User's Segmentation on Continued Knowledge Management System Use in the Public Sector

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ABSTRACT

Knowledge management systems (KMS) can help an organization support knowledge management activities and thereby increase organizational performance. This study extends the expectation-confirmation model for predicting mandatory continued KMS use in the public sector. The models are assessed using data from a sample of 627 employees of the Kaohsiung City government in Taiwan and analyzed using the finite mixture partial least squares (FIMIX-PLS) method. The results of this study indicate that (1) data heterogeneity (i.e., educational level) segments two specific groups that show different perceptions toward continued KMS use; (2) the results of aggregate-based data analysis are different from the results of group-specific data analysis; (3) compatibility, relative to confirmation, has larger impact on perceived usefulness regardless of groups; (4) the effect of user satisfaction on continued usage behavior is significant different between the two groups; (5) cognition-driven continued use and emotion-driven continued use are identified in the two groups.

KEYWORDS

1. INTRODUCTION

Although characterized as conservative and inefficient, the government has begun to improve performance in recent years (Karwan & Markland, 2006). Inspired from the private sector, the public sector has begun to introduce the IS to offer better citizen services and increase organizational performance. Introducing IS into public sector organizations is a process of digital government (or e-government) implementation. The e-government explores how governments can use information and communication technologies to implement government principles and achieve policy goals (OECD, 2016). In Taiwan, the government has implemented e-government since 1998. In 2011, the National Development Council launched the phase IV e-government program (2012–2016) with funding of approximately US$288.33 million (NDC, 2016). According to the report of Waseda University's international e-government ranking of 2015, which surveyed the e-government implementation of 63 countries, Taiwan is ranked 17th (Waseda University, 2016). From these perspectives, Taiwan may be a benchmark for understanding IS implementation in the public sector. Particularly, introducing knowledge management system (KMS) to improve government processes may be an important step toward good governance. KMS is composed of KM-related tools, such as data management system, intranet, groupware and other technologies that are associated with the organizational practice of KM (Kuo & Lee, 2011). KMS may improve organizational excellence if it is properly implemented and fully comprehended by users (Matayong & Mahmood, 2012). In Taiwan, Kaohsiung City government

has introduced a knowledge management system (KMS) for attaining performance since 2003. KMS is a mandatory IS and the Kaohsiung City government requires its employees to use it. Generally speaking, a voluntary system is defined as one where users perceive adoption of the system as non-mandatory (Venkatesh & Davis, 2000). In a voluntary use environment, users perceive that they have willful choices to use the system. In terms of voluntary continued IS use, users have volitional control to decide whether or not to continue using the system. In contrast, a mandatory system is defined as one where users perceive that they are organizationally compulsory to use the system (Agarwal & Prasad, 1997; Brown et al., 2002; Venkatesh & Davis, 2000). In a mandatory use environment, users are required to use a specific system in order to keep and perform their jobs (Brown et al., 2002; Koh et al., 2010) regardless of whether they intend to use it. In terms of mandatory continued IS use, users are forced to continue using the system. A number of studies regarding the notion of mandatory versus volitional usage behavior have been widely discussed in the IS literature. Prior studies (e.g., Karahanna et al, 1999; Moore & Benbasat, 1991; Rawstorne et. al., 1998) argued that contexts of IS adoption range between two poles: one end by voluntary adoption and the other by mandatory adoption. That is, a given IS adoption decision may seem more or less voluntary on a continuum of voluntariness. Though there can be wide variability in user perceptions of voluntariness (Agarwal & Prasad, 1997; Karahanna et al., 1999; Venkatesh & Davis, 2000), Reinders et al. (2015) mentioned that mandatory use of the IS leads to reduced perceptions of freedom of choice and increased levels of feeling manipulated.

Researchers have attempted to develop and empirically examine models of continued IS use (e.g., Bhattacherjee, 2001; Bhattacherjee & Barfar, 2011; Cheng, 2014; Chen et al., 2012; Liao et al., 2009; Limayem & Cheung, 2011). Specifically, Bhattacherjee's (2001) expectation-confirmation model (ECM) in an IS context was developed to understand users' continued IS use. Since Bhattacherjee (2001) proposed the ECM model, voluntary continued IS use has been widely examined in the private sector (e.g., Bhattacherjee et al., 2008; Chen et al., 2012; Hsu & Lin, 2015; Kim, 2011; Lee & Kwon, 2011; Stone & Baker-Eveleth, 2013; Valvi & West, 2013). Recently, empirical studies (e.g., Lin & Rivera-Sánchez, 2012; Sørebø & Eikebrokk, 2008; Wang & Hsieh, 2006; Wang et al., 2008) have begun to use the ECM in predicting mandatory continued IS use. Hossain and Quaddus (2012) suggested that mandatory use of IS is an interesting area of future research using ECM or their modified versions. We recognized Hossain and Quaddus's (2012) perspective and we also explained why ECM is equally appropriate to use in the mandatory setting and why our modified ECM model (see Figure 1) is suitable for examining mandatory continued use of the IS. First, mandatory IS uses may be largely determined by organizational expectations and may not reveal users' real perceptions about the system (e.g., satisfaction). Even when IS use is obligatory, user satisfaction may capture the user's own mental acceptance of the system and can engender different extent of use (Hsieh et al., 2012). Thus, user satisfaction has a unique and potentially critical role in influencing system success in mandatory settings (Brown et al., 2002; Chan et al., 2011; Hsieh et al., 2012). Second, as user satisfaction is widely recognized as a critical role of mandatory IS use, understanding factors that influence user satisfaction may have important implications for organizations (Brown et al., 2008; Chan et al., 2011) because this understanding may provide managers or system designers with information to heighten user satisfaction and thereby create continued use for new systems. ECM suggests that the two core determinants—i.e., perceived usefulness and expectation confirmation are general beliefs that influence user satisfaction. We suggest that compatibility as mentioned later may also be an important belief to assess user satisfaction. Third, the focus on mandatory use is problematic for the application of ECM because continuance intention has little meaning when users are required to use a system. In a mandatory environment, users must perform the system regardless of whether or not they have continuance intentions to use the system. Thus, the relationship between user's satisfaction and continuance intention may be meaningless in the ECM. Nah et al. (2004) indicated that intention is not appropriate for users to assess their mental acceptance of the system in mandatory settings. Hartwick and Barki (1994) argued that compulsive IS usage behavior is variable

