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Development of an Adoption Model for Blockchain Technology using the Unified Theory of Acceptance and use of Technology (UTAUT)

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Abstract

Blockchain is a secure record of historical transactions verified by consensus of the majority of the participating parties in the network. Even though the innovation of blockchain technology has proved to be a cutting-edge technology capable of revolutionizing the digital world, it is still going through slow adoption. Therefore, the purpose of this study is to determine the factors that affect blockchain technology adoption using the unified theory of acceptance and use of technology (UTAUT). The research model was developed by integrating two constructs which are perceived risk and trust with UTAUT. Data was collected from 157 respondents and analyzed using the Partial Least Squares Structural Equation Modelling (PLS-SEM). Results revealed that performance expectancy, facilitating conditions, trust and perceived risk had a significant effect on the intention to adopt blockchain with performance expectancy being the strongest determinant of behavioral intention. Also, effort expectancy and social influence were found non-significant.

Keywords; *Blockchain Technology Adoption, UTAUT, Perceived risk, trust, PLS-SEM.*

I. INTRODUCTION

Almost a decade ago, blockchain was proposed by Satoshi Nakamoto, an anonymous group or individual, through a white paper entitled "Bitcoin: A Peer-To-Peer Electronic Cash System" [1]. The paper introduced a technology underlying an electronic currency, Bitcoin, which allows online payments to be directly sent between two parties without involving any third party intermediaries. To put it simply, blockchain is a distributed database that stores all verified transactions grouped in immutable blocks[2-4]. Before it is approved and added to the ledger, each transaction must be verified by consensus of the participants [5].

While blockchain started as the core backbone for the Bitcoin, it soon evolved into a technology that holds a lot of promise for the future of the digital world. Yet, it is still considered in the early stages of its development. Currently, there are three stages of blockchain maturity. The first stage is *Blockchain 1.0,* which is focused mainly on digital currencies such as Bitcoin. The second stage is *Blockchain 2.0,* refers to digital finance and smart contracts. The third stage is *Blockchain 3.0*, which refers to digital society and applications that go beyond currency, economics, and markets [6-10]. This evolution of blockchain technology is facilitated by the great characteristics of blockchain design and architecture such as decentralization, transparency, anonymity, credibility, and smart contracts. Such features are what allow the potential of blockchain technology to expand beyond just being a supporting technology for cryptocurrencies and beyond financial aspects; it can be integrated into non-financial areas such as the healthcare, Internet of Things, supply chain,

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decentralized data storage, anti-counterfeit solutions, etc. [11, 12].

Blockchain technologies promise a lot of exceptional opportunities to grow entirely new businesses or transform the traditionally present ones. According to Deshpande, et al. [13], some of these opportunities include increased and improved security and privacy, cost reduction or removal, and improved trust. Yet, despite all these possibilities, for many years, blockchain technology was overshadowed by Bitcoin. However, recently blockchain technology has been gaining attention. Since blockchain technology is considered new, it is poorly understood and therefore, it is going through slow adoption. Therefore, it is important to examine what motivates people to adopt it. The purpose of this study is to determine the factors influencing blockchain technology adoption using the unified theory of acceptance and use of technology (UTAUT).

The remainder of this paper is organized as follows. The second section presents the research model and hypotheses. The research methodology is in section three and discussion for the analysis results in section four. Section five is the conclusion. Finally, section six covers the limitations and future work.

II. RESEARCH MODEL AND HYPOTHESES

Unified Theory of Acceptance and Use of Technology (UTAUT) created by means of Venkatesh, et al. [14] to consolidate the additives of the 8 fashions of confiscation Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), Motivational Model (MM), Theory of Planned Behavior (TPB), Combined TAM and TPB (C-TAM -TPB) PC utilization model (MPCU), Diffusion of Innovation Theory (DIT), and Social Cognitive Theory (SCT). The version carries 4 thriving middle UTAUT namely: execution of anticipation (PE), electricity expectation (EE), the social effect (SI), and the condition of pushing (FC). Execution anticipation (PE), electricity expectation (EE) and social affects (SI) directly impact the conduct expectancies (BI) and the conditions push (FC) and the behavior of hobby (BI) immediately influences using conduct (UB). In addition, the model presents 4 mediators, particularly: gender, age, understanding and utilization dreams. Model UTAUT beat every of the eight character hypotheses and equipped to expose up to 70% of the behavioral targets.In this study, UTAUT was extended to include two constructs that are considered key elements for blockchain technology: perceived risk and trust. Moreover, blockchain technology is currently considered a novelty and the majority of its implementations are either use cases or in their initial stages and it has not attracted enough attention and awareness yet, therefore, the use behavior variable was not included in this study. Furthermore, due to time and resource constraints and the lack of variation between the adoption intention and actual use resulting from utilizing the moderators [15, 16], this study did not include the moderating variables. Fig. 1.Exhibits the proposed research model.

