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Trust in Government and Social Media Competence as Primary Drivers: Examining Citizens'Intentions to Adopt Digital Government Applications for Risk Management

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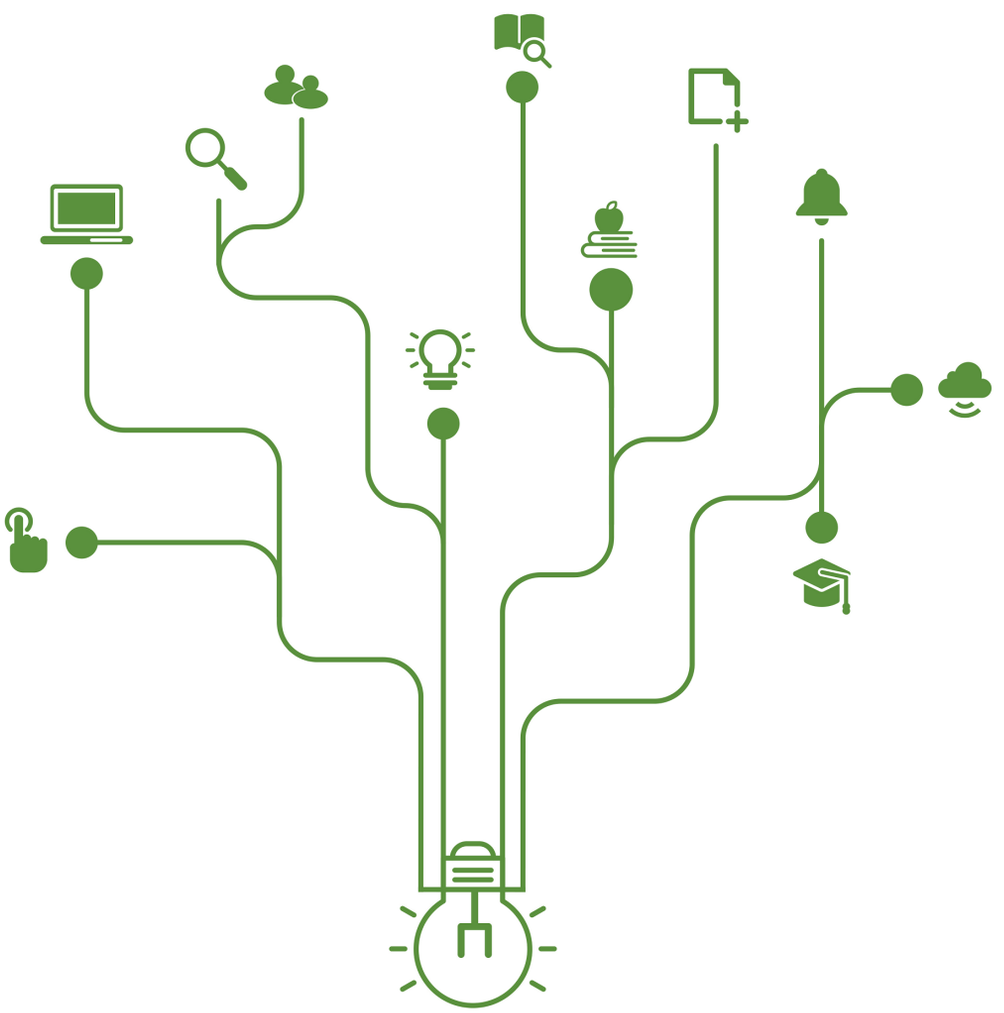

KDI SCHOOL
KDI School of Public Policy and Management

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Abstract

Building upon a framework of the unified theory of acceptance and use of technology (UTAUT), this study explores the determinants of citizens' intentions to use the government's mobile application for risk communication. An online survey was conducted with a quota sample of 700 Korean citizens. The results from structural equation modeling suggest that social media competence and trust in government information are primary determinants of willingness to accept the new application and intention to use it. Trust in government information appeared to influence the acceptance of the application both directly and indirectly through performance expectancy and effort expectancy. More confidence in the use of social media led to higher levels of performance expectancy, effort expectancy, and facilitating conditions, all of which subsequently contributed to willingness to accept the application. The acceptance of the application further influenced intention to use the application and the likelihood of positive recommendations. The findings suggest that while developing applications that meet public expectations for informational benefits and time efficiency is important, it is also necessary for the government to build trust and improve citizens' ability to use new tools in order for new information technology initiatives to fully benefit citizens.

INTRODUCTION

The role of the government and its agencies is critical in public health and emergency situations. The key to effective risk communication lies in the government's ability to inform citizens about emerging risks in a timely manner and help them make informed decisions (Cairns, de Andrade, & MacDonald, 2013). As social media and other new communication technologies facilitate rapid delivery of information and real-time interaction, governments try to find ways to improve the effectiveness of their risk communication internally and externally by utilizing such communication technologies (Jennings, Arlikatti, Andrew, & Kim, 2017; Lindsay, 2010). For example, during the Ebola outbreak in 2014, the U.S. Department of Health and Human Services collaborated with the Centers for Disease Control and Prevention (CDC) and built a microsite to syndicate information regarding CDC's response and protocol for handling those infected with the Ebola virus. This microsite with syndication functionality enabled health agencies to keep people up to date with high-quality information (Pomerleau, 2015). Another good example is the crowdsourcing website citizenscience.gov, which was developed by the U.S. government to encourage public participation for "addressing societal needs and accelerating science, technology, and innovation" (Citizenscience.gov, 2017).

When the government launches a new application for risk communication and management, its success depends on citizens' acceptance of the new tool and their use intention.

Thus, it is important to understand under which conditions the adoption and usage of such an e-government application would increase. Insights in underlying factors of adoption behavior can facilitate the development of user-oriented information technology and aid in developing a strategy to promote its use. Although the prevalence of social media and other new communication tools has been a positive force for extensive research on adoption of information technologies (Cheng & Mitomo, 2017; Zuiderwijk, Janssen, & Dwivedi, 2015), a paucity of research has been conducted in the field of health risk and emergency management.

In light of scant research on the adoption of an innovation in the context of risk communication, this study aims to provide comprehensive insights in citizens' acceptance and use intention of e-government applications for risk management. Building upon the unified theory of acceptance and use of technology (UTAUT), this study examines influential factors that determine citizens' intentions to adopt a risk management

application launched by the government in Korea. We focus on end users of such tools (i.e., lay people) rather than internal stakeholders or collaborators of the government, such as government health departments, research institutes, and hospitals.

Theoretically, this empirical investigation extends the UTAUT model to the domain of risk communication by considering predisposing factors, risk-related perceptions, social media competence, and trust. The findings of this study also provide practical guidance for governments regarding how to improve their strategies for greater usage of e-government services through social media and mobile applications in order to help citizens prepare for emerging risks and make informed decisions.

