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Assessing the General Sentiment of Malaysian Manufacturers in Adopting Blockchain Technology to Improve Supply Chain Processes

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ABSTRACT

The popularity of blockchain technology has seen a dramatic increase throughout the year of 2021 and 2022, with numerous use cases in various global industries. This includes the use of cryptocurrencies, non-fungible tokens, decentralized autonomous organizations, and others. In Malaysia, there is also an apparent increase in general awareness towards the technology, with Bank Negara Malaysia and Securities Commission actively participating in the Committee for Blockchain and Distributed Ledger Technology. This study specifically examined at the Malaysian manufacturing industry, attempting to assess their general sentiments towards blockchain technology and how it could help to improve various supply chain processes. The quantitative study received 114 valid responses from management level employees with Malaysian manufacturers, enabling the researchers to assess the task technology fit, perceived ease of use (PEOU), perceived usefulness (PUSE), and technology readiness index (TRI). The analysis indicated that there is indeed a high task technology fit in the Malaysian manufacturing sector. In addition, this industry showed a positive sentiment towards blockchain technology, with high scores in PEOU, PUSE, and TRI. The high TRI numbers also had a positive significant relationship on the decision to adopt this technology within the manufacturing companies to improve various supply chain processes.

1. Introduction

The Malaysian government has acknowledged the importance of blockchain and distributed ledger technology. Several Malaysian agencies such as Bank Negara Malaysia and Securities Commission have undertaken key roles in the country's initiatives towards blockchain adoption since 2015 [1]. Malaysia is also one of the founding members of the Committee for Blockchain and Distributed Ledger Technology (DLT), in tandem with the ISO/TC 307 level initiative.

In 2017, government agencies such as Malaysia Digital Economy Corporation (MDEC), the Ministry of Science, Technology and Innovation, Ministry of International Trade and Industry, Malaysian Communications and Multimedia Commission, and others formed the National Mirror Committee on Blockchain and DLT together. Fast forward to 2019, these initiatives continued to

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develop with the support of international blockchain communities such as Ethereum and NEO. As the technology continues to develop, there are already many applications available for Malaysia's mature manufacturing industry to leverage on. However, most of the current industry practitioners are yet to implement this technology. This phenomenon could be due to several factors such as technical uncertainties, lack of talent and cost concerns.

Given that the government has been encouraging Malaysian manufacturers to enhance their processes, and that blockchain technology promises many benefits, studies should be conducted to take a step closer to technology adoption. This study aims to understand the current industry perception towards this technology, the match with current blockchain applications, and the potential for them to implement the technology in the near future.

2. Literature Review

2.1 Blockchain Technology

Business Insider defines blockchain technology as a ledger or database that maintains a list of transactions and data records that is continuously growing [2]. This digital database stores information in blocks in a chronological manner, where no intermediary can interfere with its transactions. The decentralized and distributed manner of this database storage has since attracted many entities to explore the utilities that it can bring.

There is a growing level of importance for companies in various industries to understand the technology and its implications on the traditional business model. Despite the boom in the cryptocurrency market, blockchain technology can have great potential beyond the world of finance [3]. As the world continues to merge the physical and the digital space, blockchain technology can be applied in any area where visibility and traceability is important. For instance, buyers and sellers within the luxury goods industry can soon collaborate in a more secure, auditable, and virtual manner.

On a retail level, blockchain adoption is still in its infancy. Only around 3.1% of Malaysians own cryptocurrency, but this number is expected to grow [4]. To date, the technology is often associated with cryptocurrencies and non-fungible tokens (NFTs). However, its transparency and cost effectiveness are beginning to alter several industries such as the medical and finance sectors [5].

The core technology to make this possible is cryptography and encryption, ensuring that all transactions are recorded without the risk of tampering [6]. Ideally, a widespread use of the technology can improve ownership arguments, supply chain management, and other applications. Theoretically, blockchain technology should have a profound impact on manufacturing processes such as streamlining processes, product tracking, supply chain visibility, and others [7]. For instance, manufacturers have to move raw materials and finished goods between different countries on a regular basis. Based on Rejeb et. Al. [8], the technology can also improve trading relationships and facilitate product provenance across the supply chain.