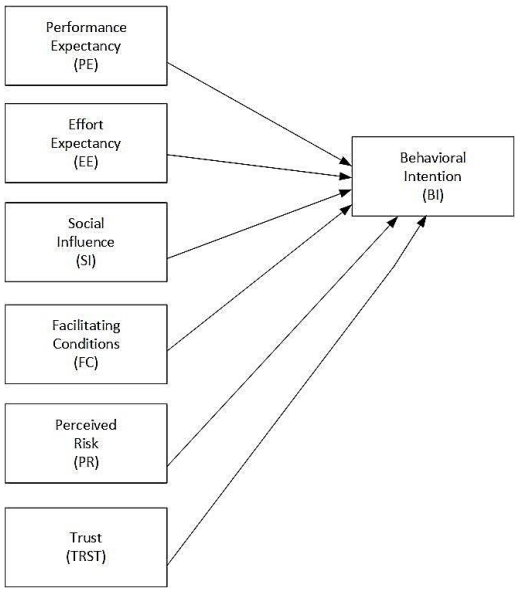

Fig.1. The proposed research model.

2.1 Performance Expectancy (PE) and Behavioral Intention (BI)

Execution hope alludes to how much individuals accept that blockchain innovation will be profitable to them and empower them to improve their activity

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execution [14]. It is seen that individuals will receive blockchain innovation in the event that they accept that it will assist them with accomplishing their objectives. Hence, it is normal that presentation hope (PE) will impact social expectation (BI) [14, 17-20]. In this manner, the theory is:

H1: Performance anticipation (PE) will impact conduct goal (BI).

2.2 Effort Expectancy (EE) and Behavioral Intention (BI)

Effort expectancy is the degree of ease and simplicity associated with using blockchain technology [14]. To put it simply, effort expectancy refers to the effort needed to use blockchain technology, whether it is found simple or complicated. Most people prefer technologies that provide them with flexibility, simplicity, usefulness, and ease of use, so if people found that blockchain technology is effortless, they would be all the more ready to utilize it. In this way, it is normal that exertion hope (EE) will affect conduct goal (BI) [14, 20-23]. In this way, the theory is as per the following:

H2: Effort hope (EE) will impact conduct goal (BI).

2.3 Social Influence (SI) and Behavioral Intention (BI)

Social impact alludes to how much individuals see that the most notable individuals in their group of friends accept they should utilize blockchain innovation [14]. It is expected that individuals for the most part tend to allude to their family, companions and associates about new innovations and their choices may be impacted by the assessments of others. It is normal that social impact (SI) will affect conduct expectation (BI) [14, 17, 19, 20, 22, 24]. Subsequently, the theory is:

H3: Social impact (SI) will affect conduct aim (BI).

2.4 Facilitating Conditions (FC) and Behavioral Intention (BI)

Encouraging Conditions is how much individuals accept that there are authoritative and specialized foundations that help blockchain innovation [14]. For instance, online instructional exercises, demos, or bolster talk would prompt lower levels of vulnerability and in this manner it ought to inspire individuals to utilize blockchain innovation. It is normal that encouraging conditions (FC) will impact social aim (BI) [19, 23, 25-27]. In this way, the speculation is:

H4: Facilitating conditions (FC) will impact conduct goal (BI).

