A Proposed Adoption Model for Blockchain Technology Using the Unified Theory of Acceptance and use of Technology (UTAUT)

* Sahar Salem [1], Nor'ashikin Ali [2]

Universiti Tenaga Nasional

Institute of Informatics and Computing in Energy
[1] *dev_sahar@hotmail.com*, [2] *shikin@uniten.edu.my*

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*Corresponding author
dev_sahar@hotmail.com

Abstract

Blockchain technology is a decentralized transaction and data management technology. It is described as a distributed database of records known as public ledger, which contains all the transactions or digital events executed and shared within the participating parties and visible to everyone. Each transaction is verified by consensus of the majority of the participants and once entered, it cannot be erased. The innovation of blockchain technology has proved to be a driving power that gave the industry its next giant leap forward, yet it is still going through slow adoption. Therefore, the purpose of this research is to examine the factors influencing the adoption of blockchain technology using the unified theory of acceptance and use of technology (UTAUT). A conceptual model is developed by extending UTAUT model to include two more constructs which are perceived risk and trust. Further empirical research will be conducted to test and validate the model.

Keywords: *Blockchain Technology Adoption, UTAUT, Perceived Risk, Trust.*

1. Introduction

In 2008, an anonymous group or individual under the pseudonym Satoshi Nakamoto published a paper entitled "Bitcoin: A Peer-To-Peer Electronic Cash System" (Nakamoto, 2008). The paper introduced a peer-to-peer version of an unregulated digital currency, which allows online payments to be sent directly between two parties without going through any third party intermediaries. Bitcoin was the first digital currency created. Blockchain started as the supporting technology that maintains Bitcoin transaction ledger. Blockchain could be defined as a distributed database of records known as a public ledger containing all transactions that have been performed and shared among participating parties (Morkunas, Paschen, & Boon, 2019). Each transaction in the public ledger must be verified by consensus of the majority of the participants. Once entered, information are immutable meaning they can never be erased or changed. The blockchain contains a record of every single transaction ever made.

Blockchain technology have not matured enough in comparison with Bitcoin and cryptocurrencies. There are three generations of blockchain: *Blockchain 1.0* for

* *Corresponding author. dev*_sahar@hotmail.com

digital currency, *Blockchain 2.0* for digital finance and smart contracts, and *Blockchain 3.0* for digital society and applications beyond currency, economics, and markets (Lu, 2018, 2019; Swan, 2015). Blockchain's characteristics include great features such as transparency, robustness, auditability, security, and smart contracts. Smart contracts are computer programs capable of automatically executing the terms of a certain contract when a preconfigured condition in met (Lu, 2019). Such features allow blockchain's potential to go beyond just being a supporting technology for cryptocurrencies; it can extend to non-financial sectors such as Internet of Things, decentralized data storage, notary documents, anti-counterfeit solutions, etc. (Ahram, Sargolzaei, Sargolzaei, Daniels, & Amaba, 2017; Wang, Chen, & Xu, 2016). An example that illustrates how blockchain technology can be used in non-financial aspects is "Alexandria" which is a freedom of speech project built on blockchain technology. The aim of the project is to "create an unalterable historical record by encoding Twitter feeds to a blockchain" (Swan, 2015).

Blockchain technologies offer many opportunities and possibilities to grow entirely new businesses and transform the traditional ones. According to Deshpande, Stewart, Lepetit, and Gunashekar (2017), some of these opportunities include: cost removal, improved transactional efficiency, novel revenues, increased security and data storage, and improved trust. Despite all the potential offered by blockchain, for many years, it went unnoticed by the public overshadowed by Bitcoin and cryptocurrencies. However, recently blockchain technology has been gaining attention as an innovation that could revolutionize the digital world (Casino, Dasaklis, & Patsakis, 2018).

Since Blockchain is perceived as a new technological revolution, it is important to explore what motivates people to invest in it and what drives them to accept it and use it. Therefore, the purpose of this research is to examine the factors influencing the adoption of blockchain technology using the unified theory of acceptance and use of technology (UTAUT).

The remainder of this paper is organized as follows. The literature review of this study is described in the next section. The third section presents the theoretical background. This is followed by the conceptual model and hypothesis in section four. Finally, the paper ends with conclusion.

