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What Makes Usage of Mobile Data Service Increase or Decrease: Perspective of Two-Factor Theory

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WHAT MAKES USAGE OF MOBILE DATA SERVICE INCREASE OR DECREASE: PERSPECTIVE OF TWO-FACTOR THEORY

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Abstract

This study is to investigate factors that affect usage change in mobile data service (MDS). The central claim of this paper is that influencing forces of usage increase in MDS are different from those of usage decrease. We propose that information quality as the motivator (forces of usage increase) and system quality as the de-motivator (forces of usage decrease) of MDS. A research model is proposed and subsequent hypotheses are empirically tested with partial least square (PLS) based on 478 responses from the users of mobile data service. We have found that information quality (as a motivator) is positively associated with usage increase in mobile data service, but system quality (as a de-motivator) is not. Also, system quality is negatively associated with usage decrease, but information quality is not. Despite the recognized limitations, our study highlights the potential value of the two-factor theory in explaining user behaviors associated with mobile data services.

Keywords: MDS, Two factor theory, Information quality, System Quality, Usage

1 INTRODUCTION

With the increasing prevalence of advanced cell-phones, various mobile data services (hereafter MDS) are gaining popularity. Although cellular networks were originally introduced for voice communications, statistics indicate that data services are replacing the matured voice service as the growth engine for telecom service providers. For example, SK Telecom, the Korea's largest mobile service provider, reported that 25.6% of revenue and 28.5% of profit came from MDS in 2006 and the share is growing (SK Telecom, 2007). Statistics also indicate that, in 2006, the average revenue per user (ARPU) for voice didn't change but MDS grew seven percents from the previous year, further highlighting its growth potential (SK Telecom, 2007). MDS is defined "as an assortment of digital data services that can be accessed using a mobile device over a wide geographic area (Hong and Tam, 2006)." A variety of MDS have been deployed, with a few reaching the status of killer applications. Many of them need to access the Internet through the cellular-phone infrastructure. In the past, when the cellular network didn't have acceptable bandwidth for data services, SMS (short messaging service) dominated MDS. Now, Internet-ready, next-generation cell-phones are driving rich digital data services into the fabric of everyday life. The huge economic stake MDS has on its stakeholders warrants focused research to understand associated dynamics behind its adoption (Hong and Tam, 2006).

Lyytinen and Yoo(2002) pointed out the limitation of traditional adoption models in explaining the rapid diffusion of innovations such as P2P or mobile services. Also, despite the increasing popularity of MDS, unexpected drop in its usage is observed among some people. Our research goal is to examine if increase and decrease in the usage of MDS are explained by two separate groups of variables pertaining to information quality and system quality. For this, we investigate following research questions. (1) Does the information quality of MDS increase service usage?; (2) Does the system quality of MDS decrease service usage? The research questions and subsequent analysis are grounded on the two factor theory pioneered by Hertzberg et al.(1959). To answer the research questions, indicator variables of information quality and system quality are determined in the context of MDS and their significance is validated through the empirical survey and data analysis. Important theoretical and practical implications (i.e., crafting service strategy, design and adjustment of associated business models) of the findings are discussed.

