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Integrating Innovation Diffusion Theory and the Technology Acceptance Model: The adoption of blockchain technology from business managers' perspective

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ABSTRACT

Financial technology (FinTech) is the new business model and technology which aims to compete with traditional financial services and blockchain is one of most famous technology use of FinTech. Blockchain is a type of distributed, electronic database (ledger) which can hold any information (e.g. records, events, transactions) and can set rules on how this information is updated. The most well-known application of blockchain is bitcoin, which is a kind of cryptocurrencies. But it can also be used in many other financial and commercial applications. A prominent example is smart contracts, for instance as offered in Ethereum. A contract can execute a transfer when certain events happen, such as payment of a security deposit, while the correct execution is enforced by the consensus protocol. The purpose of this paper is to explore the research and application landscape of blockchain technology acceptance by following a more comprehensive approach to address blockchain technology adoption. This research is to propose a unified model integrating Innovation Diffusion Theory (IDT) model and Technology Acceptance Model (TAM) to investigate continuance intention to adopt blockchain technology.

Keywords: Financial technology (FinTech), Technology Acceptance Model (TAM), Innovation Diffusion Theory (IDT), Blockchain technology,

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INTRODUCTION

The FinTech market is growing fast. But the FinTech mania is widely attributed to the 2008 worldwide financial crisis. The crisis caused from high risk investment, leaving public trust in financial institutions at an all time low. So consumers start to look for alternative methods for managing their assets, and financial institutions desperate to gain public favor, this left the door open for FinTech companies and startups. Another reason FinTech is so popular is the growing millennial generation. They are so familiar with internet and technology for their daily lives, they want their financial services to be as digital as any of their other electronic commercial services and they do not like face-to-face interaction. In order to stay on top of the latest technology trends, financial institutes have invested significant amount of time and resources in FinTech to maintain their competitiveness and keep up with new technology trends.

One particular aspect of FinTech that can help make financial services more secure is blockchain technology. The blockchain technology is the most famous business application of the FinTech. The well-known cryptocurrency bitcoin relies on blockchain technology to execute its financial transactions, but it can do so much more than this. Blockchain technology is highly secure more than ever before, so it is perfect for financial transactions and fraud prevention.

As mentioned previously, blockchain is a type of distributed, electronic ledger which can hold any information and can set rules on how this information is updated (Condos, Sorrell & Donegan, 2016). The information of ledger continually grows as blocks are appended and linked (chained) to the previous block using a hash. The hash is produced by running contents of the block in question through a cryptographic hash function. An ideal cryptographic hash function can easily produce a hash for any input, but it is very difficult to use the hash to derive the input. Additionally, any changes in the original data should result in extensive and seemingly uncorrelated changes to the hash. Finally, it should be infeasible for two different inputs to result in the same hash. Using the cryptographic hashes in this manner ensures that in order to alter an entry in a past block all subsequent blocks also need to be altered. The ledger is validated and maintained by a network of participants (nodes) according to a predefined consensus mechanism (a set of rules allowing the network to reach a global agreement) so no single centralized authority is needed. Multiple (but not necessarily all) nodes hold a full copy of the entire database (Janusz, Joy & Markus, 2017; Bitcoin developer guide, 2009).

Blockchain technology is relatively new technology of FinTech and it continues to evolves quickly. This paper intends to investigate factors affecting managements' intentions to use blockchain technology. Combining the innovation diffusion theory (IDT) with the technology acceptance model (TAM), the present study proposes an unified technology acceptance model. The proposed model was tested with data collected from business managers using the blockchain technology in Taiwan.

THEORETICAL BACKGROUND

TAM was treated as a good theoretical model to explain the acceptance of new technology, however it is questionable whether the TAM model can be applied to all the cases of new technology adoption. So many empirical research recommend integrating TAM with other theories or models to cope with radical technological change and improve the quality and explanatory power (Carter & Be´langer, 2005; Legris, Ingham & Colerette, 2003). TAM and IDT are similar in some constructs and complement each other to examine the adoption of new technology (Lee, Hsieh & Hsu, 2011). Past researchers indicate that the integration of these two theories could provide a better model than either standing alone (Wu & Wang, 2005; Chen, Gillenson & Sherrell, 2002) and some prior studies prove good results of integrating the two models (Sigala, Airey, Jones & Lockwood, 2000; Gefen, 2004).