LITERATURE

Review Risk Perceptions and Information-Seeking Behavior

Social media and new communication technologies provide convenient and efficient means for the government and related agencies to communicate with citizens in all phases of risk communication from preparedness to recovery (Jennings et al., 2017; Wiederhold, 2013). The advances of those communication tools also enable people to seek and obtain updated information in real time and to provide emotional support to each other in an emergency situation (Centers for Disease Control and Prevention, 2014). However, individuals' likelihood of using a new technology for risk information seeking varies depending on their resources and risk perceptions (Kontos, Emmons, Puleo, & Viswanath, 2010). This means that risk perceptions can serve as motivating factors for engaging in risk information-seeking behaviors and further trying out a new tool for more efficient communication.

Based on the protection motivation theory (Rogers, 1975), we assume that risk perceptions (such as perceived severity, perceived susceptibility, and perceived response efficacy) lead to risk information seeking, which may be translated into the adoption and usage of a risk communication application. The key idea of the protection motivation theory is that when exposed to fear messages, people are motivated to take protective action to handle their fear through two mechanisms: threat appraisal and coping appraisal (Rogers, 1975).

As part of the threat appraisal, perceived severity and perceived susceptibility have been considered important determinants of behavioral intention (Bockarjova & Steg, 2014;

Kim, Jeong, & Hwang, 2012; Sheeran, Harris, & Epton, 2014). Perceived severity is defined as the extent to which an individual perceives an existing risk to be serious, and perceived susceptibility refers to an individual's belief about how vulnerable oneself is to the existing threat (Sheeran et al., 2014). The coping appraisal involves response efficacy, which reflects "one's evaluation of the perceived effectiveness of participating in a recommended behavior" to avoid the existing risk (Kim et al., 2012, p. 171). Prior research has documented that higher levels of perceived severity, perceived susceptibility, and perceived response efficacy result in greater motivations to carry out protective actions (e.g., seeking updates on an emergency situation and following instructions from authorities) (Kim et al., 2012; McCaughey, Mundir, Daly, Mahdi, & Patt, 2017; Sheeran et al., 2014).

The protection motivation theory is applicable in examining risk perceptions and risk information-seeking behavior, which can be considered part of preventive action. People tend to engage in obtaining risk information if they think that the existing risk is a serious problem, that they are likely to be affected by the risk, or that complying with instructions will reduce or avoid the existing risk. In sum, these risk-related perceptions (including perceived severity, perceived susceptibility, and response efficacy) may serve as antecedents of risk information seeking. This can further influence whether or not an individual accepts a new application for risk management developed by the government. Given the theoretical basis reviewed above, we posit the following hypotheses:

H1: Risk perceptions ¯(a) perceived severity, (b) perceived susceptibility, and (c) response efficacy¯ will be positively associated with risk information-seeking behavior.

H2: Risk information-seeking behavior will be positively associated with acceptance of e-government applications.

Unified Theory of Acceptance and Use of Technology

The unified theory of acceptance and use of technology (UTAUT) is an extension of the technology acceptance model (TAM), which has been widely used in studying people's adoption behavior of accepting an innovation (Davis, 1989). Venkatesh, Morris, Davis, and Davis (2003) proposed UTAUT to improve the predictive capacity of TAM because this theoretical model had been criticized for neglecting to consider users' individual characteristics, offering only general information on individuals' perceptions of

innovations, and assuming that adoption of a new technology is a voluntary behavior (McMaster & Wastell, 2005). As a well-established theory, UTAUT has been applied to various contexts involving information and communication technologies, such as government open data (Zuiderwijk et al., 2015), mobile banking (Oliveira, Faria, Thomas, & Popovič, 2014), e-government services (Lallmahomed, Lallmahomed, & Lallmahomed, 2017), health information technology (Kijsanayotin, Pannarunothai, & Speedie, 2009), and online tourism shopping (San Martín & Herrero, 2012). In the context of risk communication, UTAUT provides a useful theoretical model for understanding and explaining what factors lead people to adopt and use new communication tools.

In the framework of UTAUT, four factors are assumed to predict the adoption and use of new technologies: performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy refers to "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh et al., 2003,

p. 447). It is similar to the concept of perceived usefulness in the TAM, and it reflects the idea that the degree to which people believe that an application will be useful for performing their job influences their acceptance of the application (Davis, 1989). Prior research has shown that performance expectancy is the strongest predictor of adoption intention (Oliveira et al., 2014; San Martín & Herrero, 2012; Venkatesh et al., 2003). In the context of risk communication, user benefits from an e-government application may involve more than obtaining risk information and updates in a timely manner. Depending on its available features, such a risk management application may allow users to report an emergency situation with a photo or video, monitor developments of emerging risks, request assistance, and provide feedback to the government (Jennings et al., 2017; Lindsay, 2010).

Another predictor of the adoption intentions of a technology is effort expectancy, which can be defined as the extent to which an individual perceives a technology to be easy to use and free of effort (Venkatesh et al., 2003). This factor mirrors the perceived ease of use in the TAM (Davis, 1989). Despite its importance and explanatory power in the original UTAUT model(Venkatesh et al., 2003), effort expectancy did not appear to have a significant relationship with behavioral intention in some prior research on online banking and payment services (Oliveira et al., 2014; Slade, Dwivedi, Piercy, & Williams, 2015). However, the findings from many other empirical studies indicate that users' perception that a new application is easy to use and maneuver with little training can

prompt their willingness to adopt the application (Hung, Tang, Chang, & Ke, 2009; San Martín & Herrero, 2012; Zuiderwijk et al., 2015).

Social influence is defined as "the degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh et al., 2003, p. 451). In addition to performance expectancy and effort expectancy, social influence affects behavioral intentions to adopt and use a new technology (Venkatesh et al., 2003). This relates to the notion that an individual's decision to adopt an innovation is influenced by the way his or her important others think of the innovation. People tend to comply with their normative belief that their peers and family members expect them to use or not use a new technological tool such as mobile banking (Eckhardt, Laumer, & Weitzel, 2009; Oliveira et al., 2014; Wang, Wu, & Wang, 2009). In other words, an individual's adoption behavior can largely depend on the perception that his or her important others value the use of a new technology and make use of it. Due to this perceived social pressure, social influence may play an important role in determining whether someone accepts a new application in the context of risk communication.

Facilitating conditions are a direct determinant of user behavior of adopting a new technology. Venkatesh et al. (2003) defined this concept as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (p. 453). The effect of facilitating conditions on use intention has been inconsistent in prior research based on UTAUT (Lallmahomed et al., 2017; Rana, Williams, Dwivedi, & Williams, 2012; Zuiderwijk et al., 2015). In Zuiderwijk et al.'s (2015) study of open data technologies, facilitating conditions did not appear to significantly contribute to triggering behavioral intentions to use open governmental and public data. However, Lallmahomed et al. (2017) found facilitating conditions to be the most significant predictor of behavioral intention to use e- government services, suggesting that the government's investment in improving information technology infrastructures with services and tools is an important basis for increasing adoption rates of e-government applications. Oliveira et al. (2014) also found that facilitating conditions had a direct, positive relationship with actual adoption of a mobile banking application. The fact that individuals' access to Internet and mobile data services varies (Pew Research Center, 2017) suggests that their facilitating conditions for adopting new applications are at different levels, thereby resulting in varying degrees of application acceptance among citizens.