2 THEORIES

The two-factor theory introduced by Herzberg et al.(1959) has become one of the most influential theories in explaining the motivation and satisfaction of organizational employees. By explaining various organizational sources of employee satisfaction and dissatisfaction, the theory has been utilized as a basis for the effective management of human resources. Herzberg et al.(1959) divided organizational factors affecting the level of employee satisfaction into two highly distinctive variables of motivators and de-motivators (also called as hygiene factors). Motivators are expected to boost job satisfaction and employee performance at an organization, but their absence or insufficiency does not necessarily grow job dissatisfaction. On the other hand, the dearth of hygiene factors is expected to result in the de-motivation and dissatisfaction of employees. Motivators offer a sense of accomplishment, recognition, challenge and responsibility, and prospect for advancement, which are largely task-related characteristics. Motivators are, therefore, mostly intrinsic to job content and administered by the employee (DeShields et al., 2002), and closely related with a person's sense of internal growth (Luthans, 1995). Meanwhile, de-motivators subsume non-task conditions such as financial rewards, security, firm rules and policy, management and supervision, and organizational environment (Herzberg et al., 1959), (Hong and Tam, 2006). They are largely extrinsic, environmental, and controlled by someone other than the employee herself/himself (DeShields et al., 2002). Their perceived strength does not necessarily fortify job satisfaction but their weakness is said to de-motivate employees. Herzberg et al.(Herzberg et al., 1959) pointed out that, to motivate employees, the management of human resources should be focused on enhancing their internal rewards rather than on removing external sources of dissatisfaction. Here, satisfiers and dissatisfiers are rather complementary in completing the theory. This complementary nature makes the two-factor theory distinctive from other theories that understood them as a differential on the satisfaction spectrum. Despite much criticism, the two-factor theory has been showing its staying power because of strengths in conceptual clarity (Bassett-Jones and Lloyd, 2005). The dual role of satisfiers and dissatisfiers might be relevant in understanding the performance of an IT-driven service. Here, the theoretical perspective of critical success factors of an IS/IT should offer a clue for successful IS/IT services (i.e., MDS) as well. According to the Delone and McLean's broad IS success model (DeLone and McLean, 1992), there are two key forces in determining the success of an information system: system quality and information quality. Their IS success model suggests that system quality (i.e., ease of use) and information quality (i.e., data reliability) affect both use and user satisfaction which, in turn, become the antecedents of personal and organizational impact (i.e., reduction in operational cost). Other studies also proposed similar models in which information quality and system quality are consistently included as predictors of user satisfaction (Chin et al., 1995; Davis et al., 1989; Seddon, 1997; Rai et al., 2002).

Variables (i.e., flexibility, portability, ease of use, reliability, and integration) of system quality reflect technical elements of an IS/IT necessary to deliver target content successfully. Dimensions of information quality (i.e., completeness, relevance, accuracy, timeliness, and consistency) represent the characteristics of information at the semantic level (DeLone and McLean, 1992). The ultimate goal of using an IS/IT is to serve people through the provision of information they need. From that angle, information quality is an intrinsic goal of system usage by people, and system quality sets extrinsic, environmental, and technical conditions necessary to satisfy user needs. Naturally, both factors may be closely interrelated rather than independent. Delone and McLean's(1992) model, in the meantime, does not discriminate the directionality (i.e., increase vs. decrease) of influences information quality and system quality have on individual and organizational performance. Accommodating the perspective of the two-factor theory, we postulate their discriminating effect on the usage of MDS.

3 STUDY VARIABLES

3.1 Information quality

Information quality is known to affect usage intention and user behavior (Davis et al., 1989) and therefore constitutes an important criterion for estimating the quality of an information system. From the review of existing literature, we determined four key elements of information quality: relevance, timeliness, reliability, and scope. Their operational definitions and literature sources are summarized in Table 1. The four variables became the first-order indicators of information quality.

Dimensions	Definition	Sources
Relevance	adequacy, preciseness, and significance of available information	Bailey and Pearson(1983), Davis et al.(1989), Seddon(1997), Wilkerson et al.(1997)
Timeliness	currency and updatedness of available information	Abels et al.(1997), Bailey and Pearson(1983), Wilkerson et al.(1997), Zmud(1978)
Reliability	accuracy and consistency of available information	Bailey and Pearson(1983), Doll and Torkzadeh (1998), King and Epstein(1983), Wilkerson et al.(1997)
Scope	completeness and exhaustiveness of available information.	Bailey and Pearson(1983), King and Epstein (1983), Wilkerson et al.(1997), Zmud(1978)

Table 1. Information Quality

3.2 System quality

The system environment of MDS is highly complicated because it implicates mobile telecommunication channels, operational support systems, terminals such as cellular phones, and user applications and interface. The system quality is therefore highly dependent on the integrity of technical architectures of MDS in nourishing user tasks and experience. We explored existing studies to identify variables that are especially relevant to user experience in MDS, and determined access, usability, and navigation as the first-order variables of system quality. Their definitions and derivational sources are summarized in Table 2.

