0.634 | 0.865 | -0.365 | 0.214 | 0.510 | -0.198 |
| IR3 | 0.220 | 0.269 | 0.339 | 0.421 | 0.558 | 0.584 | 0.668 | 0.927 | -0.370 | 0.265 | 0.519 | -0.208 |
| IR4 | 0.186 | 0.210 | 0.350 | 0.362 | 0.509 | 0.594 | 0.618 | 0.903 | -0.391 | 0.275 | 0.515 | -0.247 |
| DS1 | -0.162 | -0.150 | -0.255 | -0.187 | -0.314 | -0.309 | -0.378 | -0.410 | 0.859 | -0.097 | -0.348 | 0.382 |
| DS2 | -0.247 | -0.252 | -0.284 | -0.261 | -0.343 | -0.283 | -0.306 | -0.329 | 0.896 | -0.168 | -0.284 | 0.247 |
| DS3 | -0.212 | -0.223 | -0.363 | -0.307 | -0.375 | -0.355 | -0.323 | -0.361 | 0.908 | -0.157 | -0.255 | 0.254 |
| DS4 | -0.229 | -0.176 | -0.345 | -0.239 | -0.312 | -0.330 | -0.279 | -0.356 | 0.815 | -0.117 | -0.273 | 0.268 |
| SE1 | 0.281 | 0.249 | 0.308 | 0.337 | 0.111 | 0.273 | 0.174 | 0.317 | -0.146 | 0.872 | 0.161 | -0.024 |
| SE2 | 0.211 | 0.234 | 0.268 | 0.376 | 0.084 | 0.261 | 0.126 | 0.243 | -0.153 | 0.927 | 0.088 | -0.021 |
| SE3 | 0.182 | 0.222 | 0.272 | 0.313 | 0.105 | 0.293 | 0.202 | 0.295 | -0.141 | 0.936 | 0.125 | -0.081 |
| SE4 | 0.131 | 0.205 | 0.216 | 0.232 | 0.093 | 0.217 | 0.086 | 0.204 | -0.123 | 0.874 | 0.114 | 0.009 |
| PV1 | -0.018 | 0.116 | 0.229 | 0.100 | 0.468 | 0.350 | 0.445 | 0.445 | -0.253 | 0.069 | 0.882 | -0.251 |
| PV2 | 0.111 | 0.207 | 0.403 | 0.295 | 0.539 | 0.507 | 0.567 | 0.613 | -0.359 | 0.170 | 0.932 | -0.273 |
| PV3 | 0.124 | 0.256 | 0.325 | 0.255 | 0.454 | 0.425 | 0.461 | 0.525 | -0.273 | 0.117 | 0.853 | -0.188 |
| UD1 | 0.065 | 0.054 | -0.050 | 0.070 | -0.172 | -0.153 | -0.165 | -0.170 | 0.279 | 0.004 | -0.217 | 0.905 |
| UD2 | 0.083 | -0.005 | -0.084 | -0.051 | -0.217 | -0.157 | -0.203 | -0.253 | 0.343 | -0.045 | -0.249 | 0.942 |
| UD3 | 0.109 | 0.006 | -0.099 | -0.042 | -0.224 | -0.210 | -0.249 | -0.263 | 0.290 | -0.051 | -0.275 | 0.922 |