Perceived risk associated with the use of a new technology is an addition to

UTAUT (Slade et al., 2015). In the context of online social services, perceived risk refers to the perception of uncertainty and anxiety about performing a task or activity with a certain application due to unexpected negative outcomes (Chang, Shen, & Liu, 2016). Shareef, Kumar, Kumar, and Dwivedi (2011) viewed perceived risk as consisting of perceived uncertainty and perceived security in their study of citizens' adoption of e-government in Canada. They found that both perceptions of uncertainty and security affected adoption behavior indirectly through perceived trust toward the e-government website. Their findings suggest that perceptions of low risks of adopting an innovation lead to improved trust and subsequently result in the adoption of the innovation. Other prior studies have shown that higher levels of perceived risk lead to a reduction in behavioral intentions to adopt a technology (Ebrahim & Irani, 2005; Slade et al., 2015; Thakur & Srivastava, 2014).

Integration of Trust in Government and Social Media Competence Into UTAUT

When the government launches a new application for risk communication and begins to promote its public use, this risk management application will be a novel concept to citizens. It may not be easy for people to envision benefits and improvements in performing information- seeking tasks that can be gained through using the application. It is likely that trust in the service provider serves as a reference point for assessing the reliability and effectiveness of the application (Alsajjan & Dennis, 2010). Thus, understanding citizens' trust in the government is of considerable importance to the development and implementation of an e-government application.

Trust in the government is formed over time based on an individual's prior experience and confidence in the government's capabilities and integrity (Park, Choi, Kim, & Rho, 2015). Lack of trust in the government poses a barrier to promoting the adoption and implementation of a government-initiated technology among citizens (Fakhoury & Aubert, 2015; Lallmahomed et al., 2017; Park et al., 2015). Higher levels of trust in the government, however, can elicit the perception that its services will bring benefits to citizens as promised (Gefen, Karahanna, & Straub, 2003). This favorable perception can lead to positive evaluations of an e-government application launched to meet citizens' service expectations (e.g., improved perceptions of usefulness and ease of use). Moreover, increased trust improves the user's perception of experience in using the application, which results in intention for continuous usage (Wu & Chen, 2005).

The prior research reviewed above suggests that an individual's trust in the

government as a credible source of risk information will influence how the person perceives the new application developed by the government for risk communication. Thus, the following hypothesis is proposed:

H3: Trust in the government as a risk information source will be positively associated with (a) performance expectancy and (b) effort expectancy toward e-government applications.

In this new era of technology, an individual's adoption of an innovative communication tool is largely determined by his or her knowledge or ability to use the Internet and social media (Wirtz, Piehler, & Daiser, 2015). Individual competence regarding technology has been considered a key factor in research on acceptance of Internet-based applications, such as e-government services (Lallmahomed et al., 2017; Wirtz et al., 2015) and mobile payment applications (Slade et al., 2015). This study views social media competence as an important antecedent of using a new application that resembles social media features. Adopting the definition of Internet self-efficacy from Eastin and LaRose (2000), this study defines social media competence as the belief in one's ability to perform tasks in social media required to produce given attainments.

High levels of confidence in one's ability to use social media may positively influence perceived benefits of using a new application equipped with social media features and useful resources (e.g., usefulness and ease of use of the application) (Slade et al., 2015). Perceived benefits, in turn, may be positively related with willingness to accept the new application (Wirtz et al., 2015). This line of reasoning leads to the following hypotheses:

H4: Social media competence will be positively associated with (a) performance expectancy, (b) effort expectancy, and (c) perceptions of facilitating conditions for the use of e-government applications.

H5: Social media competence will be negatively associated with perceived risk of using e-government applications.

Based on the UTAUT model and relevant research reviewed above, it is plausible that positive perceptions about a new application launched by the government will lead to the formation of positive attitudes toward the application (Hung et al., 2009). The formation of a favorable attitude toward the government's new application for risk communication can be expanded into actual adoption and use behavior (Hung et al.,

2009; Oliveira et al., 2014; Shareef et al., 2011). Thus, the following hypotheses are posited:

H6: Individuals' acceptance of e-government applications will be positively influenced by (a) performance expectancy, (b) effort expectancy, (c) social influence, and (d) facilitating conditions; and negatively influenced by (e) perceived risk of using the applications.

H7: Acceptance of e-government applications will mediate the influences from perceptions of the applications on (a) intentions to use them and (b) patronage intentions.

H8: Acceptance of e-government applications will mediate the influence of risk information-seeking behavior on (a) intentions to use them and (b) patronage intentions.

METHODS

Sample

We conducted an online survey with a quota sample of 700 Korean citizens. A large research firm with a diverse pool of respondent panels across South Korea was hired to carry out data collection for the survey. Of the total sample, about half were male (50.7%, n = 355), and the mean age was 42 years (SD = 12.1). In terms of educational level, more than half of the respondents had a bachelor's degree (51.6%) or higher (9.0%), 16.6% had an associate degree, 22.6% completed high school, and 0.3% completed middle-school education. The details regarding sample characteristics are reported in Table 1.

Table 1. Sample Characteristics (N = 700)

	N	%
Gender		
Male	355	50.7
Female	345	49.3
Age	*M* = 41.9	*SD* = 12.1
20-29	140	20.0
30-39	154	22.0
40-49	183	26.1
50-59	177	25.3
60+	46	6.6
Education		

	N	%
Middle school graduate	2	0.3
High school graduate	158	22.6
Associate degree	116	16.6
Bachelor's degree	361	51.6
Master's or doctorate degree	63	9.0
Household monthly income		
Less than $880	29	4.1
$880 – less than $1,760	79	11.3
$1,760 – less than $2,640	101	14.4
$2,640 – less than $3,520	113	16.1
$3,520 – less than $4,400	124	17.7
$4,400 – less than $5,280	85	12.1
$5,280 – less than $6,160	58	8.3
$6,160 – less than $7,040	46	6.6
$7,040 – less than $7,920	21	3.0
$7,920 – less than $8,800	13	1.9
$8,800 or more	31	4.4

Data Collection Procedures

This survey is part of a larger project on the government's use of information communication technology and citizens' acceptance of e-government applications. Participants received an e-mail invitation to take a survey and completed it online at their convenience. Thequestionnaire consisted of demographic items, such as gender and age, and questions measuring the independent and dependent variables in this study. Participants were first asked about their trust in the government as an information source, social media competence, and risk-related perceptions and behavior. Then they read a short description about how the government was considering the development of e-government social media applications for the purpose of delivering up-to-date risk information and preparing its citizens with knowledge in the event of public health emergencies. Participants were then asked to complete the rest of the questionnaire based on what they feel and believe about the government's social media applications described in the instructions.

