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8-2010

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ABSTRACT

While a variety of information technology (IT) acceptance and use models have been extensively examined and validated in numerous contexts, most studies have been conducted in western cultures, and thus not much is known about the probable moderating role of culture on the relationships between the constructs in those models. To fill this gap in the literature, we propose to empirically investigate the probable moderating roles of national cultural differences on the relationships between the constructs in the Unified Theory of Acceptance and Use of Technology (UTAUT): a model that consolidates the most prominent eight previous IT acceptance and use models. Hofstede's five national cultural dimensions that provide a framework for national cultural differences are employed as the moderators. A self-administered survey questionnaire will be sent to healthcare practitioners in ten major healthcare organizations, five each from Taiwan and the U.S., to solicit their responses regarding their acceptance and use of Clinical Decision Support Systems (CDSSs). The findings from this proposed research are expected to generate both theoretical and practical implications.

Keywords

The unified theory of acceptance and use of technology (UTAUT), Hofstede's five national cultural dimensions, healthcare information systems, clinical decision support systems (CDSSs).

INTRODUCTION

The research on the adoption and use of information technology (IT) is regarded as one of the most mature research streams in information systems research (Jasperson, Cater and Zmud, 2005). A variety of models have been extensively examined and validated in numerous contexts. Some of the most widely accepted and validated models are technology acceptance model (TAM) (Davis, 1989), theory of planned behavior (TPB) (Ajzen, 1985), innovation diffusion theory (IDT) (Rogers, 1995), and social cognitive theory (SCT) (Bandura, 1986), just to name a few. Despite the abundant research regarding the acceptance and use of different technologies in different contexts, the vast majority of them were conducted in western cultures. The research conducted in non-western cultures, for example, in Saudi Arabia (Al-Gahtani, Hubona and Wang, 2007) and Japan (Straub, Keil and Brenner, 1997) suggests significant differences by culture in users' IT adoption and use behaviors, and thus the models need to take national cultural differences into account. In their meta-analysis of previous studies on TAM, Schepers and Wetzels (2007) also highlight the moderating role of culture in examining IT adoption phenomenon.

Among the different contexts in which users' IT adoption and use have been examined and validated, healthcare information systems have received great attention from practitioners and researchers over the past decade due to their rapidly growing adoption and use rate in the healthcare industry (Chau and Hu, 2001). While a variety of healthcare information systems such as clinical decision support systems (CDSSs), electronic medical records (EMRs), electronic prescription ordering systems (EPOSs), and automated drug dispensing systems (ADDSs) have been increasingly adopted and used by healthcare

practitioners, their adoption and use of the systems are often described as limited due to the unique structure of the healthcare industry, compared to the adoption and use of other information systems. For example, as Hennington and Janz (2007) pointed out, since most physicians are independent from the healthcare organizations with which they are affiliated, it is unlikely that they are obligated to adopt or use those systems.

Venkatesh, Morris, Davis and David (2003) introduced the unified theory of acceptance and use of technology (UTAUT): a model that consolidates the most prominent eight previous IT acceptance and use models. Along with four moderators affecting the magnitude of influences of the four core determinants on behavioral intention and usage, the UTAUT model outperformed any other previous models in explaining users' behavioral intention of adopting IT. Subsequently, the model has been employed by many studies and validated in various settings (e.g., AlAwadhi and Morris, 2008). Due to its superior explanatory power over other competing models and highly established generalizability, the UTAUT model is employed to examine the probable moderating role of culture in the adoption and use of a healthcare information system in the current proposed research. More specifically, our research proposes to empirically investigate the moderating roles of national cultural differences on the relationships between the constructs in the UTAUT model. Hofstede's five national cultural dimensions (Hofstede, 1980, 1991, 2001) that provide a framework for national cultural differences are employed as the moderators. A self-administered survey questionnaire will be sent to healthcare practitioners in ten major healthcare organizations, five each from Taiwan and the U.S., to solicit their responses regarding their acceptance and use of clinical decision support systems (CDSSs). The findings from this proposed research are expected to generate insights for multinational corporations that seek to develop technology adoption strategies across countries.

The paper is organized as follows: the next section briefly presents a literature review of the UTAUT model, Hofstede's five national cultural dimensions, and CDSSs. The third section discusses the proposed research model and hypotheses. The fourth section describes the research method that will be employed to test the research model and hypotheses. Finally, the fifth section provides discussions of theoretical and practical implications, limitations, and future direction for the research.