Technology Acceptance Model (TAM)

This study employs two major theoretical models—the TAM and IDT. We will begin by considering the model of TAM. Based on Ajzen and Fishbein's Theory of Reasoned Action (TRA) model, Davis introduced TAM for predicting technology usage and acceptance (Taylor & Todd, 1995; Davis, Bagozzi & Warshaw, 1989). TAM suggests that perceived usefulness (PU) and perceived ease of use (PEOU) are two primary determinants in explaining individual users' adoption intention. While PU is defined as the degree to which a person believes that using a particular system will enhance his or her job performance, PEOU refers to the degree to which the person believes that using the system will be free of effort. The TAM has been validated repeatedly by many scholars in different settings since it was first published and so has been widely used in technology adoption research in the past decades. However, TAM is also a relatively simple model which can be modified or extended in different ways and, therefore, many extensions integrating other theories have appeared in the literature (Zhang, Guo & Chen, 2008). The model hypothesizes that technology acceptance is decided by users behavioral intention (BI) to use, Which is in turn influenced by users' attitudes (A) toward using. Finally, attitude is directly affected by beliefs about the technology, which consists of PU and PEOU. TAM is among the most influential and discussed theories in predicting and explaining end-user behavioral technology usage. It is one of the base theories for this study because of its solid theoretical foundation (Lee, Hsieh & Hsu, 2011).

Innovation Diffusion Theory (IDT)

The most well-known theory about technical innovation is IDT. Research on IDT has been widely applied in various fields such as science, sociology, communication, agriculture, marketing, internet, and technology, etc (Rogers, 1995; Karahanna, Straub & Chervany, 1999; Agarwal, Sambamurthy & Stair, 2000). An innovation is "an idea, practice, or object that is perceived as new by an individual or another unit of adoption". On the other hand, Diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1995). Therefore, the IDT theory argues that "potential users make decisions to adopt or reject an innovation based on beliefs that they form about the innovation" (Karahanna, Straub & Chervany, 1999). IDT theory tries to explain innovation decision process, determining factors of rate of adoption, and different categories of adopters. It helps in predicting the likelihood and rate of adoption of an innovation (Chen, Gillenson & Sherrell, 2002). IDT includes five significant innovation characteristics: compatibility(CPT), relative advantage(RAD), complexity(CPX), and trialability and observability. Relative advantage is defined as the degree to which an innovation is considered as being better than the idea it replaced. This construct is found to be one of the best predictors of the adoption of an innovation. Compatibility refers to the degree to which innovation is regarded as being consistent with the potential end-users' existing values, prior experiences, and needs. Complexity is the end-users' perceived level of difficulty in understanding innovations and their ease of use. Trialability refers to the degree to which innovations can be tested on a limited basis. Observability is the degree to which the results of innovations can be visible by other people. These characteristics are used to explain end-user adoption of new technologies and the decision-making process(Lee, Hsieh & Hsu, 2011). But according to prior researches of the meta-analysis of 75 diffusion articles conducted by Tomatzky and Klein, found that only relative advantage, compatibility and complexity were consistently related to adoption of technical innovations (Tornatzky & Klein, 1982).

RESEARCH MODEL

This research proposes an integrated model based on IDT and TAM models to take advantage of these two theoretical models. The two basic TAM factors are PU and PEOU and three important factors for innovation are relative advantage, compatibility and complexity (trialability and observability are omitted due to the previous analysis of Tomatzky and Klein), which are included as the major determinants in our integrated framework of the new technology adoption (see Fig.1).

This model will better reveal how these different factors influence business managers' acceptance intentions and usage behavior of blockchain technology adoption process in FinTech industry. The validity and applicability of the proposed model will be tested based on the following hypotheses.

TAM Model Hypotheses

The proposed research model adopts TAM belief—attitude— intention—behavior relationship. These relationships can stated in the following hypotheses.

H1: users' behavioral intention (BI) had a positive effect on his or her actual use the blockchain technology.

H2: users' attitude toward using (A) had a positive effect on his or her BI to use the blockchain technology.

H3: users' perceived usefulness (PU) had a positive effect on his or her BI to use the blockchain technology.

H4: users' perceived usefulness (PU) had a positive effect on his or her attitude toward using (A) the blockchain technology.

H5: users' perceived ease of use (PEOU) had a positive effect on his or her attitude toward using (A) the blockchain technology.