because users can vary their extent of use; however, this variability may be a function of the degree to which the IS is integrated into users' tasks (Brown et al., 2002; Linders, 2006; Melone, 1990). Thus, replacing continuance intention with continued usage behavior in the ECM may be appropriate when examining mandatory IS continuance. From the three perspectives, user satisfaction and the factors influencing the user satisfaction (i.e., the focus of ECM) may be appropriately used in mandatory setting. In addition, considering continuance usage behavior as the target variable and combining additional determinant of user satisfaction (e.g., compatibility) to predict mandatory continued IS use may be more reasonable. ECM gives less evidence to explain mandatory continued IS use in the public sector. Further understanding about users' continued IS use in the public sector may be helpful for the authorities because they may make strategies to better diffuse new IS in the future. *This is the first motivation of this study.*

Additionally, previous studies (e.g., Chang & Zhu, 2011; Halilovic & Cicic, 2013; Larsen et al., 2009; Limayem & Cheung, 2008; Li & Liu, 2014; Premkumar & Bhattacherjee, 2008; Sánchez-Franco et al., 2011; Santhanamery & Ramayah, 2014; Zhou, 2011) on continued IS use assumed that data originates from a single homogeneous population. However, individuals are different. Considering individuals as homogeneous may lead to incorrect results when explaining individuals' behaviors (Becker et al., 2013, Sarstedt et al., 2009; Sarstedt & Ringle, 2010). Although researchers (e.g., Chung & Kwon, 2009; Kroenung et al., 2015; Zogheib et al., 2015; Sanchez-Franco, 2006) have begun to use multiple group comparison analysis to segment data into different groups and thereby compare the differences of group perceptions toward IS use, they usually used categorical variables, such as gender, to segment data a priori. Because the source of heterogeneity is usually unknown, respondents

Figure 1. Research model
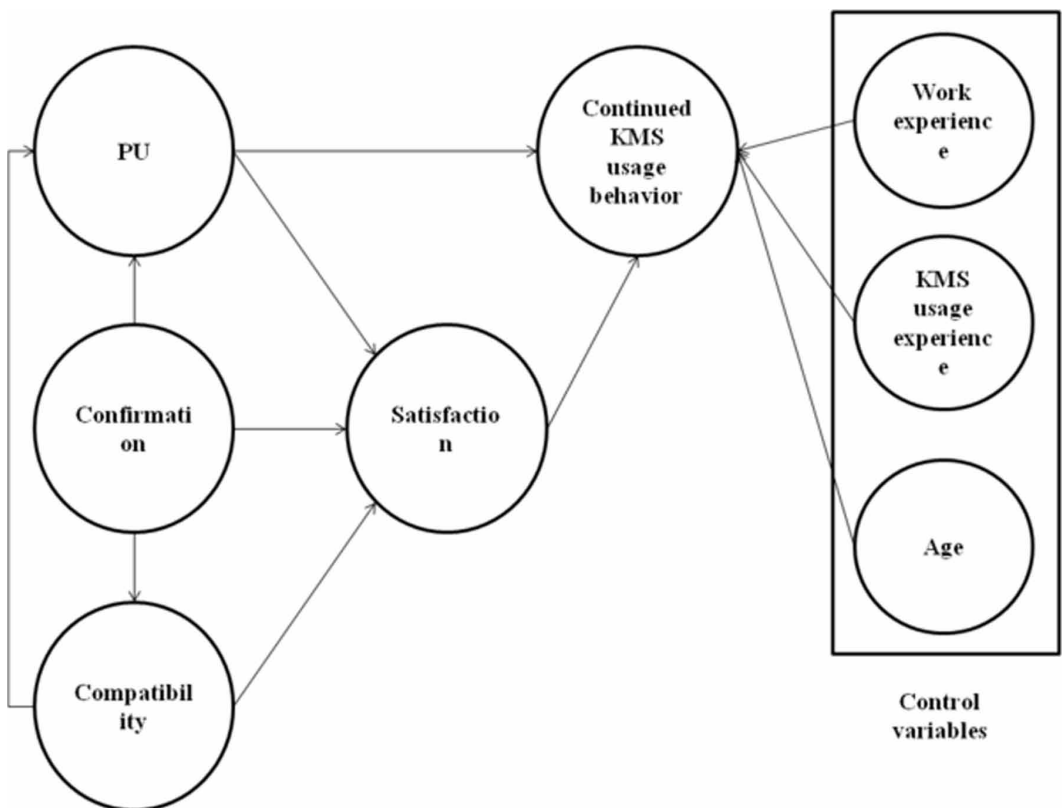
may not be classified into subgroups in advance (Hair et al. 2016; Sarstedt et al. 2009). To obtain an accurate explanation about continued IS use, data heterogeneity may be identified and treated. *This is the second motivation of this study.* According to the two motivations of this study, *the main purpose of this study is to employ ECM to examine the mandatory continued IS use considering data heterogeneity in the public sector.*

Due to the different context of continued IS use (i.e., voluntary use *versus* mandatory use), variables in the ECM may be not sufficient to explain continued IS use in mandatory environment. For example, in the Kaohsiung City government, mandatory continued KMS use may replace at least one previous work practice performed manually such as document management in order to increase employees' work efficiency. As a result, employees need to change their current work styles to meet the requirement of the KMS. Whether the KMS fits employees' work styles or is compatible with employees' work situations should be considered in explaining the perceptions of employees toward the continued KMS use. Previous studies (e.g., Karahanna *et al.,* 1999; Parthasarathy & Bhattacherjee, 1998; Low et al., 2011; Yang et al., 2012; Ye & Potter, 2011; Yu & Fang, 2009; Zhu et al., 2006) have begun to use compatibility in predicting IS post-adoption. From the perspective, "compatibility" may be not ignored when using ECM to predict mandatory continued KMS use in the public sector. Thus, we propose a public sector's ECM model (see Figure 1) and three research questions arise:

1. Identify data heterogeneity in the public sector's ECM model;
2. Conduct group-specific analysis based on the data heterogeneity;
3. Compare model differences between aggregate-based model and group-specific models.