Dimensions	Definition	Sources
Access	This represents the degree of accessibility, responsiveness, stability, and availability of MDS.	Bailey and Pearson(1983), Novak et al.(2000), Schubert and Selz(1999), Wilkerson et al.(1997)
Usability	This represents the design aspect of user screens in terms of ease of use, visual attractiveness, user friendliness, and convenience in delivering MDS.	Abels et al.(1997), Bailey and Pearson(1983), Davis(1989), Doll and Torkzadeh(1998), Wilkerson et al.(1997), Zmud(1978)

Navigation	This examines the effectiveness in navigating between screens and web pages.	Abels et al.(1997), Wilkerson et al.(1997)

Table 2. System Quality

4 RESEARCH MODEL

For the study, we propose a research model as in Figure 1. In the model, information quality and system quality constitute the second-order latent variables manifested by the selected first-order variables. The two latent variables are expected to directly affect the dependent variable, a person's behavioral change in service usage. Grounded on the two-factor theory, information quality and system quality are considered as the satisfier and the dissatisfier respectively. In sum, the goal of this research was to understand how two latent variables (information quality and system quality) affect the usage of MDS.

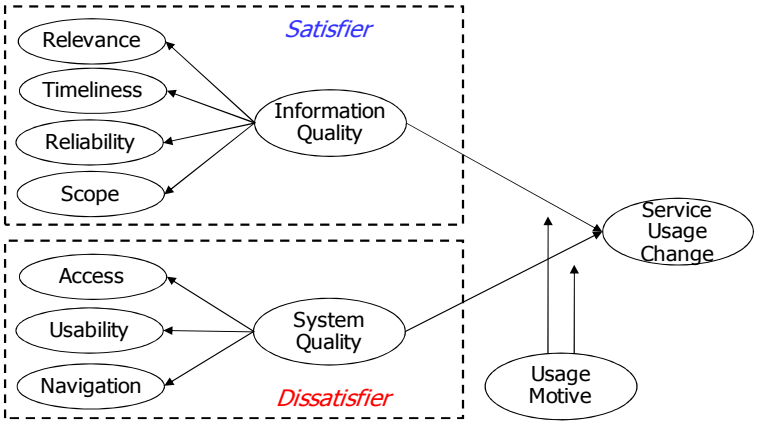

Figure 1. Research Model

5 HYPOTHESIS

5.1 MDS Increase Group

Many existing studies indicate the important role of user satisfaction and information quality in improving IS/IT usage (DeLone and McLean, 1992; Seddon, 1997). In defining the theoretical relationship among user satisfaction, information quality, and IS/IT usage, there are two schools of thought. The first group postulates that information quality affects IS/IT usage, which in turn positively enhances user satisfaction (Rai et al., 2002). User satisfaction of an IS/IT, therefore, is the consequence of actual experience. The second school of thought, in the meantime, believes that the association between information quality and IS/IT usage is mediated by user satisfaction (Goodhue,1988; Hartwick and Barki, 1994; Wixom and Todd, 2005). Many studies of the group focus on the ultimate association between information quality and system usage. Our study is in line with the second group, but the intermediating role of user satisfaction is not defined. Given that the independent variables are theoretically classified as satisfiers and dissatisfiers through their directionality of influence, our research focus is on understanding their direct effects on the behavior of MDS subscribers (usage increase or decrease).

Information quality is expected to play a significant role in enriching the experience of MDS. As information access is the ultimate reason for using an IS/IT, information quality is intrinsic in

satisfying the goal of system usage. From the perspective of the Herzberg et al.'s(1959) theory, therefore, information quality constitutes a motivator of MDS critical to support and enhance user tasks. With the two-factor theory, higher level of information quality implies greater satisfaction toward MDS, which could set off its increased use. Meanwhile, system quality is expected to offer an extrinsic value in which people take advantage of available information. It renders a mean to achieve the intended goal (i.e., information acquisition). It, therefore, offers a facilitating environment rather than being native to a task. From the discussion, it is hypothesized that:

H1: Perceived information quality is more influential than perceived system quality in increasing MDS usage.