2. Literature Review

Blockchain technology is still fairly new, but recently, it has attracted attention of researchers around the world who proposed use cases for blockchain technology adoption in various fields such as healthcare, IoT, and supply chain management. In order to be able to determine the success of a new technology, several theories and models have been created to study the factors that affect the decision to accept and use these new technologies such as Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), and the Unified Theory of Acceptance and Use of Technology (UTAUT). Out of these theories, UTAUT has gradually drawn the attention of researchers and has been applied to various studies in different fields such as mobile banking, internet banking, and e-commerce.

A study conducted by Bhatiasevi (2016) attempted to identify the factors influencing the adoption of mobile banking in Thailand and the degree of influence

each one of these factors has. This study also extends the UTAUT model with other constructs such as: perceived credibility, perceived cost, and perceived convenience. For data collection, a three-pronged approach was used which consisted of an extensive review of the literature, a qualitative method through expert interviews, and a quantitative method through a field survey. The findings show that performance expectancy (PE), effort expectancy (EE), social influence (SI) and behavioral intention (BI) to use mobile banking posited a positive relationship which is consistent with the findings of Venkatesh, Morris, Davis, and Davis (2003). From the added constructs to the UTAUT, perceived credibility (PCD) and perceived convenience (PC) had a positive effect on behavioral intention (BI). Also it was found that perceived financial cost (PFC) was not supported for the adoption of mobile banking. Moreover, this study did not find a positive relationship between facilitating conditions (FC) and use behavior (UB) which contradicts with the findings of Venkatesh et al. (2003).

In turn, Martins, Oliveira, and Popovič (2014) conducted a study to understand the main factors of internet banking adoption along with the role of perceived risk. A research model was developed which combines UTAUT with perceived risk to explain behavioral intention (BI) and use behavior (UB) of Internet banking. A survey was used to collect data from Portugal and it resulted in 249 valid respondents. The findings support some relationships of UTAUT, such as performance expectancy (PE), effort expectancy (EE), and social influence (SI), and also the role of perceived risk as a stronger predictor of intention. Finally, contrary to Venkatesh et al. (2003), the effect of facilitating condition (FC) construct from UTAUT over use behavior (UB) was found to be not significant.

In another article by Tarhini, El-Masri, Ali, and Serrano (2016), a revised UTAUT model was also used to investigate the factors that may facilitate or hinder the acceptance and use of internet banking in Lebanon. The research model was developed by extending the UTAUT model to incorporate two additional factors namely: perceived credibility (PC) and task-technology fit (TTF). The data was collected through a quantitative approach based on cross-sectional survey from 408 respondents. It was found that performance expectancy (PE), social influence (SI), perceived credibility (PC) and task-technology fit (TTF) are significant determinant in influencing behavioral intention (BI) to use internet banking, with performance expectancy (PE) being the strongest predictor of behavioral intention (BI). In addition, both behavioral intention (BI) and facilitating conditions (FC) were found to affect the actual use behavior (UB) which supports the findings of the original UTAUT model. However, contrary to the UTAUT, the effect of effort expectancy (EE) on behavioral intention (BI) was found insignificant.

Rahi, Ghani, Alnaser, and Ngah (2018) also conducted a study to understand the factors driving users to adopt internet banking in Pakistan using UTAUT. To collect the data, a quantitative approach based survey was conducted and collected responses from 398 internet banking users. The findings of this study confirmed that all four predictors performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating condition (FC) were significant in predicting users' intention to adopt internet banking. Additionally, it was found that performance expectancy (PE) was the most important factor to predict behavioral intention towards the adoption of internet banking. All of which comply with the findings of UTAUT.

The UTAUT model was also used in the mobile commerce field (m-commerce) to understand the adoption of its related applications and services. Blaise, Halloran, and Muchnick (2018) presented a study to understand the conditions that would facilitate the acceptance of m-commerce. The study investigated users' perceptions of performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating condition (FC) of m-commerce trust and perceived risk and analysed how they affect m-commerce purchase intentions. The data was collected from a total of 165 adult American users of m-commerce through a 7-point Likert scale survey. The study found that performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating condition (FC) of trust and perceived risk in the use of m-commerce provide a significant predictor of m-commerce purchase intentions. The findings are consistent with the findings of UTAUT.