2. LITERATURE REVIEW

2.1. Expectation-confirmation Model (ECM) and its Application on Mandatory Continued IS Use

In the IS literature, Bhattacherjee (2001) proposed an expectation-confirmation model (ECM) predicting continued IS use. ECM suggests that: (1) A user's intention to continue using an IS is induced by satisfaction and perceived usefulness; (2) Satisfaction and perceived usefulness are influenced by the user's confirmation of expectations; (3) Perceived usefulness is assumed to have an impact on satisfaction. ECM has been regarded as a primary IS theory and extensively used in continued IS use. Recent empirical studies (e.g., Cheng, 2014; Chen et al., 2012; Halilovic & Cicic, 2013; Hsu & Lin, 2015; Kim, 2011; Lee, 2010; Lee & Kwon, 2011; Lin et al., 2012; Santhanamery & Ramayah, 2014; Stone & Baker-Eveleth, 2013; Valvi & West, 2013) gave evidence to support that the ECM can well predict continued IS use. Although previous ECM research focused on the examination of voluntary continued IS use, few studies used ECM to predict mandatory continued IS use such as continued IS use in the public sector. When IS use is mandatory, it implies that someone else requires individuals to use the IS. If IS use is mandatory, the IS is frequently assumed to have little variance in usage (Hartwick & Barki, 1994; Rawstorne et al., 2000). As a result, individuals must use the IS whether the level of their continued intentions to use the IS are high or low. Thus, ECM may be more valuable for examining the actual IS continued usage behavior rather than examining the continued intention of using IS when the IS is organizationally mandated. Recently, empirical studies (e.g., Lin & Rivera-Sánchez, 2012; Sørebø & Eikebrokk, 2008; Wang & Hsieh, 2006; Wang et al., 2008) have begun to use the ECM in predicting mandatory continued IS use. Therefore, we propose the following hypotheses:

H_{1a}: A user's confirmation of expectations is positively related to perceived usefulness in the public sector.

H_{1b}: A user's confirmation of expectations is positively related to user satisfaction in the public sector.

H_{1c}: Perceived usefulness is positively related to user satisfaction in the public sector.

H_{1d}: Perceived usefulness is positively related to continued usage behavior in the public sector.

H_{1e}: User satisfaction is positively related to continued usage behavior in the public sector.

2.2. Roles of Compatibility in the ECM

Kleijnen et al. (2009) mentioned that innovations which cause a psychological conflict (e.g., incompatibility) and require a change in established behavioral patterns, habits and traditions are likely to be resisted. Ram (1987) indicated if people perceived that an innovation is lower compatible with their life style or past experiences, they may show higher resistance to use the innovation. Bhattacherjee and Hikmet (2007) indicated that compatibility has a positive effect on perceived usefulness which in turn, influences intention to use the technology. In this sense, if employees in the public sector perceive that an IS is compatible with their work processes, they may feel that it is useful and thus to reduce resistance and more use it. Therefore, we may suggest that the role of compatibility may not be ignored in e-government setting. IS researchers (e.g., Karahanna et al., 1999; Moore & Benbasat, 1991) defined compatibility as the extent to which adopting an IS is compatible with what people do. A great number of studies have examined the pre-adoption of technology (e.g., Al-Gahtani, 2003; Flight et al., 2011; Kuo & Lee, 2011; Liao & Lu, 2008; Lin, 2008; Wang et al., 2010) or post-adoption of technology (e.g., Chang et al., 2006; Islam, 2011; Kim et al., 2008; Liao & Lu, 2008; Reubsaet et al., 2004) by using compatibility. Empirical studies (e.g., Al-Gahtani & King, 1999; Karahanna et al., 2006; Larsen et al., 2009; Maillet et al., 2015; Oh et al., 2003; Sun et al., 2009; Zhou et al., 2010; Wu & Wang, 2005) have supported the influence of compatibility on perceived usefulness. Therefore, we propose the following hypothesis:

H_2: Compatibility is positively related to perceived usefulness in the public sector.

Bhattacherjee (2001) indicated that after a period of using the IS, users may form a judgment of the extent to which their initial expectations with the IS are confirmed. Based on the degree of confirmation, the users simultaneously develop the post-adoption appraisals of the IS (e.g., perceived usefulness). Previous studies on ECM have indicated that the users may develop additional post-adoption appraisals of the IS such as perceived ease of use (e.g., Sørebø & Eikebrokk, 2008; Roca et al., 2006), perceived fun or playfulness (e.g., Lin et al., 2005; Lin et al., 2014), perceived enjoyment (e.g., Min & Shenghua, 2007; Thong et al., 2006), or perceived fee (Kim, 2010). That is, confirmation may elicit the formation of multiple post-adoption appraisals regarding IS. According to Bhattacherjee's (2001) ECM, perceived usefulness is influenced by confirmation. Because perceived usefulness and compatibility are two post-adoption appraisals regarding IS, it is reasonable to believe that confirmation would impact on compatibility. The rationale for these associations originates from cognitive dissonance theory (Festinger, 1957). According to cognitive dissonance theory, IS users may experience cognitive dissonance or psychological tension if their pre-acceptance usefulness or compatibility perceptions are disconfirmed during actual use. Rational IS users may try to reduce this dissonance by adjusting their usefulness or compatibility perceptions so that it is more consistent with the reality. Therefore, we propose the following hypothesis:

H_3: A user's confirmation of expectations is positively related to compatibility in the public sector.

According to the ECM, positive post-adoption appraisals such as perceived usefulness may influence user satisfaction. Compatibility may imply that the use of an IS is consistent with most aspects of users' work practices. Like perceived usefulness, compatibility may induce users' positive emotion, such as satisfaction or happiness, after using IS. The causal relationship between cognition and emotion has been well documented in the social psychology literature (Ajzen, 1991), and this

relationship has been confirmed in the context of IS use (e.g., Chea & Luo, 2008; Chen et al., 2013; Kroenung et al., 2015; Kim, 2010; Lin et al., 2012). Empirical studies (e.g., Holsapple et al., 2005; Huh et al., 2009; Lin, 2012; Yusof et al., 2008) also gave evidence to support the relationship between compatibility and user satisfaction. Therefore, we propose the following hypothesis:

H_4: Compatibility is positively related to user satisfaction in the public sector.