In recent months, companies from various industries have been actively exploring this space. This includes fashion brands such as Gucci and Adidas, banks like HSBC and Deutsche Bank, financial services institutions like Visa and Mastercard, technology companies like Google and Meta, and logistics companies like Maersk and DHL. While there are many prominent use cases for the technology such as cryptocurrencies, decentralized autonomous organizations (DAOs), non-fungible tokens, and many more [9], this study will look specifically at using blockchain technology for data storage, remittance, and product traceability within the manufacturing sector in Malaysia.

2.2 Malaysian Manufacturing Scene

The manufacturing sector is one of the most important sectors in the Malaysian economy, contributing 22.7% to the gross domestic product, making it the second largest business sector in Malaysia [10]. After the pandemic-ridden years of 2020 and 2021, Malaysia is experiencing rapid recovery in 2022. As a country, the 2021 manufacturing output was $87.55B, a 16.61% increase from 2020.

According to [11], the country has registered an increase of 8.5% in Q1 2022 compared to the previous years. Nevertheless, the duo mentioned that the use of legacy systems and manual processes are putting the sector at a disadvantage. Therefore, more research needs to be conducted on technological advancements and implementation within the sector.

The manufacturing sector in Malaysia can be split into various industries, with food, beverage and tobacco taking the top spot (15%), then chemicals (13%) and fabricated metals (11%) closely behind. Other industries include plastics, electrical and electronics, machinery, transportation, non-metallic minerals, paper, medical, textile, wood, furniture, office materials, and others [12].

When it comes to manufacturing, it is no secret that China leads the industry on the global stage. However, Malaysia has proven to be competitive in several areas such as food, semiconductors, and glove manufacturing. Currently, the Malaysian government is encouraging the manufacturing sector to upgrade their capabilities through incorporation of technological advancements and hiring skilled labor [10]. Evidently, several government agencies have played their role in pushing for this initiative. For instance, the Malaysian Investment Development Authority (MIDA) has approved a total of RM195.1 billion and created more than 70,000 jobs in 2021 [13].

2.3 Task Technology Fit

The task technology fit is the underlying theory for this study. This theory describes the compatibility between a given technology and the task or process to be completed. It consists of three essential components, the task to be completed, the people involved with completing the task, and the technology to be used to complete the task [14]. Similarly, this study aims to examine if the Malaysian manufacturers and their current operations can utilize blockchain technology to improve their manufacturing processes. Therefore, the first section of the questionnaire requires the respondents to share information regarding their annual revenue, data storage, remittance, and number of employees and suppliers.

Basically, the user will evaluate the task technology fit by looking at the task itself and the characteristics of the technology, with regards to how much the technology can potentially aid in completing the task. This evaluation can be affected by various factors such as quality, compatibility, authorization, locatability, systems reliability, timeliness, relationship with users, and ease of use [15]. The task technology fit has been used in various studies involving knowledge work, team performance, education, managerial decision making, and many others [16].

2.4 Technology Acceptance Model

This study will use the technology acceptance model (TAM) to examine the various factors that influence the acceptance of blockchain technology by Malaysian manufacturers. Back in 1986, Fred Davis developed the technology acceptance model to examine how and when users will use a certain piece of technology that is being presented to them [17]. Ideally, TAM should be able to explain the users' attitude towards the technology, their intention to use it, and whether they will eventually use

the technology. According to [18], two of the most important elements to this model are perceived ease of use and perceived usefulness. Together, they should explain why people accept or reject a certain technology.