2.5 Perceived Risk (PR) and Behavioral Intention (BI)

Seen chance is how much it is accepted that blockchain innovation could cause potential misfortunes [28]. As per Williams, et al. [29], saw hazard is viewed as a typical expansion to UTAUT and a huge factor that influences the selection of new advancements. While saw chance was commonly estimated as a one-dimensional variable in the writing [30, 31], it was estimated as a two-dimensional structure (vulnerability, unfriendly results) [32] and as a multi-dimensional structure comprising of six distinct kinds of dangers (monetary hazard, execution chance, social hazard, physical hazard, security/protection chance, time chance) [28, 33]. In the extent of this exploration, the physical hazard was excluded since blockchain innovation has no danger to human life, yet the rest of the sorts of dangers were utilized as things to speak to a multidimensional build. It is normal that apparent hazard (PR) will affect social aim (BI). Since blockchain innovation is still in its beginning times, it's as yet experiencing numerous difficulties [13] and dangers [34] which could keep individuals from grasping blockchain innovation. Thusly, the theory is:

H5: Perceived hazard (PR) will affect conduct expectation (BI).

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2.6 Trust (TRST) and Behavioral Intention (BI)

In the extent of this examination, trust alludes to trust in innovation which alludes to the conviction that blockchain innovation has the fundamental attributes that are required for it to proceed true to form in circumstances where negative outcomes are conceivable [35]. Trust in innovation has been picking up consideration as a theme of enthusiasm for quite a while and since it is viewed as a significant factor that influences the reception of new advances, it has been considered in various research zones, for example, e-government [36], e-banking [37], and internet business [38]. It is normal that trust (TRST) will affect conduct expectation (BI). It has been discovered that trust is a significant determinant of conduct expectation (BI) by a few examinations [29]. Because of the oddity of blockchain innovation and since trust assumes an essential job in innovation reception, it is seen that trust will be a basic factor that influences the selection of blockchain innovation. Consequently, the theory is:

H6: Trust (TRST) will impact social expectation (BI).

III. METHODOLOGY

In this investigation, the exploration technique depended on a quantitative methodology. An online poll was managed in March 2019 and a connect to the review was later disseminated through email and through authentic visit gatherings of ACCESS Blockchain Association (Malaysia). A short presentation with a clarification of the examination was introduced toward the start of the poll. A pre-test and a pilot study were led with specialists in blockchain innovation to guarantee survey meaningfulness and to assemble their criticism. For examination of the exploration model, fractional least-square basic condition model (PLS-SEM) system was received. PLS-SEM has increased a lot of acknowledgment in scholastic research and had been applied in various fields [39] and it can oversee both enormous and little example size [40]. In this investigation, SmartPLS (V. 3.2.8) was utilized for information investigation [40, 41]. Fig. 2. Shows ventures for inquire about approach.

Fig. 2.Research methodology steps.

3.1Sample and Data Collection

The examples for this investigation were chosen among the network and individuals from ACCESS Blockchain Association (Malaysia). The members were approached to share the overview interface with their companions and partners. The interest was deliberate and reactions were unknown.The data collection resulted in 157 responses. The largest proportion of the respondents (49.04%) was aged between 31 and 40, followed by those aged between 21 and 30 (33.12%), those aged between 41 and 50 (14.01%) and those aged between 51 to 60 years (3.82%). Also, the respondents were predominantly male which accounts to 96.82% (152 respondents) and only 3.18% (5 respondents) were female. As for the industry that the respondents worked at, Financial Services had 75 respondents (47.77%) and in close proximity Technology/Media/Telecommunications had 73 respondents (46.50%). The remaining respondents were 7 (4.46%) from other industries. Table 1 shows the demographic characteristics of respondents.

Table 1. Demographic characteristics of respondents.

Characteristics		Number	Percentage
Gender	Female	5	3.18%
	Male	152	96.82%
Age	20 or under	0	0%
	21 - 30	52	33.12%
	31 – 40	77	49.04%
	41 – 50	22	14.01%
	51 – 60	6	3.82%
	Over 60	0	0%
Industry	Financial	75	47.77%
	Services	73	46.50%
	Technology/M	0	0%

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	edia/Telecommunications	2	1.27%
	Consumer	0	0%
	Products &	0	0%
	Manufacturing	0	0%
	Health Care	0	0%
	Oil & Gas	0	0%
	Automotive	7	4.46%
	Life Sciences		
	Public Sector		
	Food		
	Other		

3.2Findings

Consequences of the (external) estimation model and the (inward) basic model appraisal and theories testing are introduced underneath.