3. RESEARCH METHODOLOGY

3.1. Measurement Development

The survey measures for this study are derived from the previously published studies as follows: ECM constructs (perceived usefulness, confirmation and user satisfaction) questions from Bhattacherjee (2001), continuance usage behavior from Bhattacherjee et al. (2008) and compatibility from Karahanna et al. (1999). All constructs are measured using seven-point Likert scales ranging from "strongly disagree" (1) to "strongly agree" (7). In addition, we considered work experience, age and user experience as three control variables. We selected these variables because of their potential effect on IS usage behavior as suggested by the IS literature. Figure 1 depicts our research model, and Table 1 shows measurement items.

3.2. Survey Administration

In this study, we investigated continued KMS use in the public sector, specifically in the Kaohsiung City government in Taiwan. The Kaohsiung City government implemented KMS—i.e., document management system in 2003. The Kaohsiung City government requires its employees to use KMS. In other words, the KMS usage requirement creates a mandatory usage environment. Particularly, the main objective of the KMS is to improve the efficiency of document management process and achieve a paperless office. Prior to their switching to the KMS, employees used paper-based documents to organize, deliver, share or store information. When employees require information, they need to spend time searching and retrieving these documents in file cabinets. The advantages of the KMS are to use information technology to reduce paper used, facilitate document exchanges, search documents by different indexing, store and retrieve documents quickly, and increase the efficiency of inter-unit document collaboration. When users encounter problems regarding system usage, they can post such problems on an e-discussion, and technical professionals or other users will provide their opinions or suggestions to help users solve the problems. Thus, e-discussion can help users to quickly obtain suggestions for system operation; in addition, the e-discussion may reduce error when using system. After implementing KMS, information can be created, shared, organized and stored efficiently and appropriately in the Kaohsiung government. Understanding the factors influencing continued KMS use in the Kaohsiung government may be valuable for other governments that intend to implement KMS in the future.

We collected responses from the actual users of the KMS in the Kaohsiung City government. To reach KMS users, we first contacted the deputy secretary of the Kaohsiung City government's main administration to explain the goal and importance of our study and ask for his help. Subsequently, we discussed the questionnaire survey with an analyst who is responsible for the planning and analysis of the KMS in the Kaohsiung City government. Because the KMS has been operated by users for a period of time; however, users may have some problems in operating the system. Thus, the main administration of the Kaohsiung City government launched a series of educational training courses to teach users how to use the KMS smoothly. We decided to deliver the questionnaire to users who attended these educational training courses. Twenty educational training courses were held, and 1215 users attended the courses. As we did not serve in the Kaohsiung City government, we were prohibited from entering the educational training course classrooms. Thus, we asked the analyst

Table 1. Measurement items

Construct	Item
Perceived usefulness	1. Using the KMS in my jobs improves my performance. 2. Using the KMS in my job increases my productivity. 3. Using the KMS in my job enhances my effectiveness. 4. I find the KMS to be useful in my job.
Satisfaction	How do you feel about your overall experience of KMS? 1. very dissatisfied/very satisfied. 2. very displeased/very pleased. 3. very frustrated/very contented 4. very terrible/very delighted.
Compatibility	1. KMS is compatible with most aspects of my work. 2. KMS fits my work style. 3. KMS fits well with the way I like to work.
Confirmation	1. My experience with using KMS was better than what I expected. 2. The service level provided by KMS was better than what I expected. 3. Overall, most of my expectations from using KMS were confirmed.
Continuance usage behavior	1. In the last 7 days, how often did you use the KMS? 2. In the last 7 days, how many hours did you use the KMS?

to help us deliver the questionnaire to each user in these educational training courses and collect questionnaires after class. To ensure KMS users' privacy, the questionnaire is anonymous. During survey process, the analyst and we were not familiar with users. Thus, we ensured a double blinded survey procedure. A total of 627 questionnaires were collected (52% response rate). The majority of the respondents were women (75%). In addition, many of the respondents were between the ages of 41 and 50 (36%), followed by between 31 and 40 (33.6%), between 21 and 30 (22.1%) and over 50 (8.3%). A large portion of the respondents had work experience of between 1 and 5 years (34.1%); this was followed by more than 20 years (23.3%), 6 and 10 years (13.7%), 16 and 20 years (12.8%), 11 and 15 years (12%) and less than 1 year (4.1%). Many of the respondents graduated from university (50.2%); this was followed by graduate school (34%), college (11.5%) and high school (4.3%). Moreover, 54.3% of the respondents were employees within the Kaohsiung City government, while 45.7% of the respondents were employees in elementary schools, junior high schools and senior high schools in Kaohsiung City.

3.3. Method

We employed partial least squares structural equation analysis (PLS-SEM) to test the hypotheses in our model. PLS-SEM assumes that latent constructs' variance can be explained by minimizing the error terms and maximizing the R^2 value (Hair et al., 2014; Hair et al., 2011). In addition, we used the FIMIX-PLS approach introduced by Hahn et al. (2002) to treat the data heterogeneity. FIMIX-PLS assumes that the overall population is a mixture of group-specific density functions (Hair et al., 2016). FIMIX-PLS uses the concept of mixture regression to estimate path coefficients and capture the data heterogeneity by assessing the probability of the observations' segment membership (Hair et al., 2014). As a result, observations can be classified into a number of groups. We used SmartPLS software (Ringle et al., 2015) to estimate the theoretical model and hypothesized relationships in our model.

4. RESULTS

4.1. Measurement Model

According to Hair et al. (2014), we followed a two-stage process to estimate our model. The two-stage process included the evaluations of the measurement model and structural model. Table 2 indicates that all item loadings exceed 0.8 and are significantly positive; this suggests good item reliability. Table 3 indicates that the values of composite reliability (CR) are between 0.89 and 0.98, exceeding the threshold value of 0.7 and suggesting good internal consistency. Additionally, Table 3 indicates that the values of average variance extracted (AVE) are between 0.73 and 0.93, exceeding the threshold value of 0.5 and suggesting good convergent validity. In addition, we adopted the Fornell-Larcker criterion to judge discriminant validity. If the square root of the AVE of each construct is higher than its highest correlation with any other construct, strong discriminant validity is confirmed. According to Table 3, our measurement model has strong discriminant validity.

