The Adoption of Blockchain in Supply Chain: Is Supply Chain Ready?

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***Abstract*— Recently, blockchain technology is getting its recognition in the supply chain. After the existence of bitcoin, which blockchain acts as its underlying technology, people started to recognise the advantages of the blockchain. Blockchain has been expected to eliminate unnecessary cost and at the same time, help in improving productivity by increasing the efficiency and effectiveness in daily operation. In the era of Industrial 4.0, the collaboration of blockchain technology with other autonomous technology is necessary to achieve customer satisfaction. However, based on the current practices, blockchain is yet to be adopted by all the parties in the supply chain. Therefore, this paper aims to identify the factors which are affecting the adoption of blockchain technology in the supply chain. Factors identified are perceived benefits, top management support and supply chain partner readiness. The primary data has been collected through a structured questionnaire survey. The simple random sampling method has been used to target and collect data from suitable respondents. In conclusion, the outcome of this study is expected to identify the factors affecting the adoption of the blockchain as well as to guide the organisation to act according to increase the level of adoption.**

***Keywords*—** *blockchain, perceived benefits, top management support, supply chain partner readiness*

1. Introduction

Recently, blockchain technology is getting its recognition in the supply chain. After the existence of bitcoin, which blockchain acts as its underlying technology, people started to recognise the advantages of the blockchain. Blockchain has been expected to eliminate unnecessary cost and at the same time, help in improving productivity by increasing the efficiency and effectiveness in daily operation. In the era of Industrial 4.0, the collaboration of blockchain technology with other autonomous technology is necessary to achieve customer satisfaction. However, based on the current practices, blockchain is yet to be adopted by all the parties in the supply chain. Therefore, this paper aims to identify the factors which are affecting the adoption of blockchain technology in the supply chain. Factors identified are perceived benefits, top management support and supply chain partner readiness. The primary data has been collected through a structured questionnaire survey. The simple random sampling method has been used to target and collect data from suitable respondents. In conclusion, the outcome of this study is expected to identify the factors affecting the adoption of the blockchain as well as to guide the organisation to act according to increase the level of adoption.

2. Literature Review

2.2 Technology Acceptance Model (TAM)

Past decades, TAM has been commonly used in a previous research paper which related to Blockchain technology in various industries such as banking and supply chain [1,2]. TAM was proposed by Davis, which then be used to explain and investigate the factors of technology acceptance in a variety medium [3]. According to Davis, there are two factors which are perceived usefulness and perceived ease of use [4]. Perceived value has been defined as an individual's perception towards a technology's ability to improving their job performance which then caused an indirect effect towards his technology acceptance. Perceived ease of use means that how effortless an individual can be after adopting a particular technology [5,6].

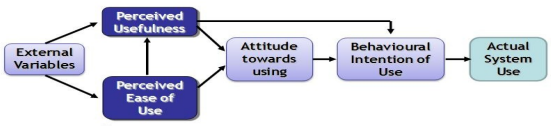

Figure 1: Technology Acceptance Model (Davis, 1989)

2.3 Compatibility

Compatibility is defined as the extent to which new technology or innovation fits the potential adopter's existing values, current needs as well as previous practice [7]. Besides, according to Calisir, Gumussoy, & Bayram, compatibility is defined as

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the degree to which innovation is perceived to be consistent with the potential users' existing values, previous experiences and requirements [7]. For instance, the feelings of familiarity for new technology can result from various aspects such as individual experiences and working practices [8]. Therefore, according to Roger in [3], the higher the familiarity of an individual towards new technology, the higher the compatibility and the lower the uncertainty. Besides, Other than existing values, previous experiences and requirements, compatibility also takes into account whether behavioural patterns and experiences of organisations and its employees are consistent with an innovation or technology [8,9]. According to Karahana, Agarwal, & Angst, the concept of compatibility can be reconstructed and enhance by categorizing its content into four different and separable constructs as the following [10]:

i. Compatibility with preferred work style
ii. Compatibility with existing work practices
iii. Compatibility with prior experiences
iv. Compatibility with values

2.4 Organisation Readiness

According to Ramdani, Kawalek and Lorenzo [11], organisation readiness can be defined as the availability of the organisation resources for technology adoption [8]. Besides, Wraikat, Bellamy and Tang, also said that organisation readiness could be described as an organisation have a certain degree where an organization have the resources, commitment, awareness and governance to adopt a particular system [12]. Therefore, organisation readiness has been separated into two, which is financial readiness and technology readiness. Financial readiness is known as the financial resources which the organisation need to invest in the new technology. According to Ramdani, Kawalek, & Lorenzo [11], Cost of implementation and lack of technology readiness has always been the factors which affected those small organisations from adopting new technology. Therefore, the resources readiness that mentioned here is the organisation's ability to support the implementation of the latest technology. Furthermore, technology readiness has included technology infrastructure and technology experts in the organisation. Technology infrastructure and sufficient technology experts have been the factors which affected the adoption of technology because if these factors are unable, it will affect the technology capacity of the organisation to invest in new technology [13].