Firstly, perceived usefulness refers to the users' perception of how much a piece of technology can improve their job performance. If it can help to perform the task better, the chances of accepting it may be higher. Ideally, using this technology should be free of effort [18]. Within the context of this study, high perceived usefulness is where the employees believe that blockchain technology can improve the supply chain processes in their respective manufacturing companies. This popular model is backed by several theories such as the self-efficacy theory and the cost-benefit paradigm.

Next, perceived ease of use refers to the users' perception of whether a particular piece of technology is easy to use. If it is too difficult to learn or use, then the effort taken to adopt the technology may not be worth the collective benefits that the technology may potentially provide [18]. Within the context of this study, the perceived ease of use that blockchain technology can provide towards various manufacturing processes should affect the likelihood of technology acceptance and eventual adoption. In this case, the implementation should be free of effort and have minimal transition complexity. Complete technology acceptance cannot only factor in the ease of use/implementation but needs to factor in how much this technology can enhance the processes in the company.

Therefore, this study aims to understand the perceived usefulness and perceived ease of use of blockchain technology from the perspective of the Malaysian manufacturers. Based on the above literature review, the below hypotheses have been formulated:

H1: There is a good fit between the Malaysian manufacturing sector and blockchain technology.

H2: Malaysian manufacturers perceive blockchain technology to be useful.

H3: Malaysian manufacturers perceive blockchain technology to be easy to use.

2.5 Technology Readiness Index

The technology readiness index (TRI) is often used to measure and understand the propensity of users to use advanced technology for various purposes [19]. This theory understands that technological advancements can bring many benefits to an organization but at the same time can bring high stress and frustration levels to users within the organization. Therefore, Parasuraman [20) has developed a scale to measure the readiness of the respondents to embrace a given technology.

Besides perceived ease of use and perceived usefulness, the technology readiness index is an important measure as to whether the company is likely to adopt a given technology. While the technology acceptance model indicates how users perceive a certain technology, it does not consider the latter intention of implementation. Within the context of this study, users that perceive blockchain technology to be useful and easy to use may not be ready to implement the technology just yet. Therefore, this study will incorporate both the technology acceptance model and technology readiness index.

When using the TRI, researchers often seek information from 4 basic aspects, the optimism towards a certain new technology, the innovativeness of the user, the degree of discomfort that the technology will reduce the overall control the user has over the process, and the insecurity stemming from the users' confidence in handling the technology. Evidently, the TRI has a good balance of 2 positive drivers and 2 negative inhibitors to technology adoption.

3. Methodology

This research adopts a quantitative approach which utilizes a questionnaire to collect data from respondents. The target respondents only include owners of Malaysian manufacturing firms or management team personnel. This study will not include micro enterprises. The rationale is to ensure the respondents have enough knowledge and are capable of answering the questionnaire items on behalf of the organization. A group of enumerators were trained to execute the questionnaire survey. All responses were kept anonymous and confidential details from all respondents were not reported or exposed.

A structured questionnaire was prepared for the purpose of data collection. The questionnaire begins with an information survey sheet, explaining the purpose of the research and assurance that confidentiality of the information will be handled with the utmost priority. Following which, the questionnaire was split into 5 sections. The first section includes the profile of the respondents, understanding the demographics and nature of business. Section B attempts to understand the respondents' perception of the blockchain technology, regarding perceived ease of use (PEOU) and perceived usefulness (PUSE). Section C will collect information on the respondents' technology readiness index (TRI). Lastly, Section D attempts to understand the probability that these firms will adopt blockchain technology soon.

Prior to the main survey, a pre-test was conducted with 5 subject matter experts to test the content validity of the questionnaire items. After the pre-test, several items were amended after considering the recommendations from these experts. Following which, a pilot test was carried out with 25 respondents to test the reliability of the questionnaire. After that, the main survey was carried out.

The results of the survey were analyzed using SPSS and SmartPLS. SPSS was used to evaluate the response rate, identify missing values and outliers, evaluate data normality, test for common method variance, and obtain the descriptive statistics of the respondents. The data was then exported to SmartPLS to evaluate the measurement model and structural model. The measurement model evaluation includes checking the reliability and validity of the measurement model, whereas the structural model evaluation is used to understand the relationships between the constructs.