RELEVANT LITERATURE REVIEW

The Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh et al. (2003) introduced the UTAUT model that consolidates the most prominent eight previous IT acceptance and use models such as theory of reasoned action (TRA) (Fishbein and Ajzen, 1975), technology acceptance model (TAM/TAM2) (Davis, 1989; Venkatesh and Davis, 2000), motivational model (MM) (Davis, Bagozzi and Warshaw, 1992), theory of planned behavior (TPB) (Ajzen, 1991), combined TAM and TPB (C-TAM-TPB) (Taylor and Todd, 1995), model of PC utilization (MPCU) (Thompson, Higgins and Howell, 1991), innovation diffusion theory (IDT) (Rogers, 1995), and social cognitive theory (SCT) (Compeau, Higgins and Huff, 1999). By conducting a longitudinal validation and comparison of the eight models, they identified four significant determinants of user acceptance and use behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions along with four moderating factors (i.e., gender, age, voluntariness, and experience). Table 1 provides definitions and root constructs of each construct as they are described in the original study (Venkatesh et al., 2003).

Construct	Definition	Root Constructs
Performance expectancy	The degree to which an individual believes that using the system will help him or her to attain gains in job performance (p.447).	'Perceived usefulness' from TAM and C-TAM-TPB, 'extrinsic motivation' from MM, 'job-fit' from MPCU, 'relative advantage' from IDT, and 'outcome expectations' from SCT
Effort expectancy	The degree of ease associated with the use of the system (p.450).	'Perceived ease of use' from TAM, 'complexity' from MPCU, and 'ease of use' from IDT
Social influence	The degree to which an individual perceived that important others believe he or she should use the new system (p.451).	'Subjective norm' in TRA, TAM2, TPB and C-TAM-TPB, 'social factors' in MPCU, and 'image' in IDT

Facilitating conditions	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system (p.453).	'Perceived behavioral control' from TPB, C-TAM-TPB, 'facilitating conditions' from MPCU, and 'compatibility' from IDT

Table 1. Definitions and Root Constructs for the Four Constructs (Venkatesh et al., 2003)

In the model, use behavior is determined by the users' behavioral intention and surrounding facilitating conditions. Their behavioral intention in turn is influenced by three determinants: users' performance expectancy, effort expectancy and social influence. Figure 1 depicts the UTAUT model (Venkatesh et al., 2003).
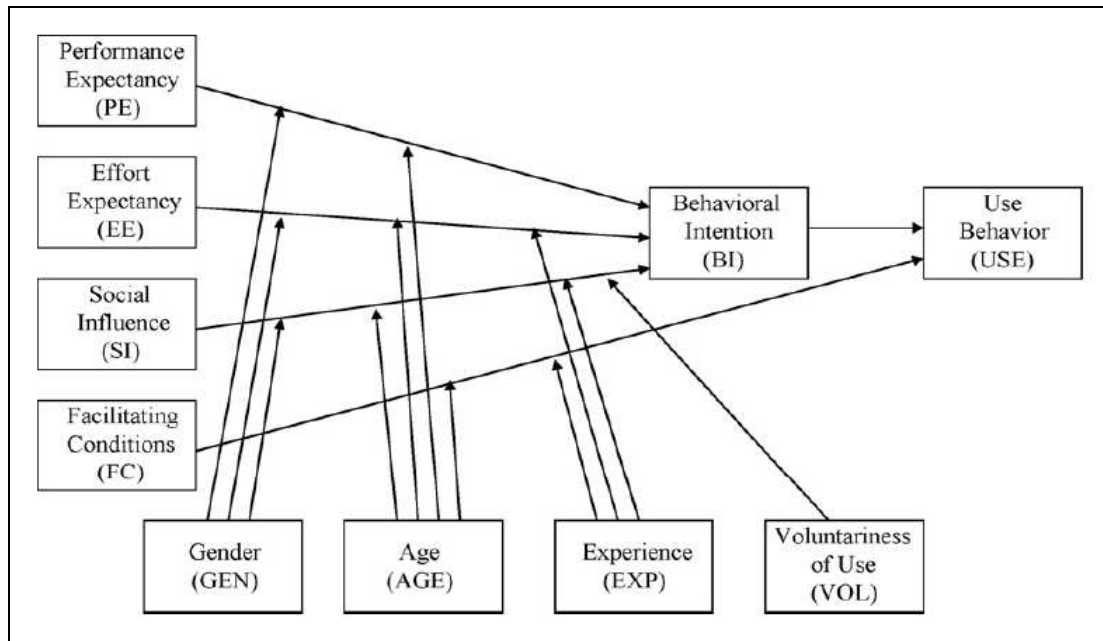