Another example for m-commerce adoption is conducted by Chou, Li, and Ho (2018). The study aimed to investigate the factors that predict users' behavioral intention (BI) to adopt m-commerce in Taiwan. The research model was developed from performance expectancy (PE), effort expectancy (EE) and social influence (SI) from the UTAUT model with the addition of Trust construct, and two of Hofstede's cultural dimensions which are: power distance (PD) and uncertainty avoidance (UA) as moderators for the UTAUT model in order to enhance the understanding of users' intention to use m-commerce. The data was collected through online questionnaires and resulted in 435 valid respondents. The study showed that performance expectancy (PE), effort expectancy (EE), social influence (SI) and trust significantly influence the behavioral intention (BI) to use m-commerce which is consistent with the original findings of UTAUT.

One more study was carried out by Sim et al. (2018) to examine the variables that affect the intention to adopt mobile commerce. The UTAUT model was used in this study which includes the four variables: performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC) and it was further extended to include two additional independent variables which are perceived effectiveness of e-commerce institutional mechanisms (PEEIM) and trust in vendors (TIV). The data was collected through questionnaires and resulted in 278 responses from Kuala Lumpur and Ipoh areas in Malaysia. The result showed that performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), perceived effectiveness of e-commerce institutional mechanisms (PEEIM), and trust in vendors (TIV) all have significant relationship with the intention to adopt m-commerce. The findings comply with the original UTAUT model.

The findings of these studies prove that the UTAUT model is applicable to people of different ages and genders, different levels of experience, and to a wide variety of technologies and innovations, thereby indicating its reliability. Thus, UTAUT provides a solid base and a useful tool in understanding the possibility of success for new technologies and innovations. It also helps to understand what drives users to adopt, accept and use new technologies. Moreover, there is a noticeable gap in the research of users' adoption of blockchain technologies and applications using UTAUT.

3. Theoretical Background

Due to blockchain being in its infancy, it is poorly understood and therefore, it is still going through slow adoption. Past studies mainly focused on studying the factors affecting the adoption of Bitcoin and cryptocurrencies, but neglected the need to explore blockchain technology beyond Bitcoin and the factors that influence the intention to adopt that technology. Recently, researchers have put attempts to conduct studies in the area of blockchain adoption (Kim, Jang, Phuong, & Gim, 2018; Li, 2017). However, these studies only proposed conceptual models with no empirical evidence. Moreover, focusing on UTAUT core factors alone may not be sufficient for the adoption of blockchain technology. Blockchain has been dubbed as "the trust machine" by The Economist (Beck, Czepluch, Lollike, & Malone, 2016), and it was denoted a ''trust-free technology" by Hawlitschek, Notheisen, and Teubner (2018), trust seems to be a key aspect of blockchain technology. Similarly, Crosby, Pattanayak, Verma, and Kalyanaraman (2016) envision that the risks associated with blockchain technology are the reason it is going through slow adoption. Therefore, it is important to study the effect of trust and risk on the adoption of blockchain technology. In this research, trust and perceived risk will be integrated with UTAUT to understand the adoption of blockchain technology.

3.1. Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology (UTAUT) was formulated by Venkatesh et al. (2003) after combining elements across eight different theories and models which are: Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), the Motivational Model (MM), Theory of Planned Behavior (TPB), Combined TAM and TPB (TAM-TPB), Model of PC utilization (MPCU), Diffusion of Innovations Theory (DIT), and Social Cognitive Theory (SCT). The UTAUT model outperforms the eight individual theories and is capable of explaining up to 70% of behavioral intention to use information systems. The model proposed four factors to explain behavioral intention and use of technology. Performance expectancy (PE), effort expectancy (EE), and social influence (SI) have a direct effect on behavioral intention (BI), while facilitating conditions (FC) and behavioral intention (BI) have a direct effect on use behavior (UB). It also introduced four moderators which are: gender, age, experience and voluntariness of use.

3.2. Perceived Risk

Perceived risk has been a common extension of UTAUT (Williams, Rana, & Dwivedi, 2015) and it is considered one of the important factors that affect the intention to adopt new technologies. Peter and Ryan (1976) defined perceived risk as expectations of losses associated with decisions. Similarly, Featherman and Pavlou (2003) defined perceived risk as the possible loss when pursuing a desired result. Perceived risk was also proposed as a two-dimensional structure combined of uncertainty and adverse consequences (Bauer, 1960) and as a multi-dimensional structure consisting of six different types of risks (financial risk, performance risk, social risk, physical risk, security/privacy risk, time risk) (Jacoby & Kaplan, 1972; Lee, 2009). In this research, a multi-dimensional construct will be used. Since the technology does not pose any threat to human life; therefore, physical risk measures were not included, but the rest will be used to represent perceived risk construct.