4.2. Processes of FIMIX-PLS Analysis

4.2.1. Analysis of Aggregate-based Data

In accordance with the suggestion of Hair et al. (2014), we performed a bootstrapping procedure (with 5000 sub-samples) to test the statistical significance of each path coefficient in our model. Figure 2 depicts the structural model coefficients in our model. Confirmation exerts a significantly positive effect on compatibility (0.611) and satisfaction (0.496); however, confirmation does not have an effect on perceived usefulness (0.109). Thus, H_{1b} and H_3 were supported. H_{1a} was not supported. Compatibility (0.333) has a significantly positive effect on satisfaction; however, perceived usefulness (0.109) does not exert an effect on satisfaction. Thus, H_4 was supported; however, H_{1c} was not supported. Compatibility (0.817) has a significantly positive effect on perceived usefulness. Thus, H_2 was supported. Perceived usefulness (0.209) and satisfaction (0.151) exert significantly positive effects on continued KMS usage behavior. Thus, H_{1d} and H_{1e} were supported. In addition, we found that three control variables (work experience, KMS usage experience and age) do not have impact on continued KMS usage behavior.

4.2.2. Partition of Aggregate-based Data

We followed the four procedures of FIMIX-PLS suggested by Hair et al. (2016) to partition observations into subgroups. To determine the number of segments, we needed to examine the fit indices. Table 4 reports fit indices for a one to five segment solution. Hair et al. (2016) suggested that researchers may choose fewer segments than indicated by AIC and more segments than indicated by MDL_5. As noted in Table 4, we should choose a segment between a two-segment solution and a four-segment solution. Hair et al. (2016) also mentioned that if AIC3 and CAIC indicate the same number of

Table 2. Construct item loadings

Construct	Item	Loading[a]	t-value
Perceived usefulness	PU1	0.953**	124.307
	PU2	0.969**	329.781
	PU3	0.930**	97.220
	PU4	0.933**	101.068
Satisfaction	SAT1	0.955**	104.906
	SAT2	0.970**	215.460
	SAT3	0.955**	145.749
	SAT4	0.973**	229.055
Compatibility	CPT1	0.944**	159.006
	CPT2	0.957**	204.595
	CPT3	0.941**	149.268
Confirmation	CFM1	0.850**	40.948
	CFM2	0.844**	39.349
	CFM3	0.865**	105.869
Continuance usage behavior	CB1	0.963**	176.784
	CB2	0.939**	80.151

[a] $^{**}P < 0.01$

**Table 3. Convergent validity and discriminant validity**

	PU	SAT	CPT	CFM	CB
PU	*0.948*				
Satisfaction	0.704	*0.963*			
Compatibility	0.883	0.732	*0.948*		
Confirmation	0.608	0.765	0.611	*0.854*	
Continued usage behavior	0.317	0.158	0.338	0.158	*0.948*
AVE	0.90	0.93	0.90	0.73	0.90
CR	0.97	0.98	0.96	0.89	0.95
Mean	5.24	4.77	5.10	4.27	5.44
SD	1.05	1.13	1.08	1.14	1.34

[a] The italic numbers in the diagonal row are square roots of average variance extracted.

[b] PU: perceived usefulness; SAT: satisfaction; CPT: compatibility; CFM: confirmation; CB: continued usage behavior

segments, choose this solution. Thus, a two-segment solution is appropriate for interpreting data heterogeneity in our research model. Over 80% of our observations were well assigned to one of the two segments with a probability of more than 0.7.

Figure 2. The results of PLS-SEM based on aggregate data set
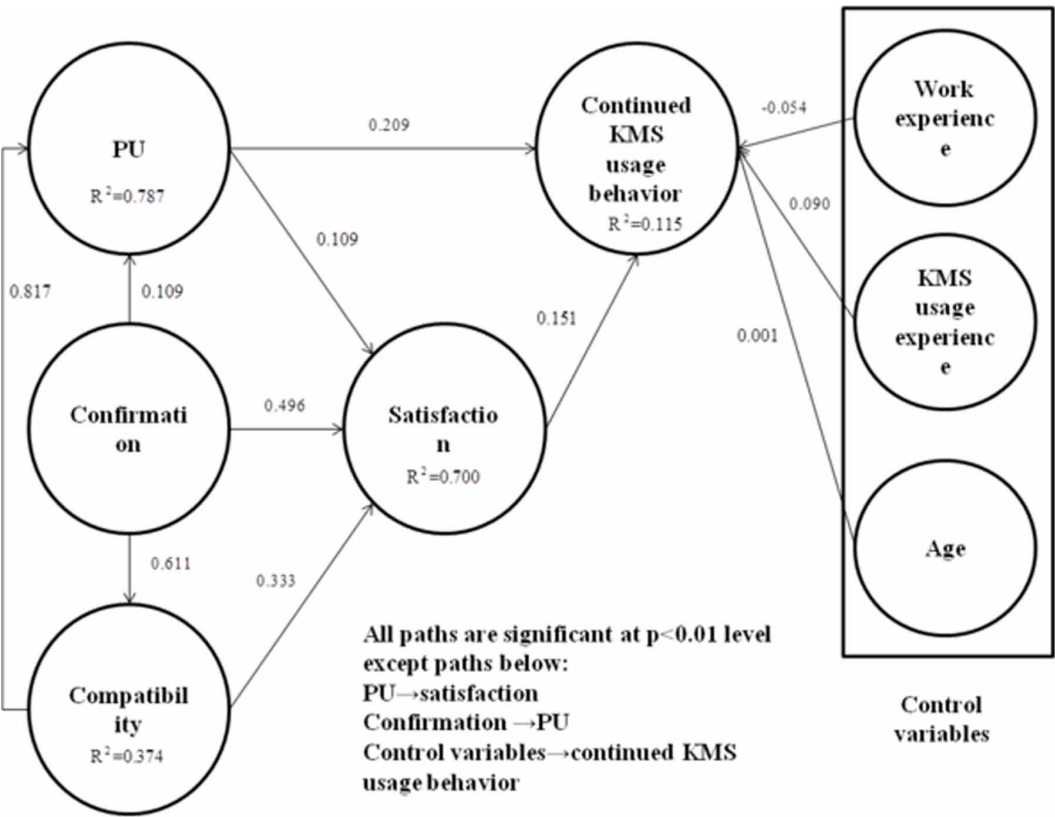
In addition, we assigned each observation to one of the two segments using the maximum segment membership probabilities obtained from FIMIX-PLS. In addition, we needed to identify an explanatory variable that matches the FIMIX-PLS partition. We used simple cross tabs (Matthews et al., 2016) to compare the partitions of FIMIX-PLS with those of demographics such as gender, age, educational level, and work experience. When we assigned users with educational level of high school, college or university to FIMIX-PLS group 1 and users with educational level of master or Ph.D. to FIMIX-PLS group 2, the best match was achieved. Table 5 shows the results of cross tabs and indicates that