5.2 Decrease in MDS usage

Studies indicate that system quality positively affect user satisfaction and system usage (DeLone and McLean, 1992; Seddon, 1997). As with information quality, we observe that there are two different association relationships defined between system quality and system usage. In the first, some studies postulate the direct and positive association between system quality and system usage (DeLone and McLean, 1992). The second group hypothesizes that system quality influences user satisfaction, which in turn increases system usage (i.e., Seddon, 1997)). The majority of these studies concur that the level of system quality is positively associated with its usage by people. From the perspective of the Herzberg et al.'s(1959) theory, system quality becomes a significant de-motivator of MDS because the variable plays a supportive (rather than native) role in achieving intended goals (i.e., information acquisition or entertainment). Once system quality reaches a certain level, therefore, its effect on service usage may become non-significant. If it begins to drop below an acceptable level, however, MDS users may begin to notice the effect of its deterioration in undertaking intended tasks, triggering their dissatisfaction. The effect of system quality is, therefore, expected to be more salient in decreasing system usage than in increasing it. In the meantime, if past studies become a guide, lowered information quality might be associated with certain declining in MDS usage. However, weakness in information quality as a satisfier may not constitute a substantial, de-motivating force in MDS usage. Therefore, it is hypothesized that:

H2: Perceived system quality is a more influential than perceived information quality in decreasing the usage of MDS.

6 SURVEY

6.1 Survey design

For the empirical study, a survey questionnaire was designed. It was composed of questions on (1) the usage of MDS (i.e., service provider, monthly spending, type of applications, usage frequency, and usage motivation); (2) information quality; (3) system quality; (4) usage changes; and (5) demographics. To improve their reliability, question items from previous studies were adequately adapted to the context of MDS. A discussion session was arranged in which graduate students (both master and Ph.D. levels) identified survey items with semantic ambiguity. Additionally, a pilot test was conducted to further improve the reliability of the questionnaire. All responses were based on the 7-point Likert scale. Table 3 summarizes the number of survey items used for the studied variables and their deriving sources.

6.2 Survey administration

The sampling frame of survey respondents is composed of people who have been using MDS for more than 6 months. For the research, only those people whose MDS usage had changed during the past six month period were targeted for the data gathering process. Survey candidates were then randomly identified from the panel of

Variables			#of items	Sources
Independent variable	Information Quality	Relevance	3	Bailey and Pearson(1983), Davis et al.(1989), Seddon(1997), Wilkerson et al. (1997)
		Timeliness	3	
		Reliability	4	
		Scope	3	
	System Quality	Access	4	Bailey and Pearson(1983), Novak et al. (2000), Schubert and Selz(1999), Wilkerson et al.(1997)
		Usability	4	
		Navigation	3	
Dependent Variable	Service Usage	Usage increase	3	Seddon(1997)
		Usage decrease	3	

Table 3. Summary of the survey questionnaire

people who met the qualification. Responses were gathered via the online survey (www.wsurvey.net) during the period of three weeks. Total 485 responses were submitted and 478 of them were used for data analysis after dropping 7 incomplete responses.

Demographics		Frequency Total: 478	%	Demographics		Frequency Total: 478	%
Gender	Male	238	49.8	Average spending for mobile data service (a month)	less than $5	159	33.3
	Female	240	50.2		$5~ less than $10	136	28.5
Age	17~19	44	9.2		$10~ less than $15	83	17.3
	20~29	252	52.7		$15~ less than $20	35	7.2
	30~39	158	33.1		$20~ less than $25	20	4.2
	40~49	22	4.6		$25~ less than $30	17	3.6
	50 ~	2	0.4		$30	28	5.9
Occupation	Student	158	33.1	Changes in service usage (recent 6 months)	Increased	310	64.9
	office worker	153	32.0		Decreased	168	35.1
	Professional	68	14.3	Motivation for service usage	information/data	138	28.9
					entertainment	340	71.1
	Technician	37	7.7	Average number of monthly usage	less than 5	239	50.0
					5 ~ less than 10	135	28.2
					10 ~ less than 15	55	11.5
	Homemaker	38	7.9		15 ~ less than 20	24	5.0
					20 ~ less than 25	2	0.4
	Other	24	5.0		25 ~ less than 30	7	1.5
					30 ~	16	3.4

Table 4. Demographics of survey respondents

6.3 Demographics

Table 4 summarizes demographics information of survey respondents. Responses were balanced in the gender distribution with 49.8% for male and 50.2% for female. The age distribution indicated that most respondents are in their 20s (54.6%) and 30s (31.7%), revealing that 20s and 30s are two most active groups using MDS. Also, the occupational distribution showed that 54% (excluding the "others" category) of surveyed were participating in economic activities and 41% (i.e., homemakers and students) were not.