MEASURES

Trust in government information. Trust in government information was operationally defined as belief in information and instructions provided by the government in a risk context. Participants were asked for their level of agreement with the following items on

a 7-point scale (1 = strongly disagree, 7 = strongly agree): “I trust the government in providing me with reliable information for protecting my safety,” “I trust information acquired from the government because it is competent to help its citizens,” “I believe that information acquired from the government is usually honest,” “I depend on the government for the purpose of obtaining information I need,” and “I consider the government as a trustworthy source for providing health risk information” (M = 2.92, SD = .71, α = .90) (see Table 2). These items were adapted from previous trust scales (Chang et al., 2016; Hsu, Chang, & Yen, 2011).

Social media competence. The ability to use social media was measured using five 7- point Likert-type items adopted from Wirtz et al.’s (2015) Internet competence scale. The items were “I feel confident when using social media and applications,” “I am comfortable when using social media and applications on my own,” “I am able to use social media and applications well on my own,” “I am able to use social media and applications even if there is nobody around to help me,” and “I feel confident and competent finding information by using search functions on social media” (M = 3.59, SD = .79, α = .94).

Table 2. Means, Standard Deviations, and Factor Loadings for Trust and Social Media Competence

Variable	Measurement Item	Mean (SD)	Loading	Eigenvalue (Variance %)
Trust in government information	I consider the government as a trustworthy source for providing health risk information.	2.98 (.82)	.880	3.57 (71.32) α = 90
	I believe that information acquired from the government is usually honest.	2.81 (.91)	.864	
	I trust information acquired from the government because it is competent to help its citizens.	2.88 (.86)	.861	
	I trust the government in providing me with reliable information for protecting my safety.	3.10 (.76)	.831	
	I depend on the government for the purpose of obtaining information I need.	2.82 (.86)	.784	
Social media competence	I am comfortable when using social media and applications on my own.	3.63 (.88)	.931	3.99 (79.91) α = 94
	I am able to use social media and applications well on my own.	3.58 (.90)	.925	
	I am able to use social media and applications even if there is nobody around to help me.	3.75 (.86)	.892	
	I feel confident when using social media and applications.	3.33 (.91)	.879	
	I feel confident and competent finding information by using search functions on social media.	3.68 (.88)	.839	

Risk-related perceptions. Risk-related perceptions were measured in terms of perceived severity, perceived susceptibility, and response efficacy (see Table 3). Each of these variables served as the antecedent of risk information-seeking behaviors in the research model.

Perceived severity was measured by the following 7-point Likert-type items adopted from Kim et al. (2012): "Potential health risks, such as infectious diseases and particulate matter, are a serious problem" and "Such potential risks pose a threat to me" (M = 3.92, SD = .64, α = .77). Perceived susceptibility was measured using two 7-point items from Kim et al. (2012): "My chances of being affected by potential health risks in my lifetime are high" and "I may encounter serious health risks in the future" (M = 3.85, SD = .68, α = .82).

The response efficacy scale was created based on Milne et al.'s (2002) measurement items: "If I follow prevention instructions, my chances of being exposed to health risks will be low" and "Following prevention instructions is a good way of reducing the possibility of facing health-related risks" (M = 3.73, SD = .62, α = .81). These items were measured on a 7-point Likert-type scale (1 = strongly disagree, 7 = strongly agree).

Risk information seeking. Participants were asked for their tendency to seek information about health-related risks with six 7-point Likert-type items adopted from (Griffin, Zheng, ter Huurne, Boerner, & Ortiz, 2008; ter Huurne, Griffin, & Gutteling, 2009). Examples of the items are "When it comes to health-related risks, I'm likely to go out of my way to get more information" and "When a public health emergency occurs, I'm likely to seek information about the causes and prevention measures" (M = 4.70, SD = .61, α = .83).

Performance expectancy. Before responding to questions that asked about participants' expectations and intentions toward e-government applications, participants read a brief statement about government plans to develop new applications for risk communication. The first UTAUT- based variable was performance expectancy. Participants were asked for their level of agreement with each of the following three items on a 7-point Likert-type scale (Lallmahomed et al., 2017): "Using e-government applications will enable me to prepare for health-related risks quickly, ""Using e-government applications will help me to find risk information quickly," and "I would find e-government applications useful in seeking information about health-related risks" (M = 3.51, SD = .71, α = .89) (see Table 4).

Table 3. Means, Standard Deviations, and Factor Loadings for Risk-Related Variables

Variable	Measurement Item	Mean (SD)	Loading	Eigenvalue (Variance %)
Perceived severity	Potential health risks (such as infectious diseases and particulate matter) are a serious problem.	4.08 (.66)	.902	1.63 (81.36) α = 77
	Such potential risks post a threat to me.	3.76 (.76)	.902	
Perceived susceptibility	My chances of being affected by potential health risks in my lifetime are high.	3.83 (.74)	.922	1.70 (85.02) α =.82
	I may encounter serious health risks in the future.	3.86 (.73)	.922	
Response efficacy	If I follow prevention instructions, my chances of being exposed to health risks will be low.	3.65 (.68)	.917	1.68 (84.10) α =.81
	Following prevention instructions is a good way of reducing the possibility of facing health-related risks.	3.80 (.67)	.917	
Risk information seeking	Whenever the topic of health risks comes up, I go out of my way to avoid learning more about it. (r)	5.72 (.90)	.820	
	When this topic comes up, I'm likely to tune it out. (r)	5.54 (.92)	.783	
	Gathering a lot of information on health risks is a waste of time. (r)	5.77 (.91)	.778	
	When it comes to health-related risks, I'm likely to go out of my way to get more information.	3.73 (.73)	.716	3.27 (54.46) α = 83
	When the topic of health risks comes up, I try to learn more about the causes and prevention measures.	3.74 (.71)	.715	
	When a public health emergency occurs, I'm likely to seek information about the causes and prevention measures.	3.71 (.76)	.594	

Table 4. Means, Standard Deviations, and Factor Loadings for UTAUT Variables

Variable	Measurement Item	Mean (SD)	Loading	Eigenvalue (Variance %)
Performance expectancy	Using e-government applications will enable me to prepare for health-related risks quickly.	3.47 (.79)	.921	2.46 (81.89) α = .89
	Using e-government applications will help me to find risk information quickly.	3.51 (.79)	.898	
	I would find e-government applications useful in seeking information about health-related risks.	3.55 (.76)	.895	
Effort expectancy	I would find e-government applications easy to use.	3.57 (.77)	.914	2.91 (72.65) α = .87
	Learning to use e-government applications would be easy for me.	3.57 (.79)	.894	
	It would be easy for me to become skillful at using such applications.	3.63 (.80)	.836	
	If the government offers applications, it would be easier to find information about risks and prevention measures.	3.54 (.80)	.757	
Social influence	People who influence me think that I should use e-government applications.	3.14 (.83)	.945	2.57 (85.80) α = .92
	People who are important to me think I should use e-government applications.	3.16 (.82)	.923	
	People whose opinions I value would prefer me to use e-government applications.	3.15 (.84)	.910	
Facilitating conditions	I have the necessary resources to use e-government applications.	3.27 (.83)	.928	1.72 (86.18) α = .89
	I have the necessary knowledge to use e-government applications.	3.36 (.85)	.928	
Perceived risk of using applications	I do not feel secure registering my information with e-government applications.	3.12 (.95)	.887	3.45 (68.93) α = .89
	I am worried about using e-government applications	3.06 (.911)	.877	
	Overall, I think it is more or less unsafe to use e-government applications.	2.85 (.83)	.834	
	I do not feel totally safe using e-government applications.	3.09 (.88)	.819	
	I feel that using such applications may cause unexpected issues.	3.26 (.85)	.724	