**Appendix 3: Validity Testing of ARPU Survey (Second Empirical Study)**

Discriminant and convergence validity test

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Increase group | | | | | | | | | | | | | | | | |
|  | Mean | SD | CSRI | AVE | RL | TL | RI | SP | AC | US | NV | IR | SA | SE | PV | ARIR |
| RL | 4.645 | 1.204 | 0.903 | 0.757 | **0.870** |  |  |  |  |  |  |  |  |  |  |  |
| TL | 4.865 | 1.464 | 0.890 | 0.729 | 0.432 | **0.854** |  |  |  |  |  |  |  |  |  |  |
| RI | 4.406 | 1.260 | 0.942 | 0.844 | 0.374 | 0.516 | **0.919** |  |  |  |  |  |  |  |  |  |
| SP | 4.577 | 1.518 | 0.952 | 0.87 | 0.285 | 0.585 | 0.408 | **0.933** |  |  |  |  |  |  |  |  |
| AC | 3.616 | 1.588 | 0.930 | 0.769 | 0.297 | 0.414 | 0.394 | 0.518 | **0.877** |  |  |  |  |  |  |  |
| US | 4.103 | 1.297 | 0.884 | 0.658 | 0.179 | 0.312 | 0.436 | 0.412 | 0.496 | **0.811** |  |  |  |  |  |  |
| NV | 3.420 | 1.472 | 0.930 | 0.816 | 0.147 | 0.209 | 0.257 | 0.197 | 0.458 | 0.615 | **0.903** |  |  |  |  |  |
| IR | 3.563 | 1.353 | 0.900 | 0.695 | 0.299 | 0.392 | 0.466 | 0.383 | 0.515 | 0.59 | 0.623 | **0.834** |  |  |  |  |
| SA | 4.024 | 0.961 | 0.830 | 0.551 | 0.41 | 0.439 | 0.436 | 0.438 | 0.419 | 0.417 | 0.219 | 0.378 | **0.742** |  |  |  |
| SE | 4.951 | 1.555 | 0.956 | 0.845 | 0.351 | 0.448 | 0.277 | 0.415 | 0.335 | 0.334 | 0.235 | 0.331 | 0.175 | **0.919** |  |  |
| PV | 3.082 | 1.425 | 0.953 | 0.871 | 0.147 | 0.236 | 0.281 | 0.286 | 0.303 | 0.406 | 0.324 | 0.536 | 0.396 | 0.123 | **0.933** |  |
| ARIR | 0.490 | 0.654 | 1.000 | 1.000 | 0.198 | 0.13 | 0.144 | 0.199 | 0.223 | 0.203 | 0.199 | 0.376 | 0.467 | 0.102 | 0.346 | 1.000 |
|  | | | | | | | | | | | | | | | | |
| Decrease Group | | | | | | | | | | | | | | | | |
|  | Mean | SD | CSRI | AVE | RL | TL | RI | SP | AC | US | NV | IR | DS | SE | PV | ARDR |
| RL | 4.509 | 1.265 | 0.912 | 0.776 | **0.881** |  |  |  |  |  |  |  |  |  |  |  |
| TL | 4.726 | 1.569 | 0.866 | 0.685 | 0.362 | **0.828** |  |  |  |  |  |  |  |  |  |  |
| RI | 4.251 | 1.287 | 0.932 | 0.820 | 0.446 | 0.508 | **0.906** |  |  |  |  |  |  |  |  |  |
| SP | 4.358 | 1.415 | 0.955 | 0.875 | 0.283 | 0.357 | 0.255 | **0.935** |  |  |  |  |  |  |  |  |
| AC | 3.310 | 1.554 | 0.932 | 0.774 | 0.163 | 0.175 | 0.308 | 0.221 | **0.880** |  |  |  |  |  |  |  |
| US | 3.841 | 1.348 | 0.878 | 0.648 | 0.262 | 0.441 | 0.299 | 0.417 | 0.364 | **0.805** |  |  |  |  |  |  |
| NV | 2.934 | 1.428 | 0.935 | 0.826 | 0.206 | 0.279 | 0.329 | 0.270 | 0.389 | 0.455 | **0.909** |  |  |  |  |  |
| IR | 3.137 | 1.361 | 0.910 | 0.718 | 0.207 | 0.263 | 0.366 | 0.376 | 0.390 | 0.540 | 0.672 | **0.847** |  |  |  |  |
| DS | 4.027 | 1.473 | 0.886 | 0.662 | -0.444 | -0.315 | -0.306 | -0.266 | -0.398 | -0.466 | -0.471 | -0.428 | **0.814** |  |  |  |
| SE | 5.303 | 1.440 | 0.966 | 0.878 | 0.180 | 0.352 | 0.189 | 0.166 | 0.174 | 0.191 | 0.080 | 0.096 | -0.149 | **0.937** |  |  |
| PV | 2.737 | 1.469 | 0.933 | 0.823 | 0.203 | 0.179 | 0.244 | 0.215 | 0.297 | 0.313 | 0.487 | 0.384 | -0.381 | 0.074 | **0.907** |  |
| ARDR | 0.289 | 0.193 | 1.000 | 1.000 | -0.215 | -0.257 | -0.119 | -0.169 | -0.265 | -0.325 | -0.247 | -0.267 | 0.461 | -0.247 | -0.294 | **1.000** |