2.5 Competitive Pressure

According to Harfoushi et al. [14], competitive pressure defines as the degree of influence which an organisation can adapt to the competition among the competitors in the same industry. Besides, Gibbs [15] also mentioned that competitive pressure is also known as external pressure which has been identified as one of the factors which affected technology adoption. Technology adoption has always been one of the strategies which are necessary to compete among the competitors. And at the same time can increase the organization efficiency level [13]. Therefore, when an organisation start to implement an innovation, the organisation itself able to alter the rules of competition. Hence, innovation will affect the structure of the industry. At the same time, the competitive landscape will be changed by leverage the new ways to outperform rivals [16]. As an intense competition will constrain an organisation's access to the external finance whereby it might influence the organisation's investment as well as the financial decision. When the organisation faced a high financial risk, it will respond by net equity increase, the balance of augmenting cash and investment reduced. This showed that competitive pressure affects that organisation's financial decision making where it will affect the organisation's access to financing [13,16]

2.6 Technology Adoption

According to Rogers in [3], adoption is a decision which the innovation has been fully utilized for the best outcome, while rejection is known as a decision which the change is not to be adopted [16].Therefore, according to Barahm et al. [17], the diffusion and adoption of technology not only contributed in the economic development of a country but also assist in closing the financial gap between a lesser country which has a technology disadvantage. However, when coming to the factors which affected the adoption of technology in the organization, top management tends to ignore or direct or indirect factors which affect the process. As there are a variety of factors which will affect the decision of adopting new technology in the organisation, those potential factors had then be classified into five broad categories which are task-related, individual, organisational, innovation-

related and environment. So, the different level of technology adoption and the capabilities of integration have then caused the gaps between the organisation in the supply chain management [11, 16, 17].

3 Methodology

3.1 Research design

This research is conducted based on the non-contrived setting, where researchers have the minimum influence power on the subjects. The approach used in this study is the quantitative approach. The unit of analysis in this study is individuals who work in the organisation within Malaysia's supply chain. Due to time constraints, cross-sectional studies are carried out in this research. A correlation study will be carried out to identify the relationship between predictor variables (compatibility, organisation readiness and competitive pressure) and a criterion variable (adoption of blockchain in the supply chain).

3.2 Sampling method and collection method

According to Krejcie and Morgan[18], the sample size of this study is 384 individuals. However, only 151 usable responses were collected from 320,778 prospect respondents due to time constraints. According to Hair et al. [19], the desired level for sample size is between 15 to 20 observations per independent variable. Hence, 151 responses are considered reliable. The sampling method used is simple random sampling. The findings of the survey show that 58.9% of the respondents' organisation size of fewer than 501 employees, while 41.1% from an organisation with more than 2000 employees.

Further, the majority of the respondents (58.2%) are from organisation establish since the year 2000. A structured questionnaire is used to obtain data from individual working in the supply chain. An online survey is distributed through e-mail, LinkedIn and Facebook to all the individuals working in the supply chain to collect respondent's opinion.

3.3 Measurement scale

The construction of a questionnaire is adopted from previous research authors. A 7-point Likert-type scale is used to indicate the degree to which respondents will intend to adopt blockchain in the supply chain. The response choice ranged from 1 (strongly disagree) to 7 (strongly agree).

3.4 Data analysis

The reliability test was carried out to identify the internal consistency reliability. A high Cronbach's alpha value will indicate high internal consistency reliability (the study had 0.80 alpha value). Then, the Pearson correlation tested the strength between predictor variables (compatibility, organisation readiness and competitive pressure) and a criterion variable (adoption of blockchain in the supply chain). And, multiple regression analysis executed to identify whether there is a significant relationship between predictor variables and criterion variables.

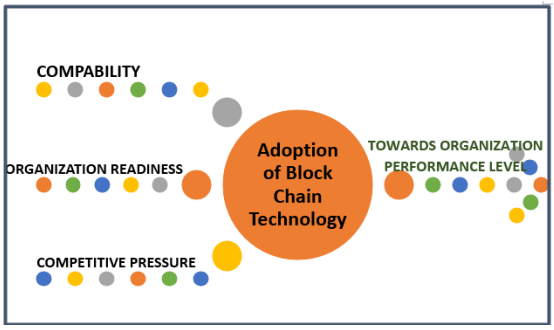

Figure 2: The research framework of adoption of blockchain in the supply chain

3.5 Research Hypothesis

H_1: There is a relationship between compatibility (CPB) and adoption of blockchain (ADB) in the supply chain.
H_2: There is a relationship between organisation readiness (ORG) and adoption of blockchain (ADB) in the supply chain.
H_3: There is a relationship between competitive pressure (CPR) and adoption of blockchain (ADB) in the supply chain.