Figure 1. The UTAUT Model (Venkatesh et al., 2003)

The UTAUT model outperformed other previous models in explaining users' behavioral intention of adopting IT. Subsequently, the model has been employed by many studies and validated in various settings. For example, Al-Gahtani et al., (2007) examined the applicability of the model to other countries beyond North America and proposed a modified UTAUT model specifically suitable to Saudi Arabia. The study found that age does not moderate the influences of performance expectancy and effort expectancy on behavioral intentions, and that the influences of the four determinants on the behavior intention and usage behavior differ by culture. The research, however, is not generalizable to other countries since it only considers Saudi Arabia as its context. It also failed to provide further explanations of how cultural dimensions moderate the influences. In this paper, we propose to empirically investigate the probable moderating roles of national cultural differences on the relationships between the constructs in the unified theory of acceptance and use of technology (UTAUT). Hofstede's five national cultural dimensions (Hofstede, 1980, 1991, 2001) that provide a framework for national cultural differences are employed as the moderators.

Hofstede's Five National Cultural Dimensions

Hofstede's national cultural dimensions (Hofstede, 1980, 2001) form the most widely adopted and validated framework for studying national culture differences in many fields such as sociology, marketing, and organizational science (Soares, Farhangmehr and Shoham, 2007). Some studies on IT adoption and use in IS research that have taken culture into account have also adopted the framework to explore the impact of national cultural differences on the adoption and use of IT (e.g, Straub et al., 1997). Hofstede (1980) initially defined four national cultural dimensions (i.e., uncertainty avoidance, power-

distance, individualism, and masculinity) that signify the cultural distances of different countries. Later, another new dimension (i.e., long-term orientation or Confucian dynamism) was added based on Bond (1987)'s study of Chinese values (Hofstede, 1991). Table 2 describes each of these five dimensions.

Hofstede's dimension	Definition
Uncertainty avoidance	The extent to which people feel threatened by uncertainty and ambiguity and try to avoid these situations (Hofstede, 1991: 113).
Power distance	Focuses on the degree of equality, or inequality, between people in the country's society. High PD indicates that inequalities of power and wealth are accepted practices and have been allowed to grow.
Masculinity	Masculinity measures the degree to which ''masculine'' values like assertiveness, performance, success and competition prevail over ''feminine'' values like the quality of life, maintaining warm personal relationships, service, caring, and solidarity.
Individualism	Focuses on the degree to which the society reinforces individual or collective achievement and interpersonal relationships. Low IDV typifies societies of a more collectivist nature with close ties between individuals. These cultures reinforce collectives where everyone takes responsibility for fellow members of their group.
Long-term orientation or Confucian dynamism	Stands for the fostering of virtues oriented towards future rewards, in particular perseverance and thrift (Hofstede, 2001: 359).

Table 2. Hofstede's Cultural Dimensions Adapted from Al-Gahtani et al. (2007)

Table 3 lists the U.S. and Taiwan's scores on these five dimensions. It can be seen that U.S. and Taiwan differ in all of these five cultural dimensions. Especially, Taiwan scores much higher than U.S. in long-term orientation, which indicates that Taiwanese are much more likely to save money and are oriented toward future rewards, compared to Americans. The U.S.'s score in individualism is greatly higher than Taiwan, which indicates that Americans are much more independent and tend to work individually, compared to Taiwanese who tend to work collectively and value interpersonal relationship. This table also indicates that Taiwanese are more likely to avoid facing anything that is uncertain and ambiguous to them (uncertainty avoidance), and are more likely to defer to people with authority (power distance), while Americans are oriented more toward performance, success and competition (masculinity).