Effort expectancy. Effort expectancy was operationally defined as the level of expectation regarding ease of use of new e-government applications for risk communication. It was measured by four 7-point Likert-type items adopted from Lallmahomed et al. (2017), including “Learning to use e-government applications would be easy for me” and “It would be easy for me to become skillful at using such applications” (M = 3.58, SD = .67, α = .83).

Social influence. Perceptions of social influence were assessed using three 7-point Likert-type scale items from Lallmahomed et al. (2017). The items are “People who influence me think that I should use e-government applications,” “People who are important to me think I should use e-government applications,” and “People whose opinions I value would prefer me to use e-government applications” (M = 3.15, SD = .77, α = .92).

Facilitating conditions. Participants were asked to rate on a 7-point scale their readiness to use new e-government applications. Two items from Lallmahomed et al.’s scale (2017) was used: “I have the necessary resources to use e-government applications” and “I have the necessary knowledge to use e-government applications” (M = 3.32, SD = .78, α = .89).

Perceived risk of using applications. Perceived risk was measured by five 7-point Likert-type scale items revised from prior research on mobile applications (Chang et al., 2016; Slade et al., 2015). Examples of the items are “I do not feel secure registering my information with e-government applications,” “Overall, I think it is more or less unsafe to use e-government applications,” and “I feel that using such applications may cause unexpected issues” (M = 3.08, SD = .73, α = .89).

Acceptance of e-government applications. Participants were asked to indicate on a 7-point scale the extent to which they think using e-government applications is (a) a good thing, (b) reasonable, (c) smart, and (d) beneficial (M = 3.30, SD = .65, α = .92) (see Table 5).

Intentions to use. Participants’ use intentions for e-government applications were measured by four 7-point Likert-type items adapted from previous research on e-government services (Fakhoury & Aubert, 2015; Lallmahomed et al., 2017; Wirtz et al., 2015). The items are “It is likely that I will use e-government applications in the future,” “I am willing to use e- government applications in the future,” “I expect to use e-government applications occasionally,” and “I intend to use e-government applications for keeping up to date with risk information” (M = 3.40, SD = .75, α = .93).

Patronage behavior. A revised version of Park et al.'s (2015) scale was used to measure intentions to recommend e-government applications to others and encourage others' use of the applications. Participants were asked to indicate their level of agreement with each of the following items: "I am willing to highly recommend e-government applications to others," "I intend to recommend e-government applications to others," and "I intend to support others' use of e-government applications" (M = 3.18, SD = .79, ☋ = .92). These items were measured on a 7- point scale (1 = strongly disagree, 7 = strongly agree).

Internal Consistency of Measures and Construction of Scale

The internal consistency of items for each variable appeared to be adequate, with an alpha of .77 to .94 (reported above for each respective measure). A series of factor analyses also confirmed the single dimensionality of the scale items used for each variable, as well as internal scale reliability. Across the scales, all factor loadings were greater than a loading criterion of .40, ranging from .715 to .934 (Harlow, 2005). The individual scores of the items for each variable were averaged to create scale composite scores.

Table 5. Means, Standard Deviations, and Factor Loadings for Acceptance and Behavioral Intentions

Variable	Measurement Item	Mean (SD)	Loading	Eigenvalue (Variance %)
Application acceptance	I think using e-government applications is reasonable.	3.29 (.72)	.925	3.22 (80.39) α = .92
	I think using e-government applications is smart.	3.26 (.73)	.899	
	I think using e-government applications is beneficial.	3.35 (.72)	.888	
	I think using e-government applications is a good thing.	3.30 (.73)	.874	
Intention to use	I expect to use e-government applications occasionally.	3.33 (.83)	.926	3.34 (83.56) α = .93
	I am willing to use e-government applications in the future.	3.48 (.80)	.924	
	It is likely that I will use e-government applications in the future.	3.35 (.83)	.904	
	I intend to use e-government applications for keeping up to date with risk information.	3.45 (.82)	.901	

Variable	Measurement Item	Mean (SD)	Loading	Eigenvalue (Variance %)
Patronage behavior	I intend to support others' use of e-government applications.	3.13 (.85)	.934	
	I am willing to highly recommend e-government applications to others.	3.16 (.85)	.932	2.59 (86.43) α = .92
	I intend to recommend e-government applications to others.	3.26 (.85)	.923	

RESULTS

For hypothesis testing, a path analysis using structural equation modeling was performed with IBM SPSS Amos 23, which enables testing a model with multiple mediators and examining direct and indirect effects simultaneously (Kline, 2005).

The initial path analysis was run assuming both direct and indirect effects of social media competence on the UTAUT-based variables, including perceived risk. An examination of path coefficients, however, indicated that the influence of social media competence on perceived risk of using e-government applications was not statistically significant at an alpha level of .05. This path (depicted as a dotted line in Figure 1) was deleted from the initial model, and for the same reason, the paths from facilitating conditions to application acceptance and from risk information seeking to application acceptance were also deleted.

With the nonsignificant paths removed and some model modifications, such as adding covariance between errors of variables, the path model reached a good data-model fit: $\chi^2(54, N = 700) = 189.34$, $p < .001$; CFI = .968, SRMR = .076, RMSEA = .060. Hu and Bentler (1999) suggest that path and structural equation models can be considered valid when the value of the Comparative Fit Index (CFI) equals or exceeds .95, the value of the Standardized Root Mean Square Residual (SRMR) is less than or equal to .09, and the value of the Root Mean Square Error of Approximation (RMSEA) is less than or equal to .06. Models are acceptable and valid enough to analyze estimated effects when meeting at least two of these criteria.

Risk Perceptions, Risk Information Seeking, and Application Acceptance

The results of the path analysis confirmed that perceived severity (β = .18, $p <$ .001), perceived susceptibility (β = .13, $p < .01$), and response efficacy (β = .20, $p <$

.001) positively influenced the behavioral tendencies of seeking risk information. Individuals who perceived potential health risks as more serious and probable were more likely to actively seek information about those risks. Additionally, the more participants believed that following prevention instructions is an effective way of reducing their chances of encountering health-related risks, the more likely they were to seek risk information. These results supported H1a, H1b, and H1c.