Note: RL: relevance, TL: timeliness, RI: reliability, SP: scope, AC: access, US: usability, NV: navigation, IR: interactivity, SA/DS: satisfaction/dissatisfaction, SE: self-efficacy, PV: perceived monetary value, ARIR/ARDR: ARPU increase/decrease rate.

Factor analysis (Usage increase group)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | RL | TL | RI | SP | AC | US | NV | IR | SA | SE | PV | ARIR |
| RL1 | 0.802 | 0.306 | 0.224 | 0.119 | 0.200 | 0.151 | 0.223 | 0.259 | 0.291 | 0.259 | 0.166 | 0.097 |
| RL2 | 0.894 | 0.392 | 0.353 | 0.285 | 0.252 | 0.164 | 0.109 | 0.265 | 0.397 | 0.292 | 0.096 | 0.150 |
| RL3 | 0.911 | 0.423 | 0.390 | 0.327 | 0.318 | 0.152 | 0.063 | 0.257 | 0.376 | 0.361 | 0.126 | 0.116 |
| TL1 | 0.369 | 0.848 | 0.458 | 0.541 | 0.314 | 0.249 | 0.169 | 0.346 | 0.288 | 0.437 | 0.172 | 0.087 |
| TL2 | 0.297 | 0.866 | 0.413 | 0.454 | 0.348 | 0.284 | 0.167 | 0.325 | 0.400 | 0.352 | 0.222 | 0.094 |
| TL3 | 0.441 | 0.848 | 0.452 | 0.504 | 0.399 | 0.267 | 0.201 | 0.335 | 0.436 | 0.361 | 0.209 | 0.100 |
| RI1 | 0.310 | 0.483 | 0.930 | 0.390 | 0.355 | 0.436 | 0.206 | 0.436 | 0.437 | 0.311 | 0.215 | 0.113 |
| RI2 | 0.366 | 0.498 | 0.934 | 0.378 | 0.402 | 0.417 | 0.267 | 0.458 | 0.407 | 0.193 | 0.316 | 0.177 |
| RI3 | 0.356 | 0.441 | 0.892 | 0.356 | 0.328 | 0.348 | 0.236 | 0.389 | 0.357 | 0.261 | 0.243 | 0.089 |
| SP1 | 0.348 | 0.561 | 0.442 | 0.926 | 0.505 | 0.406 | 0.222 | 0.399 | 0.476 | 0.416 | 0.320 | 0.191 |
| SP2 | 0.250 | 0.578 | 0.384 | 0.953 | 0.485 | 0.395 | 0.212 | 0.387 | 0.419 | 0.397 | 0.280 | 0.209 |
| SP3 | 0.200 | 0.496 | 0.315 | 0.918 | 0.459 | 0.352 | 0.115 | 0.283 | 0.328 | 0.348 | 0.199 | 0.213 |
| AC1 | 0.361 | 0.460 | 0.336 | 0.445 | 0.848 | 0.336 | 0.347 | 0.431 | 0.449 | 0.265 | 0.253 | 0.207 |
| AC2 | 0.242 | 0.360 | 0.379 | 0.489 | 0.897 | 0.456 | 0.398 | 0.454 | 0.372 | 0.297 | 0.282 | 0.244 |
| AC3 | 0.159 | 0.247 | 0.277 | 0.435 | 0.905 | 0.426 | 0.392 | 0.365 | 0.270 | 0.212 | 0.221 | 0.146 |
| AC4 | 0.288 | 0.395 | 0.394 | 0.447 | 0.857 | 0.522 | 0.470 | 0.564 | 0.384 | 0.407 | 0.309 | 0.164 |
| US1 | 0.106 | 0.264 | 0.292 | 0.320 | 0.392 | 0.770 | 0.432 | 0.410 | 0.314 | 0.326 | 0.322 | 0.122 |
| US2 | 0.142 | 0.248 | 0.208 | 0.425 | 0.336 | 0.676 | 0.310 | 0.282 | 0.226 | 0.284 | 0.126 | 0.081 |