Finally, the results were used to test the hypotheses to draw insights and conclude the study.

4. Results

4.1 Descriptive Analysis

A total of 114 valid responses were collected and entered SPSS to run the descriptive analysis. The respondents come from a variety of manufacturing industries, with the largest group being food and beverage at 17.5%, metal at 15%, and petroleum, coal, chemicals, and plastics at 15%. 30/114 respondents have less than 50 employees, 45 have between 51 to 100 employees, 27 have between 101 to 500 employees, and 12 of them have more than 500 employees. Table 1 shows PEOU, PUSE and TRI statistics.

Table 1
PEOU, PUSE and TRI statistics

Constructs	Survey items	Mean	Skewness	Kurtosis
PEOU	We should be able to easily adopt blockchain technology.	3.947	-0.311	-0.989
	We should be able to get what we want the technology to do for us.	4.026	-0.647	-0.490
	We expect the interaction with the system to be clear and understandable.	4.342	-1.179	0.350
	We expect the technology to be flexible.	4.211	-0.382	-1.213
	We expect our employees to team the relevant skills quickly.	3.947	-0.843	0.785
	We think blockchain technology should be simple to use.	4.132	-1.058	-0.706
PUSE	We think blockchain technology improves our work performance.	4.079	-0.398	-1.016
	We think blockchain technology improves our work performance.	3.842	-0.053	-0.694
	We think blockchain technology improves our productivity.	4.079	-0.497	-1.164
	We think blockchain technology improves our effectiveness at work.	4.026	-0.705	-0.228
TRI	We are optimistic about the performance improvements that blockchain technology can bring.	4.211	-0.714	-0.192
	We are optimistic about the flexibility that blockchain technology can bring.	4.026	-0.532	-0.513
	We are optimistic about the control that blockchain technology can give us.	3.921	-0.501	-0.499
	We frequently embrace new challenges that new technology brings us.	4.237	-1.209	0.999
	We are often considered leaders in new technology adoption among our peers.	4.105	-0.675	-0.387
	We feel that the use of blockchain technology can be fully understood.	3.895	-0.257	-0.849
	We feel that the use of blockchain technology contains little risks.	3.632	-0.396	-0.779
	We trust blockchain technology in handling our business operations.	3.974	-0.429	-0.633
	We are confident that there will not be leakage of confidential information if we adopt this technology.	4.000	-1.041	0.964
	We feel that information conveyed through this technology can be fully understood by other parties.	3.921	-0.754	0.530

With regards to years of establishment, there were 18 manufacturers that started manufacturing less than a year ago, 57 of them were established for 1 to 5 years, while 39 of them have been in business for more than 5 years. 27/114 respondents have an annual revenue of <RM300k, 6 of them earn between RM300,001 to RM1 million, 24 earn between RM1 million to RM5 million, and 57 of them earn more than RM5 million per year.

In terms of international financial transactions, 30 of the respondents make <RM500k worth of international transactions annually, 48 of them make between RM500k to RM1 million worth of international transactions, 18 of them have more than RM1 million, and 18 of them have no international transactions.

27 over 114 respondents keep <1TB of data, 45 hold between 1TB to 20TB of data, while 42 companies have more than 21TB of data. Lastly, the survey examines the number of suppliers these manufacturers must manage. 18 of the companies have less than 10 suppliers, 81 of them have 11 to 50 suppliers on hand, while 15 of them must manage more than 50 suppliers.

The preliminary analysis in SPSS shows that PEOU, PUSE, and TRI have all received a relatively positive sentiment among industry practitioners. The mean for PEOU ranged from 3.9 to 4.3 out of 5.0, the mean for PUSE ranged from 3.8 to 4.0, whereas the mean for TRI ranged from 3.9 to 4.2. All the three constructs were consistent with normality assumptions, with the skewness value being within ± 2.00 based on criterion proposed by Curran et. al. [21] and Hair et. al. [22] and kurtosis values being within ± 7.00 based on criterion proposed by Tabachnick and Fidell [23].