IDT Model Hypotheses – Compatibility(CPT)

Agarwal and Prasad asserted a positive relationship between user's previous compatible experiences and the new technology adoption (1999). They found that the extent of past experience with similar technologies was positively associated with an ease of use belief about the new technology innovation. Moreover, Chau and Hu reported that the effect of compatibility was found to be significant only in relation to PU (2001). Later, Wu and Wang (2005) and Chang and Tung (2008) confirmed that compatibility had a significant positive and direct effect on PU and the behavioral intention. Likewise, previous studies have investigated compatibility from different aspects, resulting in support for its impact on PU, PEOU and intention to use (Hardgrave *et al*., 2003). Based upon the preceding research, the following hypotheses were proposed:

H6: Compatibility had a positive effect on PU of the blockchain technology.

H7: Compatibility had a positive effect on PEOU of the blockchain technology.

IDT Model Hypotheses - Relative advantages(RAD)

Research consistently found that the perceived relative advantages positively affected the users' intention to use the system across different participants (Shih, 2007; Lee, 2007). However, in TAM and IDT research, the relationships among relative advantages, PU, and PEOU had seldom been studied with the only one study revealed that when the users perceived higher relative advantages, they perceived a higher level of usefulness of the technology. Accordingly, we hypothesized:

H8: The relative advantages had a positive effect on PU of the blockchain technology.

H9: The relative advantages had a positive effect on PEOU of the blockchain technology.

IDT Model Hypotheses – Complexity(CPX)

The previous empirical studies provided evidence indicating that complexity had a significantly negative effect on the intention to use technology (Shih, 2007; Lee, 2007). On top of that, a negative relationship between complexity and PU was also revealed in a study conducted by Hardgrave, *et al*. (2003). Thus, based on the preceding researches, we proposed the hypotheses as below:

H10: Complexity negatively affected PU of the blockchain technology.

H11: Complexity negatively affected PEU of the blockchain technology.

In conclusion, the proposed structure of the IDT-TAM integrated model is represented by H1-H11 as shown in Figure. 1.

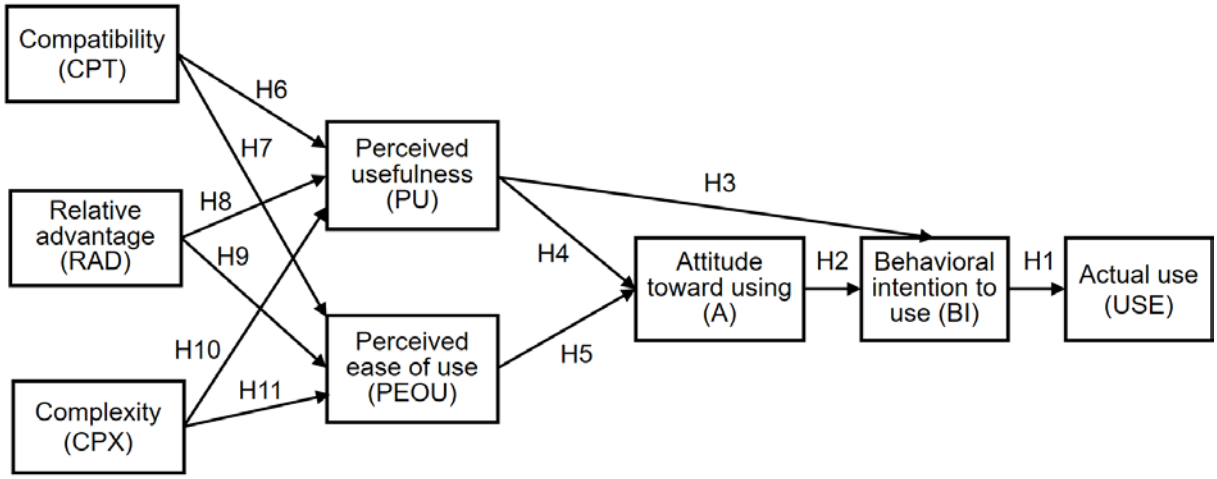

Figure 1: Proposed research model.

FUTURE RESEASRCH

This research will send a survey via e-mail or social network that directed users to a web-based questionnaire to collect data for quantitative testing of the proposed model and the survey regarding the recognition and adoption of blockchain technology among business managers. Because it is difficult to execute a random sampling for all the users using blockchain technology in Taiwan. Thus, in this research we will adopt a non-random sampling technique to collect the sample data. Additionally, because the new blockchain technology is a data-scare domains and in order to generalize results, we will gather sample data from any kinds of blockchain technology using industries, including all private companies and government agencies but not limited to financial institutes in Taiwan. The questions utilized in the questionnaire to operationalize the TAM and IDT constructs included in the proposed model will adapt from the previous research (Moore & Benbasat, 1991; Davis, 1989). All the questions will be translated into Chinese and adjusted in wording in view of the characteristics of the blockchain technology for easy understanding. Most of the items were measured using a five point Likert-type scale, ranging from "strongly disagree" (1) to "strongly agree" (5). The questionnaire will be developed and divided into three parts. The first part of the questionnaire will be to collect the users' basic demographic data, such as age, gender, annual income, educational level,