| US3 | 0.152 | 0.217 | 0.448 | 0.278 | 0.436 | 0.888 | 0.620 | 0.548 | 0.372 | 0.239 | 0.368 | 0.104 |
| US4 | 0.178 | 0.290 | 0.432 | 0.341 | 0.438 | 0.891 | 0.591 | 0.629 | 0.419 | 0.252 | 0.459 | 0.096 |
| NV1 | 0.120 | 0.163 | 0.287 | 0.144 | 0.368 | 0.591 | 0.890 | 0.468 | 0.151 | 0.196 | 0.217 | 0.071 |
| NV2 | 0.177 | 0.217 | 0.256 | 0.190 | 0.413 | 0.575 | 0.911 | 0.664 | 0.245 | 0.218 | 0.291 | 0.184 |
| NV3 | 0.100 | 0.186 | 0.155 | 0.198 | 0.459 | 0.502 | 0.908 | 0.553 | 0.197 | 0.223 | 0.369 | 0.138 |
| IR1 | 0.291 | 0.293 | 0.385 | 0.364 | 0.558 | 0.574 | 0.451 | 0.710 | 0.367 | 0.302 | 0.384 | 0.200 |
| IR2 | 0.279 | 0.310 | 0.347 | 0.313 | 0.432 | 0.387 | 0.495 | 0.768 | 0.323 | 0.179 | 0.373 | 0.201 |
| IR3 | 0.232 | 0.323 | 0.395 | 0.305 | 0.386 | 0.496 | 0.546 | 0.926 | 0.283 | 0.304 | 0.485 | 0.176 |
| IR4 | 0.214 | 0.380 | 0.427 | 0.311 | 0.381 | 0.523 | 0.577 | 0.911 | 0.309 | 0.315 | 0.528 | 0.217 |
| SA1 | 0.513 | 0.433 | 0.429 | 0.410 | 0.333 | 0.348 | 0.155 | 0.322 | 0.747 | 0.316 | 0.306 | 0.198 |
| SA2 | 0.040 | 0.282 | 0.307 | 0.273 | 0.323 | 0.312 | 0.094 | 0.202 | 0.716 | 0.004 | 0.284 | 0.273 |
| SA3 | 0.315 | 0.278 | 0.389 | 0.291 | 0.303 | 0.389 | 0.299 | 0.334 | 0.793 | 0.035 | 0.315 | 0.365 |
| SA4 | 0.340 | 0.312 | 0.158 | 0.327 | 0.285 | 0.178 | 0.089 | 0.260 | 0.710 | 0.166 | 0.270 | 0.270 |
| SE1 | 0.337 | 0.373 | 0.245 | 0.315 | 0.261 | 0.293 | 0.249 | 0.297 | 0.153 | 0.888 | 0.053 | 0.005 |
| SE2 | 0.384 | 0.457 | 0.299 | 0.395 | 0.368 | 0.336 | 0.224 | 0.319 | 0.189 | 0.956 | 0.129 | 0.063 |
| SE3 | 0.292 | 0.429 | 0.225 | 0.436 | 0.323 | 0.296 | 0.246 | 0.290 | 0.190 | 0.919 | 0.119 | 0.147 |
| SE4 | 0.276 | 0.388 | 0.250 | 0.379 | 0.277 | 0.303 | 0.145 | 0.311 | 0.109 | 0.912 | 0.149 | 0.044 |
| PV1 | 0.073 | 0.177 | 0.185 | 0.200 | 0.239 | 0.342 | 0.263 | 0.481 | 0.331 | 0.062 | 0.920 | 0.244 |
| PV2 | 0.135 | 0.215 | 0.302 | 0.288 | 0.279 | 0.406 | 0.280 | 0.529 | 0.363 | 0.107 | 0.956 | 0.241 |
| PV3 | 0.204 | 0.268 | 0.299 | 0.312 | 0.331 | 0.389 | 0.367 | 0.490 | 0.416 | 0.175 | 0.923 | 0.216 |
| ARIR | 0.199 | 0.132 | 0.146 | 0.204 | 0.227 | 0.202 | 0.199 | 0.374 | 0.470 | 0.102 | 0.347 | 0.683 |