3.2.1 Measurement Model

Estimation model evaluation includes testing the unwavering quality and legitimacy of the proposed model and its builds. Table 2 introduces the external loadings, Cronbach's alpha qualities, composite dependability (CR) and Average Variance Extracted (AVE) estimations all things considered. To start with, the external loadings were discovered noteworthy and surpassed the worthy edge estimation of 0.7. Second, the Cronbach's alpha was determined and saw as higher than 0.7, the composite unwavering quality (CR) was higher than 0.7 for every one of the builds, and the AVE was seen as more noteworthy than 0.5 which is the adequate edge. Besides, the discriminant legitimacy was estimated utilizing the criteria of Heterotrait-Monotrait proportion (HTMT) as appeared in Table 3. This methodology outflanks the Fornell-Larcker foundation and cross-loadings [42]. The discriminant legitimacy was built up since the adequate levels for the HTMT measure ought to be beneath 0.90 as proposed by Henseler, et al. [42].

Table 2.Measurement model

Construct	Indicator	Factor Loadings	Cronbach's alpha	CR	AVE
BI	BI1	0.983	0.967	0.979	0.939
	BI2	0.938			
	BI3	0.986			
EE	EE1	0.951	0.964	0.974	0.903
	EE2	0.958			
	EE3	0.968			
	EE4	0.925			
FC	FC1	0.873	0.928	0.949	0.824
	FC2	0.955			
	FC3	0.916			
	FC4	0.884			
PE	PE1	0.955	0.959	0.970	0.890
	PE2	0.958			
	PE3	0.960			
	PE4	0.899			
PR	PR1	0.915	0.934	0.950	0.791
	PR2	0.866			
	PR3	0.900			
	PR4	0.826			
	PR5	0.934			
SI	SI1	0.960	0.963	0.973	0.899
	SI2	0.957			
	SI3	0.943			
	SI4	0.933			
TRST	TRST1	0.899	0.948	0.957	0.734
	TRST2	0.913			
	TRST3	0.889			
	TRST4	0.848			
	TRST5	0.859			
	TRST6	0.847			
	TRST7	0.787			
	TRST8	0.804			

Table 3.Heterotrait-Monotrait ratio ($HTMT_{.90}$) analysis.

	BI	EE	FC	PE	PR	SI	TRST
BI							
EE	0.84						

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	0						
FC	0.854	0.855					
PE	0.855	0.871	0.853				
PR	0.455	0.663	0.537	0.599			
SI	0.759	0.859	0.852	0.801	0.560		
TRST	0.769	0.818	0.807	0.763	0.588	0.736	

3.2.2 Structural Model

To evaluate the structural model, the significance of the path coefficients as well as the R Square (R2) should be calculated. Table 4 presents the results of the path coefficients, standard deviations (std. dev.), t-statistics, and p-values. For a hypothesis to be supported, t-values should be greater than 1.96 and p-values smaller than 0.05. EE had no significant effect on BI with values β = 0.138, t-value = 0.657, and p-value = 0.511. Therefore, H2 was not supported. FC had a significant effect on BI with values β = 0.315, t-value = 2.189, and p-value = 0.029. Thus, H4 was supported. Another significant effect of PE on BI was observed with values β = 0.415, t-value = 2.590, and p-value = 0.010 which means that H1 was supported. Also, H5 (PR effect on BI) was supported with values β = 0.139, t-value = 2.078, and p-value = 0.038. The effect of SI on BI was found non-significant with values β = -0.024, t-value = 0.223, and p-value = 0.823 which means that H3 was not supported. Finally, TRST had a significant effect on BI with values β = 0.188, t-value = 2.173, and p-value = 0.030. Therefore, H6 was supported. Finally, the proposed model explained 77 percent of the variance in BI as shown in Table 5. According to Henseler, et al. [43], R^2 values larger than 0.75 represent a substantial model. Therefore, based on the results the model is reliable and substantial.

Table 4.Path coefficients and hypothesis.