4.2 Measurement Model Analysis

Before the researchers can understand the relationships between the constructs, the relationship between the respective indicators and the constructs needs to be examined first, namely the validity and reliability of the construct measures. Ideally, the indicators (questionnaire items) need to consider all the different aspects of a given construct.

The data set was exported to SmartPLS after data preparation was complete in SPSS. According to Hair et. Al [22], researchers can evaluate the measurement model using SmartPLS. The reliability and validity of the constructs were examined using various tests including internal consistency, convergent validity, and discriminant validity.

Both the Cronbach's alpha and the composite reliability were used to examine internal consistency. This ensures that the survey actually measures what it was intended to measure in the first place. The Cronbach's Alpha values ranged between 0.724 to 0.935, while the composite reliability values ranged from 0.878 to 0.944. Although some of the values are on the high side, these are all acceptable ranges [24]. The results do indicate the reliability among the constructs of the study.

Convergent validity was also measured to ensure that the indicators of the constructs are related to one another. To examine the convergent validity, all the outer loadings achieved higher than 0.708 to show indicator reliability. In addition to achieving these values, the study also used the average variance extracted (AVE) technique to establish convergent validity. In this study, all the constructs had more than 0.50, thus establishing convergent validity.

Lastly, the researchers examined discriminant validity through SmartPLS as well. Discriminant validity is an important measure to ensure constructs that are supposed to be unrelated are actually unrelated. The cross loadings showed that each indicator's outer loading was higher than the loadings on other constructs, whereas the Fornell-Larcker criterion indicated that the technology readiness index construct had a slightly lower value that the PEOU and PUSE constructs. Given that the Fornell-Larcker criterion is a more conservative approach and that the questionnaire items were validated by past researchers and also industry experts during the pre-test, all the indicators were maintained. Figure 1 shows partial least squares path model.