Factor analysis (Usage decrease group)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | RL | TL | RI | SP | AC | US | NV | IR | DS | SE | PV | ARDR |
| RL1 | 0.830 | 0.218 | 0.312 | 0.197 | 0.060 | 0.242 | 0.015 | 0.088 | -0.274 | 0.086 | 0.137 | -0.006 |
| RL2 | 0.913 | 0.320 | 0.396 | 0.249 | 0.201 | 0.242 | 0.231 | 0.187 | -0.431 | 0.228 | 0.192 | -0.249 |
| RL3 | 0.898 | 0.413 | 0.464 | 0.300 | 0.164 | 0.210 | 0.286 | 0.265 | -0.460 | 0.155 | 0.204 | -0.178 |
| TL1 | 0.299 | 0.811 | 0.413 | 0.322 | 0.121 | 0.365 | 0.166 | 0.114 | -0.170 | 0.306 | 0.029 | -0.048 |
| TL2 | 0.290 | 0.903 | 0.433 | 0.253 | 0.056 | 0.296 | 0.200 | 0.193 | -0.273 | 0.288 | 0.115 | -0.166 |
| TL3 | 0.314 | 0.763 | 0.418 | 0.319 | 0.275 | 0.451 | 0.338 | 0.360 | -0.345 | 0.280 | 0.316 | -0.108 |
| RI1 | 0.382 | 0.487 | 0.907 | 0.235 | 0.230 | 0.203 | 0.269 | 0.334 | -0.247 | 0.125 | 0.222 | -0.019 |
| RI2 | 0.369 | 0.465 | 0.930 | 0.259 | 0.290 | 0.301 | 0.319 | 0.351 | -0.288 | 0.168 | 0.207 | -0.041 |
| RI3 | 0.463 | 0.427 | 0.878 | 0.196 | 0.317 | 0.307 | 0.305 | 0.307 | -0.297 | 0.221 | 0.235 | -0.129 |
| SP1 | 0.203 | 0.339 | 0.272 | 0.923 | 0.249 | 0.321 | 0.282 | 0.388 | -0.225 | 0.173 | 0.239 | -0.049 |
| SP2 | 0.296 | 0.320 | 0.201 | 0.954 | 0.198 | 0.397 | 0.243 | 0.330 | -0.260 | 0.114 | 0.195 | -0.078 |
| SP3 | 0.296 | 0.344 | 0.244 | 0.929 | 0.174 | 0.452 | 0.234 | 0.339 | -0.261 | 0.180 | 0.171 | -0.101 |
| AC1 | 0.194 | 0.217 | 0.185 | 0.242 | 0.853 | 0.315 | 0.318 | 0.357 | -0.389 | 0.242 | 0.205 | -0.246 |
| AC2 | 0.195 | 0.145 | 0.255 | 0.251 | 0.911 | 0.325 | 0.396 | 0.384 | -0.349 | 0.142 | 0.338 | -0.096 |
| AC3 | 0.120 | 0.118 | 0.302 | 0.207 | 0.918 | 0.351 | 0.363 | 0.395 | -0.351 | 0.161 | 0.246 | -0.106 |
| AC4 | 0.063 | 0.138 | 0.342 | 0.071 | 0.835 | 0.288 | 0.288 | 0.229 | -0.311 | 0.068 | 0.253 | -0.118 |
| US1 | 0.179 | 0.350 | 0.230 | 0.225 | 0.301 | 0.827 | 0.355 | 0.414 | -0.368 | 0.151 | 0.158 | -0.221 |
| US2 | 0.324 | 0.276 | 0.197 | 0.541 | 0.089 | 0.607 | 0.231 | 0.329 | -0.311 | 0.143 | 0.201 | -0.037 |
| US3 | 0.230 | 0.446 | 0.296 | 0.354 | 0.387 | 0.910 | 0.363 | 0.409 | -0.394 | 0.202 | 0.240 | -0.142 |