3.3. Trust

Trust has been receiving attention as a topic of interest for a long time. It has been applied in different research areas such as: e-government (Carter & Bélanger, 2005), e-banking (Reid, 2009), e-commerce (Blank & Dutton, 2012) and blockchain for supply chain transparency (Francisco & Swanson, 2018). In this research, trust refers to trust in technology. Mcknight, Carter, Thatcher, and Clay (2011) proposed trust in technology constructs which are paralleled to the social trust factors of ability, benevolence and integrity from Mayer, Davis, and Schoorman (1995). According to Mcknight et al. (2011), trust in a specific technology is reflected through three beliefs: functionality, helpfulness, and reliability. Functionality refers to the capability, functionality, and features needed to complete a required task. Helpfulness refers to providing adequate and responsive help for users. Reliability refers to reliable, dependable and consistent correct operation. These three beliefs combined reflect the essence of trust in technology. Therefore, they have been adopted to represent the trust construct.

4. Conceptual Model and Hypothesis

Based on the theoretical background, perceived risk and trust will be integrated with the Unified Theory of Acceptance and Use of Technology (UTAUT) to propose the conceptual model for this research. Also, since this is not a longitudinal study, the moderating variable experience will not be included. Moreover, at this point, the use of blockchain is considered voluntary, so the moderating variable voluntariness of use will not be included. The research model is shown in Figure 1.

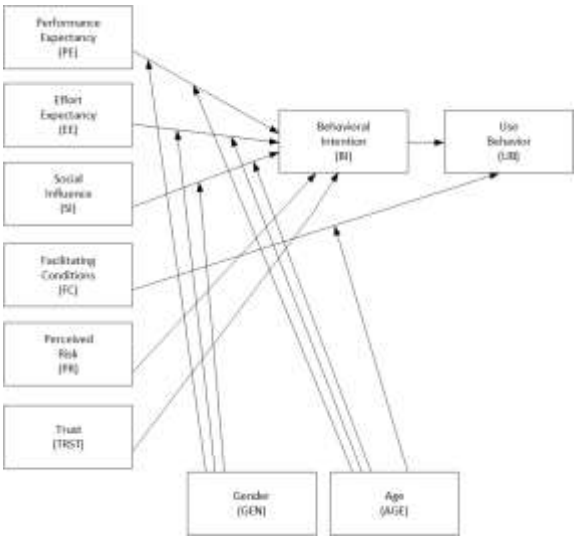

Figure 1. Proposed UTAUT model

4.1. Performance Expectancy (PE) and Behavioral Intention (BI)

Performance expectancy is the degree to which users believe that using blockchain technology will help them to achieve gains and improvements in their job (Venkatesh et al., 2003). Based on the findings of Venkatesh et al. (2003), it is perceived that in this research, people will adopt blockchain technology if they believe it will have positive outcomes. Therefore, it is expected that performance

expectancy (PE) will have a positive influence on behavioral intention (BI). This relationship will be moderated by gender and age, and it is expected that the effect will be stronger for men, especially for younger men. Therefore, the hypotheses are:

H1: Performance expectancy will have a positive influence on behavioral intention.

H2: Gender will positively moderate the influence of performance expectancy on behavioral intention for men.

H3: Age will positively moderate the influence of performance expectancy on behavioral intention for younger men.

4.2. Effort Expectancy (EE) and Behavioral Intention (BI)

Effort expectancy refers to the degree of ease associated with using blockchain technology (Venkatesh et al., 2003). In other words, increased levels of ease of using blockchain should result in increased intention to use it. Additionally, if people find blockchain easy to use, they would be more willing to use it. Thus, it is expected that effort expectancy (EE) will have a positive influence on behavioral intention (BI) (Venkatesh et al., 2003). Also, it is expected that the relationship will be moderated by gender and age, and the effect will be stronger for women, and particularly older women. Therefore, the hypotheses are as follows:

H4: Effort expectancy will have a positive influence on behavioral intention.

H5: Gender will positively moderate the influence of effort expectancy on behavioral intention for women.