Cultural Dimension	United States	Taiwan
Uncertainty Avoidance	46	69
Power Distance	40	58
Masculinity	62	45
Individualism	91	17
Long-Term Orientation	29	87

Table 3. Hofstede Index Scores for the U.S. and Taiwan (Hofstede, 2001)

Straub et al. (1997) explained the relationship between the different cultural dimensions and the predicting power of an individual's IT adoption behavior by TAM. The study suggests: 1) the higher a culture's degree of uncertainty avoidance is, the less often people will adopt technology (i.e., email), 2) the higher a culture's power distance is, the less likely people will adopt e-mail technology, 3) the higher a culture's individualism is, the more likely people will use the technology, 4) the higher a culture's masculinity is, people would tend not to adopt the technology. Based on Straub et al. (1997), we develop our hypotheses, and further rationale for each hypothesis is presented in the third section. One study that is similar to the current one was conducted by Pavlou and Chai (2002) that examined the moderating roles of Hofstede's cultural dimensions

(China vs. the U.S.) in e-commerce context by drawing on TPB. Their study, however, didn't take uncertainty avoidance and masculinity dimensions into account as moderators. In order to fully understand how culture moderates IT adoption, we consider all of the Hofstede's cultural dimensions in our study by drawing on UTAUT.

Clinical Decision Support Systems

In this proposed research, clinical decision support systems (CDSSs) will be used as the technology to be adopted. With the advent of computer systems, healthcare information systems have also received great attention from practitioners and researchers over the past decade. Accordingly, numerous healthcare systems have been adopted such as online electric medical bibliographical database (MEDLINE) with which healthcare practitioners can improve the quality of health care. CDSSs are defined as any computer programs designed to help health professionals make clinical decisions (Musen, Shahar and Shortliffe, 2006). By collecting, integrating and analyzing various patients' history records, CDSSs can provide additional evaluations and recommendations based on practitioners' observations of patients' characteristics. Examples include a CDSS that is used to help real-time diagnosis of patients' disease and provide treatment and medication recommendations (Hunt, Haynes, Hanna and Smith, 1998). However, there are still many adoption barriers in practitioners' adopting and using the system. For example, practitioners still need to make their own judgments and decisions about the relatedness of information acquired for patients' possible diseases, which can diminish their perceived usefulness of the system (Ou, West, Lazarescu and Clay, 2008). While these barriers call for more research attention to be directed toward healthcare information systems, another reason that CDSSs are chosen as the technology to be studied in this proposed research is that the technology is still in its very early stage of adoption, especially in Taiwan. As discussed in Venkatesh (2003), the best timing to examine a technology acceptance model is when the technology is still in its introductory stage and thus the respondents are still in their active adoption decision-making process.

RESEARCH MODEL AND HYPOTHESES

The objectives of this proposed research are two-fold: 1) examine the applicability and explicability of the UTAUT model to different countries (i.e. Taiwan), 2) examine how national culture differences affect the applicability of UTAUT to different countries. The corresponding research questions are: 1) does the UTAUT model hold for different countries (i.e. Taiwan)?, 2) how do Hofstede's national cultural dimensions moderate the relationships between the constructs in the UTAUT model? Figure 2 depicts the research model. Next, the detailed rationale for each hypothesis is provided.
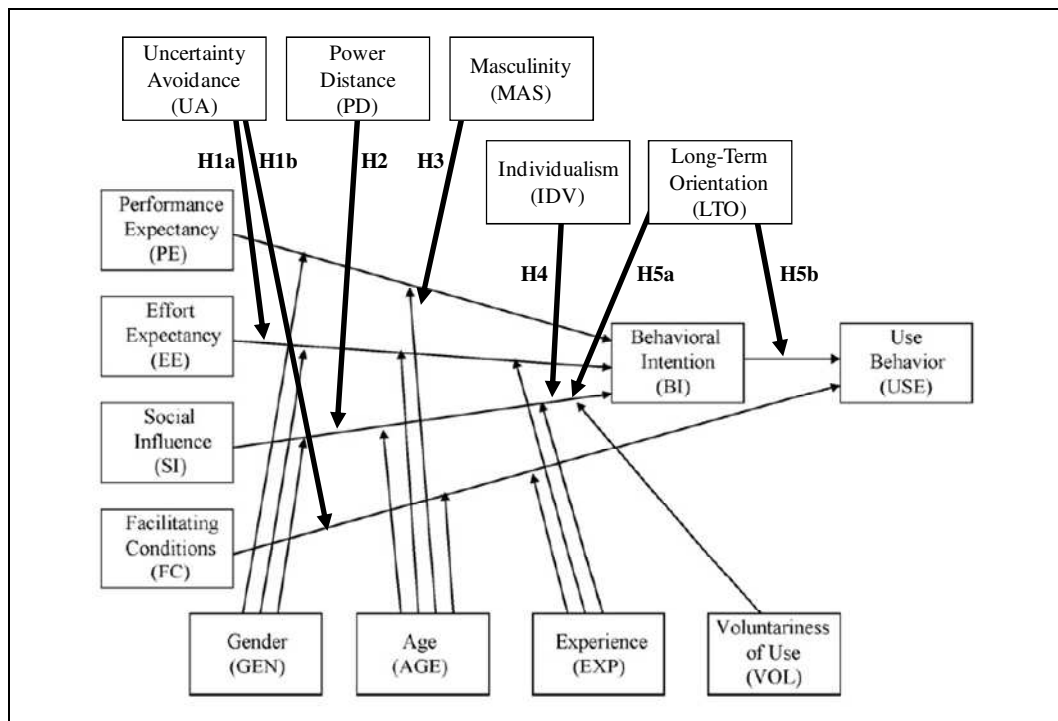