Inconsistent with the expectation in H2, risk information seeking did not appear to positively influence acceptance of e-government applications for risk communication.

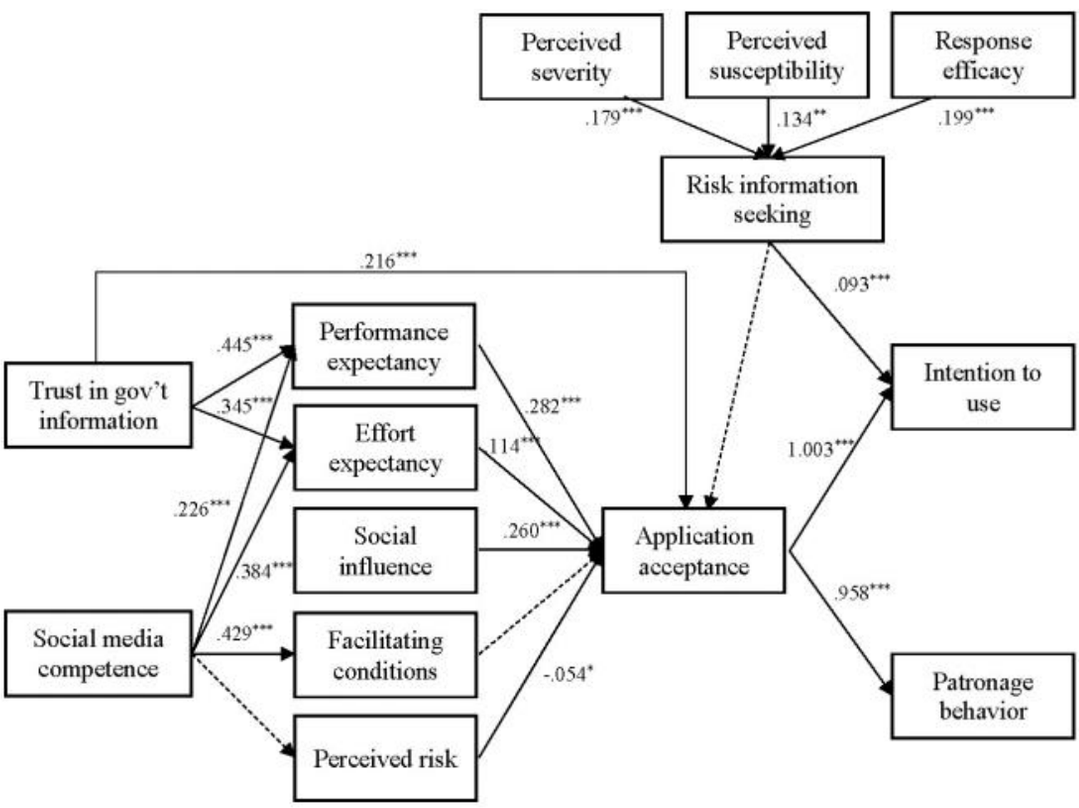

Figure 1. Path model for the adoption of the government's application for risk preparation and response.
Model fit indices: $\chi^2(54, N = 700) = 189.338$, $p < .001$; CFI = .968, SRMR = .076, RMSEA = .060. Standardized path coefficients are reported in this diagram. *p < .05, **p < .01, ***p < .001

Social Media Competence and Expectancy Toward Applications

The results indicated that social media competence was positively associated with performance expectancy ($\beta = .23$, $p < .001$), effort expectancy ($\beta = .38$, $p < .001$), and perceptions of facilitating conditions for using the e-government applications ($\beta = .43$, $p < .001$). Participants who reported higher levels of confidence in using social media were more likely to believe that the e-government applications would be useful and easy to

use. They also more positively evaluated the knowledge and resources they would need in using the applications.

Based on these results, H4a, H4b, and H4c were supported. However, social media competence did not appear to significantly influence perceptions of potential risks associated with using the e-government applications, thus refuting H5.

Expectancy Variables, Application Acceptance, and Behavioral Intentions

H6 examined whether acceptance of e-government applications would be influenced by(a) performance expectancy, (b) effort expectancy, (c) social influence, (d) facilitating conditions, and (e) perceived risk of using the applications. As expected, the first three antecedents— performance expectancy ($\beta = .28$, $p < .001$), effort expectancy ($\beta = .11$, $p < .001$), and social influence ($\beta = .26$, $p < .001$)—were positively associated with acceptance of the applications. Effort expectancy, in particular, had an indirect effect on application acceptance through social influence ($\beta = .43$, $p < .001$), as well as a direct influence. Regarding H6e, perceived risk of using the applications ($\beta = -.05$, $p < .05$) also appeared to be a significant factor, negatively influencing application acceptance. Perceptions of facilitating conditions, however, did not have a significant relationship with application acceptance. Therefore, H6a, H6b, H6c, and H6e were supported, but H6d was not supported.

The results showed that the influences of these significant expectancy variables— performance expectancy, effort expectancy, social influence, and perceived risk—on behavioral intentions were mediated by acceptance of the e-government applications. Application acceptance was positively associated with use intention ($\beta = 1.00$, $p < .001$) and patronage intention ($\beta = .96$, $p < .001$). These significant paths allowed the expectancy variables to influence the two types of behavioral intentions indirectly through acceptance of the applications (see Table 6 for all direct and indirect effects in the final path model). Thus, H7 was supported.

Table 6. Standardized Parameter Estimates for the Final Path Model

Path	Direct	Indirect	Total
Trust in gov't info → performance expectancy	.445***		.445
Trust in gov't info → effort expectancy	.345***		.345
Trust in gov't info → social influence		.148	.148
Trust in gov't info → application acceptance	.216***	.203	.419
Trust in gov't info → use intention		.421	.421
Trust in gov't info → patronage intention		.402	.402
Social media competence → performance expectancy	.226***		.226
Social media competence → effort expectancy	.384***		.384
Social media competence → social influence		.165	.165
Social media competence → facilitating conditions	.429***		.429
Social media competence → application acceptance		.150	.150
Social media competence → use intention		.151	.151
Social media competence → patronage intention		.144	.144
Perceived severity → information seeking	.179***		.179
Perceived severity → use intention		.017	.017
Perceived susceptibility → information seeking	.134**		.134
Perceived susceptibility → use intention		.012	.012
Response efficacy → information seeking	.199***		.199
Response efficacy → use intention		.018	.018
Information seeking → use intention	.093***		.093
Performance expectancy → application acceptance	.282***		.282
Performance expectancy → use intention		.283	.283
Performance expectancy → patronage intention		.270	.270
Effort expectancy → social influence	.428***		.428
Effort expectancy → application acceptance	.114***	.111	.225
Effort expectancy → use intention		.226	.226
Effort expectancy → patronage intention		.216	.216
Social influence → application acceptance	.260***		.260
Social influence → use intention		.261	.261
Social influence → patronage intention		.249	.249
Perceived risk → application acceptance	-.054*		-.054
Perceived risk → use intention		-.054	-.054
Perceived risk → patronage intention		-.051	-.051
Application acceptance → use intention	1.003***		1.003
Application acceptance → patronage intention	.958***		.958

* $p < .05$, ** $p < .01$, *** $p < .001$

Contrary to the expectation in H8, acceptance of the e-government applications did not serve as a significant mediator between risk information seeking behavior and behavioral intentions toward the applications. The relationship between risk information seeking and application acceptance was

not statistically significant. Without the indirect route through application acceptance, risk information seeking appeared to directly exert a positive influence on intentions to use the applications (δ = .09, p < .001). However, risk information seeking did not have any significant influence on patronage intentions.