H6: Age will positively moderate the influence of effort expectancy on behavioral intention for older women.

4.3. Social Influence (SI) and Behavioral Intention (BI)

Social influence is the degree to which users perceive that important others believe they should use blockchain technology (Venkatesh et al., 2003). The assumption is that people often tend to consult their social network about new technologies and their decisions can be influenced by what others believe to be important. It is expected that social influence (SI) will have a positive influence on behavioral intention (BI). Also it is expected that such influence will be moderated by gender and age. According to Venkatesh et al. (2003), the effect will be stronger for women as well as for younger people. Therefore, the hypotheses are:

H7: Social influence will have a positive influence on behavioral intention.

H8: Gender will positively moderate the influence of social influence on behavioral intention for women.

H9: Age will positively moderate the influence of social influence on behavioral intention for younger people.

4.4. Facilitating Conditions (FC) and Use Behavioral (UB)

Facilitating conditions is the degree to which a user believes that there is an existing organizational and technical infrastructure to support the use of blockchain

technology (Venkatesh et al., 2003). The increased levels of facilitating conditions such as online tutorials, demos, or support chat should lead to lower levels of uncertainty and therefore it should result in increased behavioral intention to use blockchain technology. It is expected that facilitating conditions (FC) will have a positive influence on use behavior (UB). Also, age is expected to have negative effect on the relationship. Therefore, the hypotheses are:

H10: Facilitating conditions will have a positive influence on use behavior.

H11: Age will negatively moderate the influence of facilitating conditions on use behavior.

4.5. Perceived Risk (PR) and Behavioral Intention (BI)

Perceived risk is the degree to which users believe that using blockchain technology causes possible losses (Lee, 2009). It is expected that perceived risk (PR) will have a negative influence on behavioral intention (BI) to use Blockchain Technology. People are known to be resistant to change by nature, they do not like to come out of their comfort zone. Therefore, risks such as security issues or loss of privacy among other challenges may prevent them from embracing new opportunities. Also, since blockchain technology is still new, it comes with many challenges such as lack of proper understanding of what is blockchain (Deshpande et al., 2017) and security and privacy risks (Crosby et al., 2016). Therefore, the hypothesis is:

H12: Perceived risk will have a negative influence on behavioral intention.

4.6. Trust (TRST) and Behavioral Intention (BI)

Trust in this research refers to trust in technology which is the belief that blockchain technology has the necessary attributes needed for it to perform as expected in a certain situation in which negative consequences are possible (Mcknight et al., 2011). It is expected that trust (TRST) will have a positive influence on behavioral intention (BI). Trust has been found to be a significant predictor of behavioral intention by a number of the studies reviewed by Williams et al. (2015). Since trust plays a vital role in the acceptance of new technologies, it is likely that it will be a critical factor due to the novelty of blockchain technology. Therefore, the hypothesis is:

H13: Trust will have a positive influence on behavioral intention.

4.7. Behavioral Intention (BI) and Use Behavior (UB)

Behavioral intention is the degree of users' willingness to use blockchain technology (Venkatesh et al., 2003). It is expected that behavioral intention (BI) will have a positive influence on use behavior (UB) of Blockchain Technology. This was concluded in the findings of Venkatesh et al. (2003). Therefore, the hypothesis is:

H14: Behavioral intention (BI) will positively influence use behavior (UB) of Blockchain Technology.

5. Conclusion

The purpose of this research is to examine the factors influencing the adoption of blockchain technology by using unified theory of acceptance and use of technology (UTAUT) combined with two additional constructs that are considered important to blockchain technology which are perceived risk and trust.

Since there is a significantly limited academic work that focuses on the factors that encourage the successful adoption of blockchain technology, the expected theoretical contribution of this research is that it will enhance the applicability of UTAUT for blockchain technology adoption. In addition, it will provide the finding on the effect of trust and perceived risk to blockchain technology adoption which was not done before. As for the expected practical contribution, the proposed model in this research can be used as a guideline for blockchain users as it provides insight into the factors that motivate people to adopt blockchain technology.

The future work on this research is to provide empirical results to the proposed conceptual model. To test the proposed model, this research will be using the survey method for data collection. All measures will be constructed using previously validated instruments with proper modifications. Finally for the analysis, the model will be tested using partial least squares structural equation modelling (PLS-SEM).

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