Table 4. Fit indices for a one to five segment solution

| Criteria | No. of segments | | | | |
	1	2	3	4	5
AIC	5,730.87	5,505.50	5,528.51	5,572.39	**5,464.29**
AIC_3	5,744.87	**5,534.50**	5,572.51	5,631.39	5,538.29
AIC_4	5,758.87	5,563.50	5,616.51	5,690.39	5,612.29
BIC	5,793.04	5,634.29	5,723.91	5,834.40	5,792.92
CAIC	5,807.04	**5,663.29**	5,767.91	5,893.4	5,866.92
MDL_5	**6,153.74**	6,381.44	6,857.51	7,354.47	7,699.44
LnL	-2,851.44	-2,723.75	-2,720.25	-2,727.19	-2,658.14
EN		0.499	0.497	0.521	0.533

$$(2 + 25 + 69 + 315)\Big/191 + 2 = 96.33\%$$ of the observations match the FIMIX-PLS partition. Such a ratio is higher than the cut-off value of 60% suggested by Hair et al. (2016). In Taiwan, high school is a compulsory educational level, and college or university is required for a good job. We regarded users who have the educational level of high school, college or university as $Group_{essential\ education}$. Additionally, we regarded users who have the educational level of masters or Ph.D. as $Group_{research\text{-}oriented\ education}$. Thus, "education-specific" can capture data heterogeneity.

5. DISCUSSION

5.1. Appropriateness of User Segmentation

This study uses FIMIX-PLS to identify and treat data heterogeneity in the public sector's ECM model. Comparing paths in group-specific models (e.g., FIMIX-PLS $Group_1$ vs. $Group_{essential\ education}$ and FIMIX-PLS $Group_2$ vs. $Group_{research\text{-}oriented\ education}$; see Table 6), we found that ten paths are consistent, but one path is inconsistent. Our results reported a 90% overlap between the FIMIX-PLS partition and the one produced by "education-specific". Because the overlap of 90% exceeds the overlap of 60% suggested by Hair et al. (2016), our results should be considered satisfactory. Comparing the path coefficients from two education-specific groups with those from the FIMIX-PLS groups shows that the results align well. In other words, our results suggest that the FIMIX-PLS results may be adequately reproduced by using the "education-specific" partition.

5.2. Model Comparisons

5.2.1. Factors Influencing user Satisfaction for Mandatory IS Continuance

According to the Table 6, we found inconsistent results in aggregate-based data analysis and group-specific analysis. Our results indicated that confirmation is the most important factor influencing user satisfaction, followed by compatibility in the aggregate-based data analysis and $Group_{research\text{-}oriented\ education}$ analysis. However, $Group_{essential\ education}$ analysis showed confirmation as the most important factor inducing user satisfaction, followed by compatibility and perceived usefulness. When considering compatibility into ECM model, the effect of perceived usefulness may be weakened in $Group_{essential\ education}$ or such effect is nonsignificant in $Group_{research\text{-}oriented\ education}$. In this sense, the impact of compatibility may be larger than that of perceived usefulness on explaining user satisfaction with mandatory IS. Validating the effect of compatibility on user satisfaction is our contribution in the context of mandatory continued IS use. From a theoretical perspective, user's segmentation may clarify the determinants of user satisfaction for different users. To make clear causality between perceived usefulness and user satisfaction, it is beneficial for future researchers to consider data heterogeneity when examining mandatory continued IS use. From a practical implication, the authorities may

Table 5. Cross tab of FIMIX-PLS partition and educational level

Educational level	FIMIX-PLS groups		
	1	2	Sum
High school	27	0	27
College	69	3	72
University	315	0	315
Master program	20	191	211
Ph.D. program	0	2	2
Sum	431	196	627

Table 6. The results of FIMIX-PLS

Table 6. The results of FIMIX-PLS

	Original sample	FIMIX-PLS group 1	FIMIX-PLS group 2	Group$_{essential}$ educational level	Group$_{research-oriented}$ educational level
N	627	448	179	431	196
Relative segment size (100%)	100	71.45	28.55	68.74	31.26
Path					
Confirmation → PU	0.109	0.113*	0.095	0.108	0.108*
Confirmation → Compatibility	0.611**	0.606**	0.632**	0.617**	0.602**
PU → Satisfaction	0.109	0.141*	0.043	0.128*	0.056
Confirmation → Satisfaction	0.496**	0.488**	0.549**	0.473**	0.580**
Compatibility → Satisfaction	0.333**	0.319**	0.326**	0.348**	0.277**
PU → continued KMS usage behavior	0.209**	0.195*	0.194*	0.191*	0.204*
Satisfaction → contiuned KMS usage behavior	0.151*	0.227**	-0.033	0.234**	-0.041
Compatibility → PU	0.817**	0.822**	0.800**	0.827**	0.793**
Work experience → continued KMS usage behavior	-0.054	0.055	-0.044	0.048	-0.015
KMS usage experience → continued KMS usage behavior	0.090	0.002	0.080	-0.019	0.072
Age → continued KMS usage behavior	0.001	-0.006	0.008	-0.017	0.006
Measurement model assessment					
AVE	+	+	+	+	+
CR	+	+	+	+	+
Discriminant validity	+	+	+	+	+
R^2					
Perceived usefulness	0.787	0.802	0.746	0.804	0.742
Satisfaction	0.700	0.712	0.688	0.718	0.674
Compatibility	0.374	0.367	0.399	0.381	0.363
Continued KMS usage behavior	0.115	0.158	0.069	0.158	0.073
Weighted R^2					
Perceived usefulness	0.787		0.786		0.785
Satisfaction	0.700		0.705		0.704
Compatibility	0.374		0.376		0.375
Continued KMS use	0.115		0.133		0.131
GoF	0.588	0.600	0.572	0.602	0.566
Q^2	0.446	0.457	0.413	0.468	0.391