| US4 | 0.148 | 0.332 | 0.231 | 0.289 | 0.344 | 0.843 | 0.491 | 0.575 | -0.422 | 0.117 | 0.402 | -0.203 |
| NV1 | 0.123 | 0.194 | 0.223 | 0.219 | 0.324 | 0.385 | 0.895 | 0.599 | -0.400 | 0.016 | 0.423 | -0.077 |
| NV2 | 0.264 | 0.255 | 0.356 | 0.248 | 0.321 | 0.428 | 0.933 | 0.633 | -0.448 | 0.038 | 0.492 | -0.147 |
| NV3 | 0.172 | 0.312 | 0.316 | 0.270 | 0.418 | 0.427 | 0.899 | 0.600 | -0.435 | 0.167 | 0.412 | -0.162 |
| IR1 | 0.275 | 0.199 | 0.332 | 0.305 | 0.366 | 0.490 | 0.602 | 0.814 | -0.441 | 0.118 | 0.307 | -0.118 |
| IR2 | 0.259 | 0.208 | 0.312 | 0.442 | 0.409 | 0.441 | 0.555 | 0.741 | -0.342 | 0.131 | 0.329 | -0.107 |
| IR3 | 0.091 | 0.214 | 0.283 | 0.258 | 0.297 | 0.459 | 0.566 | 0.917 | -0.352 | 0.036 | 0.348 | -0.189 |
| IR4 | 0.105 | 0.270 | 0.319 | 0.297 | 0.272 | 0.447 | 0.561 | 0.906 | -0.324 | 0.055 | 0.321 | -0.203 |
| DS1 | -0.328 | -0.141 | -0.145 | -0.164 | -0.434 | -0.387 | -0.375 | -0.310 | 0.800 | -0.066 | -0.316 | 0.237 |
| DS2 | -0.406 | -0.366 | -0.324 | -0.273 | -0.266 | -0.427 | -0.404 | -0.369 | 0.868 | -0.184 | -0.260 | 0.230 |
| DS3 | -0.322 | -0.244 | -0.259 | -0.226 | -0.311 | -0.413 | -0.459 | -0.434 | 0.891 | 0.003 | -0.320 | 0.270 |
| DS4 | -0.404 | -0.274 | -0.270 | -0.198 | -0.292 | -0.273 | -0.274 | -0.262 | 0.679 | -0.273 | -0.361 | 0.354 |
| SE1 | 0.247 | 0.375 | 0.216 | 0.120 | 0.127 | 0.239 | 0.055 | 0.084 | -0.201 | 0.917 | 0.030 | -0.178 |
| SE2 | 0.152 | 0.322 | 0.157 | 0.156 | 0.192 | 0.203 | 0.075 | 0.087 | -0.135 | 0.968 | 0.037 | -0.172 |
| SE3 | 0.131 | 0.293 | 0.148 | 0.170 | 0.193 | 0.118 | 0.107 | 0.120 | -0.136 | 0.937 | 0.092 | -0.091 |
| SE4 | 0.146 | 0.330 | 0.187 | 0.175 | 0.140 | 0.155 | 0.065 | 0.070 | -0.088 | 0.925 | 0.121 | -0.016 |
| PV1 | 0.161 | 0.145 | 0.187 | 0.187 | 0.268 | 0.232 | 0.426 | 0.326 | -0.299 | 0.102 | 0.896 | -0.101 |
| PV2 | 0.213 | 0.203 | 0.223 | 0.206 | 0.247 | 0.337 | 0.443 | 0.379 | -0.373 | 0.026 | 0.946 | -0.153 |
| PV3 | 0.177 | 0.137 | 0.255 | 0.193 | 0.296 | 0.279 | 0.458 | 0.339 | -0.364 | 0.077 | 0.878 | -0.095 |
| ARDR | -0.220 | -0.246 | -0.116 | -0.155 | -0.257 | -0.318 | -0.239 | -0.265 | 0.455 | -0.234 | -0.274 | 0.773 |