work experience, prior experience using new technology, etc. The second part of the questionnaire was based on the constructs of PU, PEOU, BI , A, USE in the TAM model and was adapted from the measurement defined by Davis *et al*. and Venkatesh & Davis (Davis, Bagozzi & Warshaw, 1989; Venkatesh & Davis, 2000). The third part of the questionnaire was based on IDT including compatibility (CPT), complexity (CPX), relative advantages (RAD), observability (OB), and trialability (TRI). The above items were adapted from the previous studies (Taylor & Todd, 1995; Davis, Bagozzi & Warshaw, 1989; Moore & Benbasat, 1991; Karahanna, Straub & Chervany, 1999).

REFERENCES

[1] Agarwal, R., Sambamurthy, V., & Stair, R. M. (2000). The evolving relationship between general and specific computer efficacy: An empirical assessment. *Information Systems Research*, *11*(4), 418-430.

[2] Agarwal, R., & Prasad, J. (1999). Are individual differences germane to the acceptance of new information technologies?. *Decision Sciences*, *30*, 361-391.

[3] Bitcoin Developer Guide (2009). Retrieved from https://bitcoin.org/en/developer-guide (20 September 2017).

[4] Carter, L. & Be´langer, F. (2005). The utilization of e-government services: Citizen trust, innovation and acceptance factors. *Information Systems Journa*l, *15*(1), 5-25.

[5] Chang, S. C., & Tung, F. C. (2008). An empirical investigation of students' behavioural intentions to use the online learning course websites' , *British Journal of Educational Technology*, *39*(1), 71-83.

[6] Chau, Y. K., & Hu, J. H. (2001). Information technology acceptance by individual professionals: A model comparison approach. *Decision Sciences*, *32*(4), 669-719.

[7] Chen, L. D., Gillenson, M. L., & Sherrell, D. L. (2002). Enticing online consumers: An extended technology acceptance perspective. *Information and Management*, *39*(8), 705-719.

[8] Condos J., Sorrell W.H., & Donegan S.L. (2016). Opportunities and risks. Technical report on *Blockchain technology*, State of Vermont, USA.

[9] Davis, F D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340.

[10] Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical model. *Management Science*, *35*(8), 982-1003.

[11] Gefen, D. (2004). What makes an ERP implementation relationship worthwhile: Linking trust mechanisms and ERP usefulness. *Journal of Management Information Systems*, *21*(1), 263-288.

[12] Hardgrave, B., Davis, F., & Riemenschneider, C. (2003). Investigating Determinants of Software Developers' Intentions to Follow Methodologies. *Journal of Management Information Systems*, *20*(1), 123-151.

[13] Janusz J. Sikorski, Joy H & Markus K (2017). Blockchain technology in the chemical industry: Machine-to-machine electricity market. *Applied Energy*; *195*, 234-246.

[14] Karahanna, E., Straub, D.W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly*, *23*, 183-213.

[15] Lee, Y. H., Hsieh, Y. C., & Hsu, C. N. (2011). Adding innovation diffusion theory to the technology acceptance model: Supporting employees' intentions to use e-learning systems. *Journal of Educational Technology & Society*, *14*(4), 124.

[16] Lee, Y. H. (2007). Exploring key factors that affect consumers to adopt e-reading services. (Master's thesis, Huafan University, Taiwan).

[17] Legris, P., Ingham, J. & Colerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information and Management*, *40*, 191-204.

[18] Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, *2*(3), 192-222.

[19] Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.

[20] Shih, C. H. (2007) *Integrating Innovation Diffusion Theory and UTAUT to Explore The Influencing Factors on Teacher Adopt Elearning System – With MOODLE as an Example*. (Master's thesis, Dayeh University, Taiwan).

[21] Sigala, M., Airey, D., Jones, P., & Lockwood, A. (2000). The diffusion and application of multimedia technologies in the tourism and hospitality industries. In *Information and Communication Technologies in Tourism 2000* (pp. 396-407). Vienna: Springer.

[22] Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, *6*(1), 144-176.

[23] Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, *1*, 28-45.

[24] Venkatesh, V., & Davis F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186-204.

[25] Wu, J. H., & Wang, S. C. (2005). What drives mobile commerce? An empirical evaluation of the revised technology acceptance model. *Information and Management*, *42*(5), 719-729.