4 FINDINGS AND DISCUSSIONS

Table 1. Correlations between constructs and scale reliability values

Variable	Number of Items	Mean	Standard Deviation	CPB	ORG	CPR	ADB
CPB	5	4.7007	0.86282		0.697**	0.413**	0.528**
ORG	5	4.6755	1.00896	0.697**		0.498**	0.663**
CPR	5	4.8159	0.89548	0.413**	0.498**		0.608**
ADB	5	4.8649	0.98700	0.528**	0.663**	0.608**	

****. Correlation is significant at the 0.01 level (2-tailed)**
a CPB – Compatibility, ORG – Organisation readiness, CPR – Competitive Pressure, ADB – Adoption of Blockchain in Supply Chain

Descriptive analysis has been carried out to explain the background and demographics of our respondent based on the frequency and percentage. Initially, all the variables in the study were tested using Cronbach's Alpha and showed the reliability value is higher than 0.7, which means that all the variables are reliable and can be used in this study. This research objective is to examine the relationship between compatibility (CPB), Organisation readiness (ORG), competitive pressure (CPR) and adoption of blockchain in the supply chain (ADB). The correlations between constructs and scale reliability values are presented in ***Table 1***. Findings from ***Table 1*** shows that only two predictor's variables are significantly correlated to the adoption of blockchain in the supply chain which is organisation readiness which r = 0.663 and competitive pressure which r= 0.608, both p < 0.05). However, there are no significant relationship shows between compatibility and adoption of blockchain in a supply chain because of p= 0.299, which p> 0.05. The strongest correlation was found between organisation readiness (ORG) and the adoption of blockchain in the supply chain (ADB).

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std Error of the Estimation
1	0.738[a]	0.545	0.536	0.67236

a. Predictors: (Constant), CPR, CPB, ORG
b. Dependent Variable: ADB

Table 3: ANOVA & Coefficient table

ANOVA						
Model		Sum of Square	Df	Mean Square	F	Sig
1	Regression	79.671	3	26.557	58.746	0.000[b]
	Residual	66.453	147	0.452		
	Total	146.124	150			
Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.558	0.358		1.560	0.121
	CPB	0.093	0.089	0.081	1.043	0.299
	ORG	0.417	0.080	0.426	5.203	0.000
	CPR	0.399	0.071	0.362	5.610	0.000

a. Dependent Variable: ADB
b. Predictors: (Constant), CPB, ORG, CPR
c. CPB – Compatibility, ORG – Organisation readiness, CPR – Competitive Pressure, ADB – Adoption of Blockchain in Supply Chain

This result provides preliminary support with the alternative hypothesis that organisation readiness and competitive pressure have a significant relationship with the adoption of blockchain in the supply chain. This is consistent with the previous findings indicating organisation readiness [21, 16-18] and competitive pressure [19-20] are significant predictors towards the adoption of blockchain in the supply chain. However, there is the previous study which indicates that compatibility does not have a significant relationship with adoption of blockchain in the supply chain [2, 8, 12]. The findings of the multiple regression analysis are presented in ***Table 2***. The results indicate that this hypothesis of this study is statistically significant, $R^2 = 0.545$, adjusted $R^2 = 0.536$, $F(3,147) = 58.746$, $p < 0.05$) which means that 58.746% of the variance in adoption of blockchain in supply chain is explained by the predictors variables (CPB, ORG, CPR). The hypothesis of this study compatibility with acceptance of (H_1), organisation readiness (H_2) and competitive pressure (H_3) are related to the adoption of blockchain in the supply chain.

Moreover, based on ***Table 3 - ANOVA***, the regression model was statistically significant ($R^2 = 0.545$, $F(3,147) = 58.746$, $p < 0.05$). By referring to ***Table 3 – Coefficient table***, organisation readiness ($\beta = 0.426$, $p< 0.05$) shows a positive relationship which indicates that the higher the level of organisation readiness, the higher the intention to adopt blockchain in the supply chain. Competitive pressure was positively related to the adoption of blockchain in the supply chain ($\beta = 0.362$, $p<0.05$) which shows that the higher the competitive pressure, the higher the intention to adopt blockchain in the supply chain. Lastly, compatibility ($\beta = 0.081$, $p>0.05$) shows no significant relationship with the adoption of blockchain in the supply chain which means that compatibility of blockchain technology will not affect the intention of blockchain adoption in the supply chain similar to [20]. These findings have supported H_2 and H_3 but have rejected H_1. Therefore, findings in this research have suggested that the organisation more likely to adopt blockchain in the supply chain if there is a high level of organisational readiness and competitive pressure [16]

5 CONCLUSIONS

This study has proven that the two factors, which are organisation readiness and competitive pressure, have positive relationships towards the adoption of blockchain in the supply chain. In contrast, compatibility does not have any link towards the adoption of blockchain in the supply chain. Hence, we can say that the objectives of this research are accomplished in investigating the factors affecting the adoption of blockchain in the supply chain. As blockchain has the enormous potential to disrupt the supply chain, therefore, the collaboration between government and industry giants to organise programmes is needed to allow people to understand more about the benefits and use case of blockchain in the supply chain. However, there are some limitations of this study, such as time constraints and limited knowledge information towards blockchain technology. Thus, respondents' opinions towards blockchain adoption might or might not different in future. Hence, future research is encouraged to test with a larger sample size as well as other possible variables

items to extend this study. In a nutshell, hopefully, this study not only can be a guideline for future research but also for the organisation to understand more about their partners' concern before adopting blockchain in their operation to achieve customer satisfaction.

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