Among the surveyed, 62.2% and 37.8% reported increase and decrease in the usage of MDS respectively. This seems to reflect the upward trend of Internet access via faster cellular phone infrastructure. About 80% of the surveyed people reported that the average spending on data service was less than $15 a month. It was also learned that the main motivation for using MDS was not the information access but entertainment (72.3%). This seems to be closely associated with the fact that people in their 20s and 30s dominated the user group.

7 RESULTS

7.1 Test of validities

We used PLS to validate the integrity of the research model and the significance of proposed hypotheses. As a structural modeling technique, it has been frequently used to examine social and organizational phenomena associated with information systems (Rai et al., 2002).

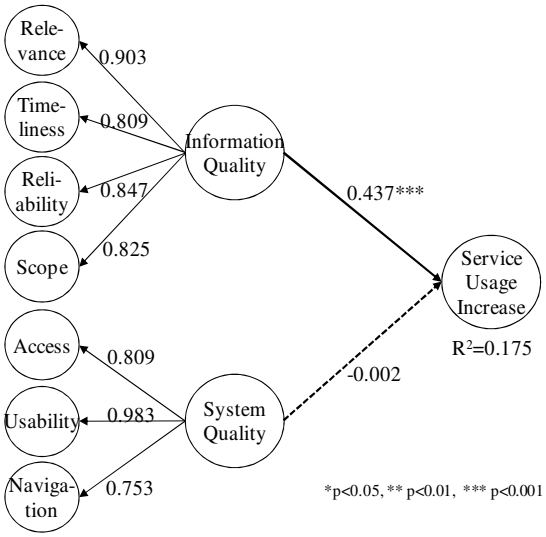

Figure 2. Path Coefficient (Increase group)

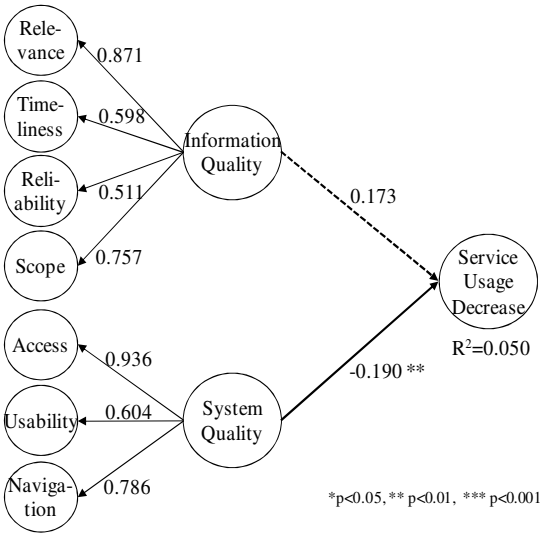

Figure 3. Path Coefficient (Decrease group)

We can analyze convergent validity by comparing factor loadings and cross-loadings (Wixom and Watson, 2001) and they are summarized in Appendix 1. When convergent validity was tested separately for two groups (usage increase and usage decrease groups), the result was almost identical to that of combined data. It confirmed that high-degree of convergence among indicator items of studied factors (both first-order and second-order factors) has been achieved. The factor loading test also confirmed the reliability of first-order variables as the manifesting variables of second-order, latent variables (information quality and system quality). In PLS, testing the reliability of a factor can be done via the CSRI, similar to the Cronbach's alpha. If CSRI is greater than 0.7, it is estimated that the internal consistency of indicator items is achieved (Fornell and Larcker,1981). Appendix 2 shows both CSRIs and Cronbach's alphas in which all constructs have values greater than 0.7, confirming their reliability. To examine the discriminant validity between constructs, values of squared AVE are presented in Appendix 3. In both first-order and second-order factors, they are greater than the squared values of correlation coefficients indicating appropriate discrimination between studied variables

7.2 Analysis of structural model

The PLS-based structural modeling is separately conducted on the usage increase (Figure 2) and the usage decrease groups (Figure 3). With the significance of measurement models confirmed (Appendix 1), Figures 2, 3 summarize path coefficients of structural models only.

Survey responses are divided into two (increase and decrease) groups based on the usage change during the last 6 month period. In the usage increase group (Figure 2), information quality positively affected the use of MDS (t=5.953) but the effect of system quality on the dependent variable was negligible (support H1). R-square reveals that 17.5 percent of variations in the usage growth are explained by information quality, a substantial explanatory power of the variable.