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[Figure 1] Research model



[Figure 2] Average DSM usage in ARPU analysis

(₩ = Korean Won. 1 US$ is roughly equivalent to 1100 Won.)



1. Usage increase group (N = 300)



1. Usage decrease group (N = 261)

[Figure 3] SEM analysis based on self-report dataset only



1. Usage increase group (N = 138)



1. Usage decrease group (N = 146)

[Figure 4] Structural model based on ARPU dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | | Operationalization | # of items | Sources of survey items |
| Exogenous  Variables | Information  Quality | Relevance: Adequacy, precision, and significance of available information | 3 | Bailey &  Pearson (1983)  Davis et al. (1989)  Seddon (1997)  Wilkerson et al. (1997)  McKinney et al. (2002) |
| Timeliness: Currency of available information | 3 |
| Reliability: Accuracy and consistency/stability of available information | 3 |
| Scope: Completeness and exhaustiveness of available information | 3 |
| System  Quality | Access: Degree of accessibility, stability, responsiveness, and availability of DSM | 4 | Bailey &  Pearson (1983)  Novak et al. (2000)  Wilkerson et al. (1997)  McKinney et al. (2002) |
| Usability: Design aspect of user screens in terms of ease of use, visual attractiveness, user friendliness, and convenience in delivering mobile IT services | 4 |
| Navigation: Effectiveness in navigating between screens while using mobile IT services | 3 |
| Interactivity: Effectiveness of the search engine and elements of personal design | 4 |
| Satisfaction/  Dissatisfaction | Degree of satisfaction with DSM | 4 | McKinney et al. (2002),  Oliver (1980), Westbrook & Oliver (1980) |
| Degree of dissatisfaction with DSM | 4 |
| Self-efficacy | Self-confidence in DSM usage | 4 | Lewis et al. (2003) |
| Perceived Monetary Value | Perceived value of DSM for the price | 3 | Hong & Tam (2006) |
| Endogenous  Variables | Usage Increase / Decrease | Perception of usage increase/decrease during the past six-month period | 3 | Seddon (1997) |
| Changes in ARPU (average revenue per use) during the past six-month period | NA |  |
|  |