Notes: *$p < 0.05$, **$p < 0.01$, + = measurment model evaluation criterion fulfilled

emphasize the usefulness of the mandatory IS to enhance user satisfaction for users having essential educational levels rather than for users having research-oriented educational levels.

Table 6 also reported that confirmation and compatibility jointly explain 67.4% of the user satisfaction variance in Group$_{research-oriented education}$. Confirmation, compatibility and perceived usefulness jointly explain 71.8% of the user satisfaction variance in Group$_{essential education}$. Thus, these determinants are good predictors for user satisfaction with mandatory IS. As mentioned in the Table 6, confirmation is the most important consideration to induce user satisfaction with KMS in the Kaohsiung City government regardless of the composition of education-specific groups. That is, users consider realizing their expectations as being more important than instrumentality of IS in forming emotion.

From a theoretical perspective, our findings related to the strongest impact of confirmation on user satisfaction may advance the body of research on mandatory continued IS use in the public sector. From a practical implication, the authorities may strengthen users' perceptions about the confirmation of expectations in order to increase their satisfaction with the IS in the public sector. The authorities may issue a brochure in advance to let users know what the functions of the IS are. In this way, users may not have inappropriate expectations about the IS and users' perceptions between pre-adoption expectations and actual performance of the IS may not show too much discrepancies, and thus, they may display satisfaction with the IS.

5.2.2. Factors Influencing Perceived Usefulness of Mandatory IS

Table 6 reported that compatibility is the only factor to influence perceived usefulness in aggregate-based data (0.827) and $Group_{essential\ education}$ (0.817). However, compatibility (0.793) is the most important factor to induce perceived usefulness, followed by confirmation (0.108) in $Group_{research-oriented\ education}$. Compatibility explains 80.4% of the perceived usefulness variance in $Group_{essential\ education}$. Compatibility and confirmation jointly explain 74.2% of the perceived usefulness variance in $Group_{research-oriented\ education}$. Thus, the two determinants are good predictors for perceived usefulness of the mandatory IS. Our results indicated that compatibility has the most effect on perceived usefulness, suggesting that user perception of mandatory IS instrumentality may be primary adjusted by their perceptions of compatibility. Our findings are consistent with few studies (e.g., Larsen et al., 2009; Lin & Wang, 2012) to support compatibility has a stronger impact on perceived usefulness than confirmation. In this sense, compatibility should not be ignored when predicting the usefulness of the mandatory IS.

Traditionally, introducing an IS (e.g., KMS) to change traditional work situations for increasing organizational performance in the public sector may be a challenge. Compatibility is an important factor influencing the failure of an IS in the public sector (Heeks, 1999; Heeks & Bhatnagar, 1999). If the IS is incompatible with users' current work situations or does not fit into users' work styles, users may consider the IS as a useless tool, thus leading to less use and failed implementation of the IS in the public sector. This finding implies that task-IS fit shows more importance than the confirmation of expectations when strengthening the usefulness of the IS in mandatory environment. From a practical implication, the authorities should emphasize on compatibility rather than confirmation to elicit users' perceived usefulness of the IS in the public sector. The authorities may let users or user representatives participate in the process of designing IS functionality. By doing so, IS designers can consider users' job-relevant needs into IS functionality. If IS can be customized to the specific needs of work, users may feel the IS is fit into their work situations and thus to strengthen their perceptions about the usefulness of the IS.

5.2.3. Factors Influencing Mandatory Continued IS Usage Behavior

With regard to the antecedent of continued KMS usage behavior, our study reported different results between $Group_{essential\ education}$ and $Group_{research-oriented\ education}$. The analysis of $Group_{essential\ education}$ revealed that the effect of user satisfaction on continued usage behavior is higher than that of perceived usefulness on continued usage behavior. Satisfaction and perceived usefulness jointly explain 15.8% of the continued usage behavior variance. In contrast, the analysis of $Group_{research-oriented\ education}$ indicated that perceived usefulness rather than user satisfaction has an effect on continued usage behavior. Perceived usefulness explains 7.3% of the continued usage behavior variance. Because these determinants explain less continued usage behavior variance, continued usage behavior may have additional salient predictors than those identified in our ECM model. Although $Group_{essential\ education}$ and $Group_{research-oriented\ education}$ must continue to use KMS, they may show different extent of use. We further examined two measurement items of usage behavior by performing cross tabs analyses. First item is to measure *how often did you use the KMS in the last 7 days?* 32.1% of the users in the $Group_{essential\ education}$ rate extremely frequent use, followed by quite frequent use (25.3%), slightly frequent use (19%), neither (14.4%), slightly infrequent use (5.1%), quite infrequent use (4.1%) and extremely infrequent use (0%). In addition,

28.7% of the users in the Group$_{\text{research-oriented education}}$ rate quite frequent use, followed by extremely frequent use (28.2%), slightly frequent use (23.1%), neither (13%), slightly infrequent use (5.6%), quite infrequent use (1.4%) and extremely infrequent use (0%). We found that more than half of the users in Group$_{\text{essential education}}$ (57.4%) and Group$_{\text{research-oriented}}$ (56.9%) often use KMS (i.e., extremely and quite frequent use) while others show less use. Second item is to measure *how many hours did you use the KMS in the last 7 days?* 25.5% of the users in the Group$_{\text{essential education}}$ rate more than 25 hours, followed by 20-25 hours (23.6%), 15-20 hours (22.6%), 10-15 hours (17.3%), 5-10 hours (7.3%), 1-5 hours (3.6%) and less than 1 hours (0%). In addition, 26.9% of the users in the Group$_{\text{research-oriented education}}$ rate 20-25 hours, followed by more than 25 hours (25.9%), 15-20 hours (25%), 10-15 hours (17.6%), 5-10 hours (2.8%), 1-5 hours (1.9%) and less than 1 hours (0%). We found that 49.1% of the users in Group$_{\text{essential education}}$ and more than half of the users in Group$_{\text{research-oriented}}$ (52.8%) spend a lot of time (i.e., more than 20 hours) to use KMS while others spend less time to use KMS. In sum, our findings reveal that almost half of the users in the two groups often use KMS or spend a lot of time using KMS to comply organizational requirement; however, others show different levels of use. In other words, even when users are required to continue using KMS, their usage behaviors are still variable.