DISCUSSION

This study aims to provide theoretical and practical insights into citizens' adoption of an e-government application for risk communication. Expanding the UTAUT model with risk- related variables and other predisposing factors, this study illuminates under which conditions citizens will accept and use such an application. Overall, this study provides support for the applicability of UTAUT to the context of risk communication. Citizens' acceptance of the e- government application for risk management appeared to be positively influenced by performance expectancy, effort expectancy, and social influence. Perceived risk of using the application was negatively associated with application acceptance. Subsequently, application acceptance exerted a positive influence on intention to use the application and recommend it to other people. These results suggest that the more benefits and the fewer risks people see in the new application, the more likely they are to use it and support others' use of it.

Facilitating conditions, however, did not have a significant relationship with application acceptance, which is consistent with Zuiderwijk et al.'s (2015) finding. A possible reason for this nonsignificant result is that South Korea ranked first in terms of smartphone penetration, with 88% of the adult population owning a smartphone (Rainie & Perrin, 2017). Also, South Korea stands out as the world leader in Internet connection speed, and almost all adults in South Korea (92.4%) are Internet users (Internet World Stats, 2017). All of these statistics imply that Korean citizens do not significantly differ in access to resources necessary to use an e-government application.

A notable finding is that both social media competence and trust in the government as an information source served as primary antecedents for the adoption of the e-government application. Trust in the government appeared to generate positive perceptions of performance expectancy and effort expectancy. In other words, citizens with higher levels of trust in the government are more likely to expect that a new application developed by the government will save them time and effort in pursing their

communication goals (e.g., obtaining risk information) and provide useful resources to meet their needs. Social media competence was also found to positively influence performance expectancy and effort expectancy, although it was not significantly associated with perceived risk of using the application. More competent users had greater expectations that the use of the application would be easy and effortless. This result suggests that improved competence with social media and new technologies prompts favorable perceptions of the benefits of using a new risk management application, which positively affected acceptance and usage of the application. From a practical perspective, to encourage greater adoption and usage among citizens, the government may need to consider investing in education on digital and technological skills through easy-to-follow training programs and demos. These efforts will reduce users' efforts and struggles in navigating the new application and thus increase their continuation intention to use it (Zuiderwijk et al., 2015).

The findings of this study confirm that risk information seeking is also a decision factor for whether or not to adopt an e-government application for risk communication. Additionally, risk perceptions—perceived severity, perceived susceptibility, and response efficacy—appeared to positively influence risk information-seeking behavior. People tend to engage in active information acquisition when they think that an existing risk is a serious problem and that their likelihood of being affected is high (Sheeran et al., 2014). While public messages causing too much fear should be avoided, the government and its agencies should make citizens aware of an emerging risk and its potential impact, especially when it is an unknown or underestimated risk. It is also necessary to create awareness about available resources and instructions that citizens can use in preparing for and managing a potential risk. Focusing on the effectiveness of following the government's guidelines should be part of this communication practice in order to enhance citizens' response-efficacy perceptions.

This study has limitations inherent to the use of quota sampling and surveying people on a new application that is not yet available to the public. However, the current work contributes to theoretical and practical knowledge about innovation adoption in the context of risk communication. From a theoretical perspective, this study adds empirical evidence to the literature on adoption of information communication technology. It also advances the UTAUT model by integrating risk variables from the protection motivation theory and other primary antecedents. Practically, the findings of this study provide insights into the development of strategies and programs for greater usage of

e-government services, as well as investment decisions regarding information communication technologies.

References

Alsajjan, B., & Dennis, C. (2010). Internet banking acceptance model: Cross-market examination. *Journal of Business Research, 63*, 957-963. doi:10.1016/j.jbusres.2008.12.014

Bockarjova, M., & Steg, L. (2014). Can Protection Motivation Theory predict pro-environmental behavior? Explaining the adoption of electric vehicles in the Netherlands. *Global Environmental Change, 28*, 276-288. doi:10.1016/j.gloenvcha.2014.06.010

Cairns, G., de Andrade, M., & MacDonald, L. (2013). Reputation, relationships, risk communication, and the role of trust in the prevention and control of communicable disease: A review. *Journal of Health Communication, 18*(12), 1550-1565. doi:10.1080/10810730.2013.840696

Centers for Disease Control and Prevention. (2014). CERC: Social Media and Mobile Media Devices.

Chang, S. E., Shen, W.-C., & Liu, A. Y. (2016). Why mobile users trust smartphone social networking services? A PLS-SEM approach. *Journal of Business Research, 69*(11), 4890-4895. doi:10.1016/j.jbusres.2016.04.048

Cheng, J. W., & Mitomo, H. (2017). The underlying factors of the perceived usefulness of using smart wearable devices for disaster applications. *Telematics and Informatics, 34*(2), 528- 539. doi:10.1016/j.tele.2016.09.010

Citizenscience.gov. (2017). About citizenscience.gov. Retrieved from https://www.citizenscience.gov/about/

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340. doi:10.2307/249008

Eastin, M. S., & LaRose, R. (2000). Internet self-efficacy and the psychology of the digital divide. *Journal of Computer-Mediated Communication, 6*(1). doi:10.1111/j.1083- 6101.2000.tb00110.x

Ebrahim, Z., & Irani, Z. (2005). E-government adoption: Architecture and barriers. *Business Process Management Journal, 11*(5), 589-611. doi:10.1108/14637150510619902

Eckhardt, A., Laumer, S., & Weitzel, T. (2009). Who influences whom? Analyzing workplace referents' social influence on IT adoption and non-adoption. *Journal of Information Technology, 24*(1), 11-24.

Fakhoury, R., & Aubert, B. (2015). Citizenship, trust, and behavioural intentions to

use public e- services: The case of Lebanon. *International Journal of Information Management, 35*(3), 346-351. doi:10.1016/j.ijinfomgt.2015.02.002

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: An integrated model. *MIS Quarterly, 27*(1), 51-90.

Griffin, R. J., Zheng, Y., ter Huurne, E., Boerner, F., & Ortiz, S. (2008). After the flood: Anger, attribution, and the seeking of information. *Science Communication, 29*(3), 285-315.