Hypothesis	Path coefficients	Standard deviations (std. dev.)	t-statistics	p-values	Supported
EE -> BI	0.138	0.210	0.657	0.511	No
FC -> BI	0.315	0.144	2.189	0.029	Yes
PE -> BI	0.415	0.160	2.590	0.010	Yes
PR -> BI	0.139	0.067	2.078	0.038	Yes
SI -> BI	-0.024	0.107	0.223	0.823	No
TRST -> BI	0.188	0.087	2.173	0.030	Yes

Table 5.R-square (R^2) results.

Dependent Variable	R Square	R Square Adjusted
BI	0.779	0.770

IV. DISCUSSION

The motivation behind this examination is to analyze the variables that influence the reception of blockchain innovation. In this examination, the UTAUT model was reached out to incorporate two key components for blockchain innovation reception which are: saw hazard and trust. The outcomes uncovered that the fluctuation in social aim was 77.0 percent. It likewise uncovered that exhibition hope significantly affected the conduct expectation to receive blockchain innovation which is reliable with the discoveries of Venkatesh, et al. [14] and some different investigations in various fields [17-20, 44]. Additionally, encouraging conditions significantly affected conduct expectation which was bolstered by past examinations [19, 23, 25-27]. Concerning the extra builds, it was discovered that trust impacted the conduct expectation to embrace blockchain innovation which well contrasts and recently revealed discoveries of different investigations that

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incorporated different kinds of trust with UTAUT [17, 23, 44, 45]. Like recently yielded outcomes, it was discovered that apparent hazard additionally significantly affected the social expectation to receive blockchain innovation [18, 20, 24]. In addition, steady with the discoveries of Venkatesh, et al. [14], it was discovered that performance expectancy is the strongest determinant of behavioral intention. Surprisingly, the results revealed that both effort expectancy and social influence had no significant effect on behavioral intention which contradicts with the findings of Venkatesh, et al. [14]. Yet, effort expectancy was found insignificant in other studies [18, 45, 46] as well as social influence [21, 45]. For the effort expectancy, it is not considered important for users of blockchain technology due to the fact that it is believed that ease of use becomes less important compared to performance, facilitating conditions, trust, and perceived risk when making the decision to adopt blockchain. As for the social influence, it seems that since blockchain technology is still a relatively new topic and it only started attracting attention quite recently, the decision to adopt it is not reliant on one's social circle (i.e. family, friends, colleagues, coworkers). An interesting finding in this aspect is that social influence negatively affects behavioral intention. In other words, it means that social influence did not give positive impact for users in making the decision to adopt blockchain.

From a theoretical perspective, this study contributes to the literature by utilizing the UTAUT model to understand the adoption of blockchain technology and it also proposes two new constructs, namely perceived risk and trust, which are considered important for blockchain technology adoption.

In practice, the findings of this study bring insight for those planning to adopt blockchain technology. The results indicate that the successful adoption of blockchain technology depends on several points. First, the knowledge that the technology is beneficial.Second, the availability of support infrastructures to help users when needed. Third, the trust that the technology would be reliable, dependable and would have the necessary characteristics to perform as expected. Finally, fewer risks and losses associated with the technology result in higher chances for successful adoption.

V. CONCLUSION

This investigation adds significant exact proof to the writing on blockchain innovation reception. In this investigation, the proposed model depended on the UTAUT model with the expansion of outer variables that are accepted to be huge for blockchain innovation so as to look at the components that influence its reception. The investigation was done utilizing PLS-SEM approach, and the acquired outcomes demonstrated that the proposed model is solid and generous. From the outcomes, it tends to be seen that exhibition hope, encouraging conditions, saw hazard and trust affected the goal to receive blockchain innovation. Be that as it may, exertion hope and social impact had no huge effect on conduct goal. At last, this examination recommends that there is a genuine need to lead increasingly broad research on blockchain innovation appropriation.

VI. LIMITATION AND FUTURE WORK

This examination has a few confinements that should be tended to later on. To begin with, the model considered two extra develops to help clarify blockchain innovation selection. Future investigations may consider broadening the model by incorporating distinctive blockchain related builds or diverse innovation appropriation hypotheses. Second, this examination included neither the utilization conduct build nor the arbitrators which ought to be considered in future research. Third, this investigation had a little example size. This constraint might be relieved in future research. At last, this investigation utilized PLS-SEM to dissect the information. For future research, various procedures could be utilized.

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