In the usage decrease group (Figure 3), the system quality variable was negatively associated with usage decrease (t=2.540). It confirmed that the lower the perceived quality of the MDS system, the larger the reduction in service usage resulted.

However, the effect of information quality on the dependent variable was insignificant (support H2). Although statistically insignificant, it was somewhat surprising that information quality had a positive association with usage reduction. With R-square, 0.050, the decrease group was less sensitive to the change in the independent variables than the increase group was. This seems to imply that overall people react more to the change of information quality than to the change of system quality in altering their usage behavior of MDS.

8 DISCUSSION

We attempted to examine the existence of uni-directional influences information quality and system quality have on the usage of MDS. From the two-factor theory, we derived our proposition that information quality becomes a significant satisfier (therefore motivator) of MDS usage and, meanwhile, system quality constitutes its dis-satisfier (therefore de-motivator). The two-stage approach with exploratory and confirmative analysis revealed that there is a considerable discriminating effect between information quality and system quality in explaining the overall usage behavior among MDS subscribers.

Several findings are made from the empirical research. As implied by the two-factor theory, the influencing force that increased MDS usage differed from the one that decreased MDS usage. Information quality had a positive effect on usage increase and, meanwhile, system quality negatively affected usage decrease. The direct role of information quality in decreasing and of system quality in increasing service usage was not significant. The results confirm that information quality manifested in the form of relevance, timeliness, reliability, and scope of available information, is a significant satisfier of MDS and a key motivator of its increased adoption. Meanwhile, system quality manifested in the form of accessibility, usability, and navigation is a key de-motivator whose enhancement doesn't grow service usage but whose compromise discourages people from continued MDS usage.

The study outcomes have powerful implications on practitioners, especially in marketing MDS products to prospective users. Depending on the prospect for the future growth of MDS, a service provider may plan for resource allocation to strengthen either information quality or system quality. For example, when there is much growth potential in a particular segment (or application) of MDS, a firm may place more resources on furthering information quality to improve its market penetration. Meanwhile, when a segment of MDS is considered close to maturation in the growth curve, a firm may channel more resources in improving system quality to keep existing customers from defection or lessening service usage. From a slightly different angle, offering high information quality can be more challenging and costly than improving system quality because the former represents a soft infrastructure that may require a continuous flow of investment in MDS. Meanwhile, when enhanced information quality of MDS results in higher subscription cost to customers, this might de-motivate people who access it mostly for

entertainment. Offering MDS may, therefore, need strategic balancing between information and system quality to optimize the financial performance of a service provider.

9 LIMITATIONS AND FUTURE RESEARCH

Our research has limitations. In the first, theories imply that the research model can be further extended incorporating mediating variables (i.e., user satisfaction) and other independent variables. We postulated direct association between the explanatory variables (information and system quality) and the usage change. It was grounded on the two-factor theory in which information quality and system quality represented satisfier and dissatisfier variables. Many extant studies (i.e., (Seddon, 1997)), however, presume that the level of user satisfaction triggers changes in the user behavior associated with an IS/IT service, and therefore an extended research model with user satisfaction and its subsequent validation may further enhance our understanding of dynamics related with MDS usage. Only 17.5 and 5.0 percents of variations are explained by information quality for the increase group and by system quality for the decrease group respectively. This implies the existence of other important variables that should be counted to increase the predictability of user behaviors in MDS. For example, the effect of financial factors is not examined here to focus on IT/IS issues of information and system quality. Herzberg et al.'s(Herzberg et al., 1959) two factor theory, however, clearly implies that the financial burden has a special implication on the MDS usage, especially in the usage decrease group. In future studies, analyzing cost issues as part of the research model is expected to enrich our understanding of inter-factor dynamics (i.e., enhanced information quality vs. higher subscription cost) in MDS usage. As another potential weakness of this study, data analysis on the decrease group may be biased due to the lack of data points. Further research is warranted based on enlarged data points. Meanwhile, we also acknowledge a realistic challenge in finding enough observations with "decrease" responses when people are increasingly rely on rich MDS services. Through the study we learned that the application of the two-factor theory (Luthans, 1995) to various subjects of IT/IS adoption and usage could result in a healthy contribution to existing knowledge base. As related, the results of extant studies (i.e., (DeLone and McLean, 1992), (Seddon, 1997) may be revisited from the perspective of uni-directionality, especially when the study variables are theoretically sound to be categorized into two distinguished groups. Subsequent results and their comparison with current studies are expected to enrich our understanding of target issues. As a matter of fact, the two-factor theory has been applied to many non-IS/IT studies and proved its consistent value (Bassett-Jones and Lloyd, 2005). Nonetheless, to the best of our knowledge, its potential has not been fully capitalized by the IS/IT community.