Harlow, L. L. (2005). *The essence of multivariate thinking: Basic themes and methods*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Hsu, M.-H., Chang, C.-M., & Yen, C.-H. (2011). Exploring the antecedents of trust in virtual communities. *Behavior & Information Technology, 30*(5), 587-601.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55.

Hung, S.-Y., Tang, K.-Z., Chang, C.-M., & Ke, C.-D. (2009). User acceptance of intergovernmental services: An example of electronic document management system. *Government Information Quarterly, 26*(2), 387-397. doi:10.1016/j.giq.2008.07.003

Internet World Stats. (2017). Internet Usage in Asia. Retrieved from http://www.internetworldstats.com/stats3.htm-asia

Jennings, E. A., Arlikatti, S., Andrew, S. A., & Kim, K. (2017). Adoption of information and communication technologies (ICTs) by local emergency management agencies in the United States. *International Review of Public Administration, 22*(2), 193-210.

Kijsanayotin, B., Pannarunothai, S., & Speedie, S. M. (2009). Factors influencing health information technology adoption in Thailand's community health centers: applying the UTAUT model. *Int J Med Inform, 78*(6), 404-416. doi:10.1016/j.ijmedinf.2008.12.005

Kim, S., Jeong, S.-H., & Hwang, Y. (2012). Predictors of pro-environmental behaviors of American and Korean students. *Science Communication, 35*(2), 168-188. doi:10.1177/1075547012441692

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. New York: Guilford.

Kontos, E. Z., Emmons, K. M., Puleo, E., & Viswanath, K. (2010). Communication inequalities and public health implications of adult social networking site use in the United States. *Journal of Health Communication, 15*, 216-235.

Lallmahomed, M. Z. I., Lallmahomed, N., & Lallmahomed, G. M. (2017). Factors influencing the adoption of e-government services in Mauritius. *Telematics and Informatics, 34*(4), 57-72. doi:10.1016/j.tele.2017.01.003

Lindsay, B. R. (2010). Social media and disasters: Current uses, future options and policy considerations. *Journal of Current Issues in Media & Telecommunications, 2*(4), 287-297.

McCaughey, J. W., Mundir, I., Daly, P., Mahdi, S., & Patt, A. (2017). Trust and distrust of tsunami vertical evacuation buildings: Extending protection motivation theory to examine choices under social influence. *International Journal of Disaster Risk Reduction, 24*, 462- 473. doi:10.1016/j.ijdrr.2017.06.016

McMaster, T., & Wastell, D. (2005). Diffusion – or delusion? Challenging an IS research tradition. *Information Technology & People, 18*(4), 383-404. doi:10.1108/09593840510633851

Milne, S., Orbell, S., & Sheeran, P. (2002). Combining motivational and volitional interventions to promote exercise participation: Protection motivation theory and implementation intentions. *British Journal of Health Psychology, 7*, 163-184.

Oliveira, T., Faria, M., Thomas, M. A., & Popovič, A. (2014). Extending the understanding of mobile banking adoption: When UTAUT meets TTF and ITM. *International Journal of Information Management, 34*(5), 689-703. doi:10.1016/j.ijinfomgt.2014.06.004

Park, M. J., Choi, H., Kim, S. K., & Rho, J. J. (2015). Trust in government's social media service and citizen's patronage behavior. *Telematics and Informatics, 32*(4), 629-641. doi:10.1016/j.tele.2015.02.006

Pomerleau, M. (2015). CDC's open gov success during Ebola outbreak. *GCN*. Retrieved from https://gcn.com/articles/2015/03/20/nih-ebola-content-syndication.aspx

Rainie, L., & Perrin, A. (2017). 10 facts about smartphones as the iPhone turns 10. *Pew Research Center*. Retrieved from http://www.pewresearch.org/fact-tank/2017/06/28/10-facts-about-smartphones/

Rana, N. P., Williams, M. D., Dwivedi, Y. K., & Williams, J. (2012). Theories and theoretical models for examining the adoption of e-government services. *e-Service Journal, 8*(2), 26- 56. doi:10.2979/eservicej.8.2.26

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology, 91*(1), 93-114.

San Martín, H., & Herrero, Á. (2012). Influence of the user's psychological factors on the online purchase intention in rural tourism: Integrating innovativeness to the UTAUT framework. *Tourism Management, 33*(2), 341-350. doi:10.1016/j.tourman.2011.04.003

Shareef, M. A., Kumar, V., Kumar, U., & Dwivedi, Y. K. (2011). e-Government Adoption Model (GAM): Differing service maturity levels. *Government Information Quarterly, 28*(1), 17-35. doi:10.1016/j.giq.2010.05.006

Sheeran, P., Harris, P. R., & Epton, T. (2014). Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental

studies. *Psycholol*gical *Bulletin, 140*(2), 511-543. doi:10.1037/a0033065

Slade, E. L., Dwivedi, Y. K., Piercy, N. C., & Williams, M. D. (2015). Modeling consumers' adoption intentions of remote mobile payments in the United Kingdom: Extending UTAUT with innovativeness, risk, and trust. *Psychology & Marketing, 32*(8), 860-873. doi:10.1002/mar.20823 ter Huurne, E. F. J., Griffin, R. J., & Gutteling, J. M. (2009). Risk information seeking among

U.S. and Dutch residents: An application of the model of risk information seeking and processing. *Science Communication, 31*(2), 215-237. doi:10.1177/1075547009332653

Thakur, R., & Srivastava, M. (2014). Adoption readiness, personal innovativeness, perceived risk and usage intention across customer groups for mobile payment services in India. *Internet Research, 24*(3), 369-392. doi:10.1108/IntR-12-2012-0244

Venkatesh, V., Morris, M., G., Davis, G., B., & Davis, F., D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478.

Wang, Y.-S., Wu, M.-C., & Wang, H.-Y. (2009). Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British Journal of Educational Technology, 40*(1), 92-118. doi:10.1111/j.1467-8535.2007.00809.x

Wiederhold, B. K. (2013). In a disaster, social media has the power to save lives.

Cyberpsychology, Behavior, and Social Networking, 16(11), 781-782. doi:10.1089/cyber.2013.1532

Wirtz, B. W., Piehler, R., & Daiser, P. (2015). E-government portal characteristics and individual appeal: An examination of e-government and citizen acceptance in the context of local administration portals. *Journal of Nonprofit & Public Sector Marketing, 27*(1), 70-98. doi:10.1080/10495142.2014.965082

Wu, I.-L., & Chen, J.-L. (2005). An extension of Trust and TAM model with TPB in the initial adoption of on-line tax: An empirical study. *International Journal of Human-Computer Studies, 62*(6), 784-808.

Zuiderwijk, A., Janssen, M., & Dwivedi, Y. K. (2015). Acceptance and use predictors of open data technologies: Drawing upon the unified theory of acceptance and use of technology. *Government Information Quarterly, 32*(4), 429-440. doi:10.1016/j.giq.2015.09.005