Figure 2. The Proposed Research Model and Hypotheses

Uncertainty Avoidance

Uncertainty avoidance means the level of tolerance for uncertainty and ambiguity within the society. Therefore, it can be assumed that the higher uncertainty avoidance a country has, the more likely people in the country will think that it is difficult to use a new technology and to learn to use it requires more effort. Thus, uncertainty avoidance may negatively moderate the effort expectancy (i.e., the degree of ease associated with the use of the system). Also, for a country with higher uncertainty avoidance, even though organizational and technical infrastructure exists to support use of a new technology, people in this country may still be more likely to avoid using it, compared to people in countries with lower uncertainty avoidance. We, therefore, hypothesize as follows:

> *H1a: Uncertainty avoidance will negatively moderate the influence of effort expectancy on behavioral intention*

> *H1b: Uncertainty avoidance will negatively moderate the influence of facilitating conditions on use behavior.*

Power Distance

Power Distance means the degree of equality, or inequality, between people in the country's society. In other words, the higher power distance a country has, the more likely people in the country will defer to people with authority or higher position. Based on this idea, it can be assumed that the higher power distance a country has, the more likely people in that country will be influenced by others, especially those with higher position, when adopting a new technology (that is, social influence), compared to people in countries with lower power distance. Therefore, the next hypothesis is as follows:

> *H2: Power distance will positively moderate the influence of social influence on behavioral intention.*

Masculinity

Masculinity means the degree to which masculine values such as assertiveness, performance, success and competition prevail over feminine values such as the quality of life. Therefore, the higher masculinity a country has, the more likely people in that country will be aggressive to achieve their goal, compared to people in countries with lower masculinity. Therefore, it can be assumed that users in a country with higher masculinity will be more likely to adopt a technology if they believe this technology will promote their performance. We, therefore, hypothesize as follows:

> *H3: Masculinity will positively moderate the influence of performance expectancy on behavioral intention.*

Individualism

Individualism means the degree to which a society reinforces individual or collective achievement and interpersonal relationships. In other words, the higher individualism a country has, the more likely people in the country tend to work individually, compared to people in countries with lower individualism will more likely to work collectively. Based on this idea, it can be assumed that users in a country with higher individualism will be less likely to be influenced by others to adopt a new technology even they perceive others want them to do so. Therefore, the next hypothesis is as follows:

> *H4: Individualism will negatively moderate the influence of social influence on behavioral intention.*

Long-term Orientation

Countries with long-term orientation are oriented towards future reward, in particular perseverance and thrift. This means, the higher long-term orientation a country has, which is more apparent in eastern countries, the more likely people in that country will save money for future use and will refrain from spending for instant but transient pleasures. While people in countries with lower long-term orientation tend to spend money for pleasure and social and status obligations. Therefore, it is assumed that people in countries with lower long-term orientation will be more likely to be influenced by others to adopt a new technology (that is, social influence), compared to users in countries with higher long-term orientation. Besides, even though users are intend to adopt a new technology, for people in countries with higher long-term orientation, they will be more likely to refrain from instantly adopting it to use. We, therefore, hypothesize:

> *H5a: Long-term orientation will negatively moderate the influence of social influence on behavioral intention.*

> *H5b: Long-term orientation will negatively moderate the influence of behavioral intention on use behavior.*

METHODOLOGY

Healthcare practitioners (i.e., physicians and other healthcare professionals who have adopted CDSSs) in ten major healthcare organizations, five each from Taiwan and the U.S., will be invited to participate in the study. More specifically, the two university medical centers, one in the authors' current institution in the U.S. and another in an institution in Taiwan that one of the authors previously attended, will be first contacted for the research. The remaining four organizations for each country will be identified based on their recommendations. After we obtain agreement from ten organizations, a self-administered survey questionnaire will be mailed to the healthcare practitioners in those ten organizations to solicit their responses regarding their acceptance and use of CDSSs along with the certificate of appreciation. For those who have not returned the survey after three weeks, direct contact via phone will be made to encourage their participation. The two countries (i.e., Taiwan and the U.S.) were selected due to the following two reasons: first, Taiwan and the U.S. differ markedly on several of Hofstede's five national cultural dimensions as shown in Table 3, also, since one of the authors is Taiwanese, the issues concerning language and culture in conducting a cross-national research will be mitigated. As for the questionnaire items to test the UTAUT mode, the same items used in Venkatesh et al. (2003) will be employed. For Hofstede's five national cultural dimensions, the items used in Hofstede (2001) has been adapted to the context of IT adoption and use for the research, and they will be pre-validated using healthcare practitioners in those two university medical centers. Some sample items to test Hofstede's five national cultural dimensions are shown in Table 4. Finally, the data will be analyzed using a PLS structural equation modeling software (i.e., SmartPLS).

Cultural Dimension	Sample Items; Scale ranges from 5 (strongly agree) to 1 (strongly disagree)
Uncertainty Avoidance	1. I prefer not to change in my job-related routines.
	2. I like to try new technologies for job-related purposes.
	3. I feel more comfortable in a more secure and less stressful job environment.
Power Distance	1. I feel uncomfortable if I disagree with my supervisor.
	2. My supervisor often affects my job-related decisions in an autocratic or persuasive way.
	3. I like to consult my supervisor for my job-related decision making.
Masculinity	1. I enjoy challenges in my job.
	2. I pursue opportunities for high earning and position.
	3. The balance of work time and family time is important to me.
Individualism	1. The quality of my job-related decisions is normally better than that of making decision with my colleagues.
	2. I like to make my job-related decisions by myself.
	3. My job-related skills are more important in achieving my career goal than some expert colleagues I know.
Long-Term Orientation or Confucian dynamism	1. Thrift is important to me.
	2. Perseverance is important to me.
	3. Personal steadiness and stability is important to me.

Table 4. Sample Items for Hofstede's Five National Cultural Dimensions (adapted from Hofstede, 2001)

DISCUSSIONS

This proposed research is expected to generate both theoretical and practical implications. As previously mentioned, given the abundant research regarding the acceptance and use of different technologies in different contexts, most of them were conducted in western cultures and not many have been done concerning eastern cultures. By empirically investigating the moderating effects of Hofstede's five national cultural dimensions on the relationships between the constructs in the UTAUT model, the research contributes to this lack of the literature. Also, the research will be conducted in a healthcare information systems context (i.e. CDSSs). As mentioned earlier, although a variety of healthcare information systems have been

increasingly adopted and used by healthcare practitioners, their adoption and use of the systems are often described as limited due to the unique structure of the healthcare industry (e.g., hard to mandate, experience level), and there has been lack of research that has attempted to distinguish the adoption and use of healthcare information systems from other information systems (Hennington and Janz, 2007). In this regard, the current proposed research also contributes to this gap in the literature by examining the applicability of the UTAUT model to a healthcare information system (i.e. CDSSs). For example, the moderating effect of voluntariness of use, one of the moderators in the UTAUT model, has not been fully examined in the context (Hennington and Janz, 2007), and thus it will be interesting to see how it differs from the effect in other contexts. Likewise, the findings from this proposed research are also expected to produce practical implications, for example, for multinational corporations that seek to develop technology adoption strategies across countries or for healthcare organizations that seek to increase the adoption and use rate of the systems that they have implemented among their healthcare practitioners.

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