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Appendix 1. Tests of convergence validity

Items	RL	TL	RI	SP	AC	US	NV	UD
RL1	0.853	0.346	0.312	0.246	0.116	0.169	0.152	0.104
RL2	0.906	0.337	0.304	0.309	0.172	0.181	0.161	0.134
RL3	0.880	0.428	0.453	0.351	0.154	0.203	0.175	0.033

TL1	0.401	0.845	0.483	0.478	0.184	0.268	0.321	0.001
TL2	0.244	0.847	0.331	0.376	0.252	0.286	0.271	-.017
TL3	0.372	0.690	0.470	0.313	0.283	0.265	0.273	-.085
RI1	0.395	0.471	0.871	0.354	0.248	0.280	0.366	-.042
RI2	0.412	0.518	0.885	0.395	0.301	0.339	0.426	-.022
RI3	0.333	0.424	0.884	0.384	0.283	0.309	0.438	-.074
RI4	0.295	0.468	0.901	0.392	0.273	0.258	0.375	-.059
SP1	0.278	0.469	0.355	0.876	0.080	0.242	0.290	0.014
SP2	0.317	0.428	0.368	0.918	0.112	0.290	0.303	0.093
SP3	0.291	0.365	0.391	0.773	0.245	0.435	0.423	0.043
AC1	0.231	0.293	0.320	0.239	0.862	0.603	0.607	-.102
AC2	0.141	0.230	0.253	0.151	0.907	0.476	0.540	-.215
AC3	0.008	0.243	0.208	0.056	0.878	0.419	0.422	-.210
AC4	0.213	0.275	0.319	0.131	0.867	0.443	0.509	-.157
US1	0.192	0.314	0.260	0.389	0.410	0.844	0.554	0.032
US2	0.195	0.285	0.291	0.308	0.514	0.871	0.581	-.017
US3	0.146	0.292	0.301	0.282	0.504	0.910	0.637	-.045
US4	0.194	0.292	0.306	0.301	0.477	0.833	0.675	-.134
NV1	0.137	0.323	0.409	0.296	0.486	0.559	0.864	-.076
NV2	0.206	0.327	0.427	0.397	0.529	0.702	0.904	-.146
NV3	0.151	0.318	0.378	0.346	0.565	0.628	0.910	-.149
UD1	0.076	-.008	-.008	0.032	-.174	-0.041	-.114	0.927
UD2	0.120	-.018	-.025	0.089	-.198	-0.055	-.127	0.970
UD3	0.089	-.073	-.111	0.040	-.178	-0.035	-.149	0.930

Table 5. Convergent Validity(Increase group: n=310)