[Table 1] Operationalization of study variables and literature sources

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Summary Items and  Categories | | Test 1  (N = 561) | Test 2  (N = 284) | Summary Items and  Categories | | Test 1  (N = 561) | Test 2  (N = 284) |
| Average  DSM Fees /Month ($) | < 5 | 11.9 | 1.8 | Entertain-  ment | Ringtone | 29.9 | 14.7 |
| < 10 | 10.3 | 10.2 | Color Ring/  Music | 10.3 | 12.2 |
| < 20 | 39.4 | 34.9 | Wall Screen | 1.4 | 5.2 |
| < 30 | 22.6 | 16.2 | Game | 14.3 | 10.5 |
| < 40 | 7.5 | 18.3 | Movies / Multimedia | 2.0 | 1.8 |
| < 50 | 3.7 | 9.5 | Photo | 8.4 | 11.4 |
| > 50 | 4.5 | 9.2 | Communication | MMS/email | 5.9 | 12.9 |
| Usage  Motive | Utilitarian | 34.9 | 40.5 | Messenger | 0.9 | 2.6 |
| Hedonic | 65.1 | 59.5 | Information | Geographical Information | 0.9 | 3.0 |
| Gender | Male | 45.6 | 43.7 | Searching | 7.5 | 10.6 |
| Female | 54.4 | 56.3 | News/Stock  Lifestyle Info. | 6.8 | 4.7 |
| Age | 10~19 | 6.8 | 3.5 | Finance | Shopping/  Reservations | 1.6 | 3.3 |
| 20–29 | 43.9 | 64.4 | m-Banking | 7.3 | 2.3 |
| 30–39 | 31.6 | 25.0 | Event/Lottery | 1.4 | 3.5 |
| 40–49 | 13.0 | 6.0 | Other | - | 1.4 | 1.2 |
| Over 50 | 4.8 | 1.1 |
| Average  Income  /Month | < 1K | 27.5 | 36.3 | Job | Student | 27.5 | 27.5 |
| < 2K | 28.3 | 38.4 | Professional/  Business Person | 53.3 | 55.3 |
| < 3K | 19.3 | 16.5 | Homemaker | 10.3 | 2.5 |
| < 4K | 25.0 | 8.8 | Business Owner | 6.4 | 4.2 |
| Other | 2.5 | 10.6 |
| Education | Middle School | 2.3 | 0.4 |  | | | |
| High School | 19.6 | 21.1 |
| Undergraduate | 67.0 | 70.4 |
| Graduate | 11.1 | 8.1 |

[Table 2] Demographics and descriptive statistics of survey respondents

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Hypotheses | Estimator | Self-report  Data | | |  | ARPU-based  Data | |
| Usage  Increase Group  (N = 300) | | Usage  Decrease Group  (N = 261) |  | Usage  Increase Group  (N = 138) | Usage  Decrease Group  (N = 146) |
| H1: Information Quality →  Satisfaction/Dissatisfaction  (Result supports H1) | Path Coef. | 0.592 | | -0.172 |  | 0.456 | -0.230 |
| S.E. | 0.062 | | 0.071 | 0.080 | 0.070 |
| t-value | 69.886\*\*\* | | | 24.255\*\*\* | |
| H2: System Quality →  Satisfaction/Dissatisfaction  (Result supports H2) | Path Coef.  S.E.  t-value | 0.089 | -0.279 | |  | 0.108 | -0.372 |
| 0.073 | 0.096 | | 0.097 | 0.079 |
| -23.382\*\*\* | | | -28.823\*\*\* | |
| H3: Monetary Value →  Satisfaction/Dissatisfaction  (Result does not support H3) | Path Coef. | 0.164 | | -0.105 |  | 0.201 | -0.138 |
| S.E. | 0.061 | | 0.074 | 0.094 | 0.074 |
| t-value | 7.636\*\*\* | | | 7.935\*\*\* | |
| H4: Monetary Value →  Usage Increase/Decrease  (Result does not support H4) | Path Coef. | 0.105 | | -0.176 |  | 0.189 | -0.146 |
| S.E. | 0.074 | | 0.058 | 0.105 | 0.069 |
| t-value | -11.877\*\*\* | | | 6.554\*\*\* | |
| H5: Self-efficacy →  Usage Increase/Decrease  (Result does not support H5) | Path Coef. | 0.242 | | -0.002 |  | 0.019 | -0.174 |
| S.E. | 0.063 | | 0.086 | 0.108 | 0.069 |
| t-value | 32.969\*\*\* | | | -20.511\*\*\* | |
| H6: Satisfaction /dissatisfaction → Usage Increase /Decrease  (Result supports H6) | Path Coef. | 0.44\*\* | | 0.28\*\* |  | 0.39\*\* | 0.38\*\* |

\* *p* < 0.05, \*\* *p* < 0.01, \*\*\* *p* < 0.001.

[Table 3] Results of hypothesis testing