Our results indicated that the usefulness of KMS is a crucial factor motivating users having research-oriented educational levels (e.g., master or Ph.D.) to use KMS continuously. In contrast, users having essential educational levels (e.g., high school or university) emphasize their satisfaction with KMS. When considering continued KMS usage behavior, Group$_{\text{research-oriented education}}$ is cognitive-driven, but Group$_{\text{essential education}}$ is emotion-driven. According to all results of this study, we may understand that Group$_{\text{essential education}}$ and Group$_{\text{research-oriented education}}$ show different perceptions toward continued KMS use in the public sector. However, we were not able to judge whether these perceptions show significant differences. Therefore, we performed a PLS multi-group analysis (PLS-MGA) to examine whether Group$_{\text{essential education}}$ and Group$_{\text{research-oriented education}}$ exhibit significant differences in model relationships. We only found that the strength of the relationship between user satisfaction and continued usage behavior is higher for Group$_{\text{essential education}}$ than for Group$_{\text{research-oriented education}}$ (the difference of path coefficient=0.276, $t = 2.146$). The results of PLS-MGA imply that the higher level of satisfaction felt by users having essential educational levels, the more continued usage behavior they demonstrate.

Although FIMIX-PLS have already applied in consumer studies to identify customer segments, no study uses FIMIX-PLS to segment IS users in the public sector. Previous studies (e.g., Chung & Kwon, 2009; Kroenung et al., 2015; Zogheib et al., 2015; Sanchez-Franco, 2006) usually used categorical variables (e.g., gender or experience) to capture heterogeneity a priori and subsequently used PLS-MGA to analyze the significant differences of model relationships. However, our study used FIMIX-PLS to capture heterogeneity a posteriori and further used PLS-MGA to analyze the significant differences of model relationships. This study may contribute to IS methodological research by introducing the viewpoint of hybrid (i.e., FIMIX-PLS and PLS-MGA) to distinguish and compare users' perceptions toward continued IS uses. From a practical implication, the authorities in the public sector should adopt a two-fold strategy for enhancing continued IS usage behaviors when they hold user training. The authorities may educate users having research-oriented educational levels about what are the potential benefits of continued IS use and educate users having essential educational levels on how to continue using IS effectively so as to increase their satisfaction and strengthen their perceptions of IS usefulness.

6. CONCLUSION AND LIMITATIONS

In this study, we examines mandatory continued IS use by employing ECM in the public sector. Our public sector's ECM model not only reflects the spirit of Bhattacherjee's (2001) ECM but also takes advantage of user segmentation. Similar to all other studies, our study has its limitations. The first limitation concerns the generalizability of our results. Our study emphasized a survey of

KMS. Although we conducted our study with care, we do not claim that our findings will be equally applicable in the context of other IS. Future research should investigate other IS to strengthen the cross-validation of our findings. Second, our results may have been influenced by self-selection bias. Our sample comprises users who voluntarily participated in the educational training courses of KMS. Thus, we cannot investigate the perceptions of other KMS users who did not register to participate in the courses. Such unregistered users may have different perceptions regarding continued KMS use. Future researchers may cooperate with the Kaohsiung City government to reach such unregistered users and examine their perceptions regarding continued KMS use. Third, the results of this study showed that the explained variance of continued usage behavior is relatively low in the two groups. Future studies may add other variables into our ECM model to increase the explained variance of continued usage behavior. Due to mandatory use, users are forced to use an IS. In addition to perceived usefulness and satisfaction, we suggest that future studies may focus on whether or not users are pleasant or happy to strengthen more use of the IS. Davis (1993) considered attitude toward using as only one predictor to predict actual system use in TAM model. Rogers (2003) mentioned that attitude is an important factor for influencing an individual to continue or discontinue an innovation. Previous studies (e.g., Davis, 1993; Porter & Donthu, 2006; Morris & Venkatesh, 2000) have provided evidence to support the direct effect of attitude on behavior. To increase the explained variance of continued usage behavior, attitude may be suggested to combine into our ECM model. Finally, Figure 2 reports that the predictive ability of user satisfaction is 67.4% for $Group_{essential\ education}$ and 71.8% for $Group_{research-oriented\ education}$. Even though our group-based models show good predictive abilities for user satisfaction, how to increase higher level of user satisfaction is still worthy further explored. Previous studies (e.g., Au et al., 2002; Rouibah et al., 2009; Simon, 2000; Sun et al., 2008; Zhang et al., 2005) reported that "training and education" may have a direct or indirect influence on user satisfaction in IS setting. In our study, users have operated KMS by reading operation manual for a period of time before training (i.e., instruction-based training) was launched. In addition, users also discussed with technical experts on e-discussion for system use. Under these conditions, users may already have good understandings for how to operate KMS. Thus, instructing users for increasing their expertise of KMS could not have a great impact on user satisfaction. Although training was not considered in this study, it still could have potentially influence on user satisfaction. We suggest that future studies may clarify the impact of training on user satisfaction and further examine whether or not different training methods such as instruction-based training, exploration training or behavior modeling training (e.g., Chou, 2001; Chou & Wang, 2000; Davis & Davis, 1990; Simon, 2000) have different effects on user satisfaction for mandatory continued IS use. Given the importance of IS use on the public sector, we hope our results will be valuable to others who engage in exploring the theory and practice of mandatory IS use area.

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