Items	RL	TL	RI	SP	AC	US	NV	UI
RL1	0.881	0.547	0.602	0.532	0.372	0.346	0.328	0.303
RL2	0.941	0.580	0.641	0.546	0.388	0.374	0.322	0.345
RL3	0.937	0.627	0.621	0.554	0.376	0.375	0.330	0.398
TL1	0.573	0.915	0.608	0.582	0.363	0.336	0.325	0.313
TL2	0.551	0.871	0.556	0.552	0.289	0.352	0.254	0.259
TL3	0.572	0.879	0.628	0.549	0.378	0.377	0.362	0.335
RI1	0.603	0.619	0.932	0.570	0.511	0.501	0.454	0.368
RI2	0.679	0.683	0.941	0.619	0.518	0.499	0.461	0.363
RI3	0.624	0.609	0.926	0.530	0.546	0.498	0.482	0.319
RI4	0.612	0.594	0.928	0.572	0.569	0.532	0.524	0.278
SP1	0.580	0.556	0.548	0.897	0.427	0.433	0.377	0.326
SP2	0.503	0.590	0.519	0.911	0.423	0.438	0.401	0.348
SP3	0.489	0.533	0.571	0.850	0.550	0.541	0.530	0.246
AC1	0.409	0.414	0.578	0.532	0.911	0.661	0.667	0.208
AC2	0.387	0.391	0.550	0.504	0.931	0.666	0.673	0.176
AC3	0.299	0.233	0.425	0.381	0.882	0.550	0.546	0.138
AC4	0.396	0.361	0.530	0.481	0.902	0.620	0.619	0.180
US1	0.326	0.339	0.504	0.473	0.663	0.903	0.676	0.184
US2	0.382	0.401	0.492	0.492	0.613	0.914	0.645	0.228
US3	0.385	0.363	0.504	0.492	0.615	0.913	0.660	0.228
US4	0.350	0.348	0.480	0.467	0.616	0.908	0.697	0.218
NV1	0.339	0.306	0.446	0.430	0.573	0.672	0.897	0.216
NV2	0.316	0.349	0.481	0.468	0.665	0.668	0.943	0.145

NV3	0.331	0.326	0.505	0.462	0.683	0.708	0.940	0.143
UI1	0.390	0.373	0.376	0.339	0.186	0.231	0.185	0.929
UI2	0.300	0.263	0.324	0.291	0.192	0.236	0.201	0.910
UI3	0.347	0.289	0.273	0.323	0.156	0.182	0.110	0.916

Note: RL: relevance; RI: reliability; TL: timeliness; SP: scope; AC: access; US: usability; NV: navigation; IQ: information quality; SQ: system quality; UI: usage increase; UD: usage decrease

Table 6. Convergent Validity(Decrease group: n=168)

Appendix 2. Reliability tests

Variables		Composite Reliability		AVE		Cronbach's Alpha	
		Incre.Group	Decre. Group	Incre.Group	Decre. Group	Incre. Group	Decre.Group
1st Ord.	RL	0.943	0.911	0.847	0.774	0.909	0.854
	TL	0.918	0.838	0.790	0.636	0.867	0.709
	RI	0.963	0.935	0.868	0.784	0.949	0.908
	SP	0.917	0.892	0.786	0.735	0.863	0.818
	AC	0.949	0.931	0.822	0.772	0.928	0.901
	US	0.950	0.922	0.826	0.748	0.930	0.887
	NV	0.948	0.922	0.859	0.797	0.918	0.872
2nd Ord.	UI/UD	0.942	0.960	0.844	0.888	0.908	0.938
	IQ	0.914	0.778	0.728	0.480	0.875	0.865
	SQ	0.924	0.838	0.803	0.639	0.878	0.857

Table 7. Reliability test

Appendix 3. Tests of discriminant validity

Correlation of Latent Variables- 1st order

	RL	TL	RI	SP	AC	US	NV	UI
RL	0.920							
TL	0.636	0.889						
RI	0.675	0.672	0.932					
SP	0.591	0.632	0.615	0.887				
AC	0.412	0.387	0.575	0.524	0.907			
US	0.397	0.399	0.545	0.529	0.689	0.909		
NV	0.355	0.353	0.515	0.490	0.692	0.736	0.927	
UI	0.376	0.335	0.353	0.345	0.193	0.235	0.180	0.918

Correlation of Latent Variables- 2nd order

	UI	IQ	SQ
UI	0.918		
IQ	0.418	0.853	
SQ	0.230	0.597	0.896

Correlation of Latent Variables- 1st order

	RL	TL	RI	SP	AC	US	NV	UD
RL	0.880							
TL	0.421	0.649						
RI	0.405	0.531	0.885					
SP	0.344	0.492	0.431	0.858				
AC	0.168	0.296	0.312	0.164	0.879			
US	0.209	0.341	0.335	0.369	0.551	0.865		
NV	0.185	0.361	0.453	0.389	0.591	0.707	0.893	
UD	0.101	-0.034	-0.05	0.057	-0.194	-0.047	-0.137	0.942

Correlation of Latent Variables- 2nd order

	UD	IQ	SQ
UD	0.942		
IQ	0.266	0.693	
SQ	0.132	-0.141	0.799

Table 8. Discriminant validity(Increase group: n=310 / Decrease group: n=168)