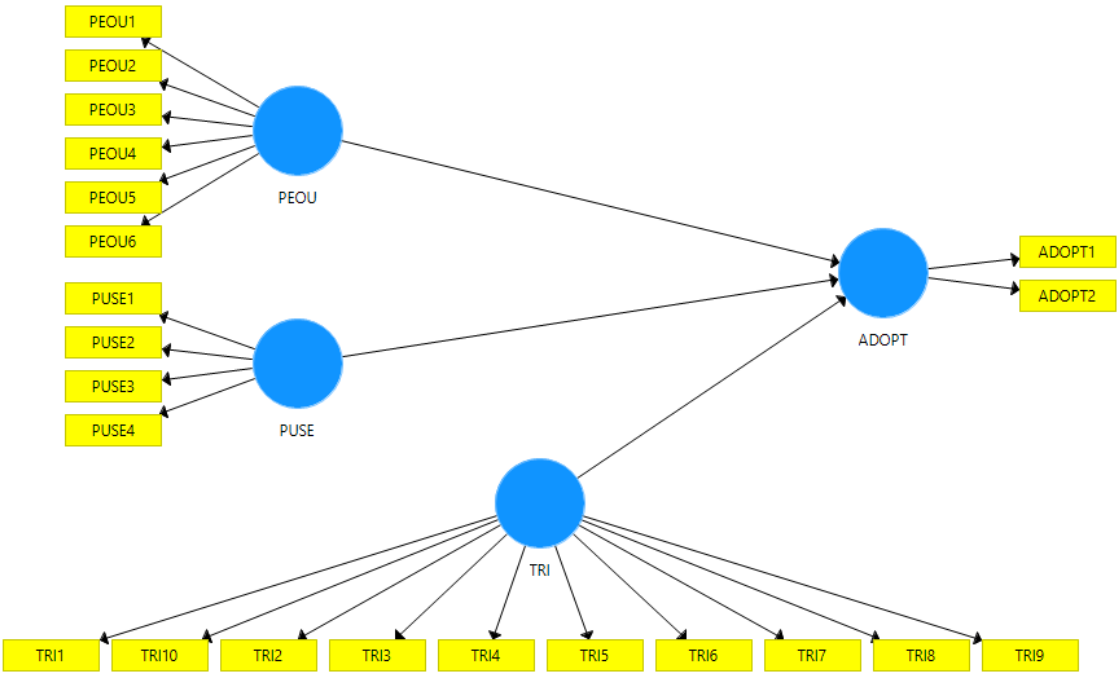

Fig. 1. Partial least squares path model

4.3 Structural Model Analysis

Since the measurement model has been confirmed to be valid and reliable, the data analysis can proceed to evaluating the structural model. The structural model is the underlying theory for using the path model. This evaluation effectively helps the researchers to test the hypotheses and understand its predictive capabilities.

First, the model needs to go through a collinearity assessment to ensure that there are no significant levels of collinearity among the constructs. In this study, no construct has a variance inflation factor of above 5.00, indicating that there are no collinearity issues present in the study [22]. The following step is to evaluate the path coefficients to examine the relationships among the constructs. Using the bootstrapping feature in SmartPLS, the results indicate that TRI has a significant impact on blockchain adoption with a p-value of 0.036, whereas PEOU and PUSE had no significant relationship on blockchain adoption with T-values of 0.511 and 0.611 respectively.

The structural model evaluation also produced an R2 value of 0.285, which explains the predictive accuracy of the model. This shows the collective effect that PEOU, PUSE, and TRI has on blockchain adoption among Malaysian manufacturers. A value of 0.285 can be interpreted as weak or moderate depending on the perceived context [22]. In addition, the effect size (f2) of TRI on blockchain adoption is 0.039, which is considered as a large effect size [25]. Whereas the other two independent variables had a much smaller effect size at only 0.003 and 0.007.

4. Discussion and Conclusions

This study was conducted with three objectives: to understand the current industry perception towards this technology, the match with current blockchain applications, and the potential for them to implement the technology in the near future.

Based on the coefficient of determination (R2), the impact that the independent variables have on blockchain adoption can be considered as a significant impact. Besides the perception and readiness of the Malaysian manufacturers, there can be other significant concerns that will also

impact adoption decisions in the future. This can include cost concerns, change management, transition time, security concerns, and employee training. Nevertheless, this study has shown that Malaysian manufacturers have an overall positive sentiment towards blockchain technology and are ready to leverage the technology to improve various company processes.

The path coefficients also show that technology readiness index (TRI) has a significant impact on blockchain adoption in the future, but not perceived ease of use (PEOU) and perceived usefulness (PUSE). One of the reasons for this phenomenon is that PEOU and PUSE indicate the respective perception of the respondents but may not necessarily represent the company as a whole. A positive perception of the benefits that the technology can bring to the company does not automatically translate to a decision to implement the technology within the company. However, a high TRI does indicate that the company is ready to adopt the technology, which translates into adoption decisions more directly.

Based on the responses, many of these companies manage a sizeable amount of international financial transactions and store large amounts of digital data. These are aspects that can make blockchain technology a good tool for these manufacturers to be more efficient. Among the 114 respondents, 84% of them mentioned that they may implement the technology within the coming year, 89% indicated that they will implement the technology within the next 5 years, while 100% mentioned that they should be implementing the technology into their business operations in the future.

Nevertheless, do keep in mind that the respondents are only representatives of companies that have a rudimentary understanding of blockchain technology, and the study did not include respondents or companies that do not understand the technology. Therefore, even if 84% of the respondents intends to implement this technology within the next year, it does not indicate what percentage of the industry intend to implement it. Another caveat to the study is the limited sample size. This is because the response rate of companies is usually lower than those of consumers, and also due to the low understanding of blockchain technology within the country.

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