Blockchain technology adoption in SMEs: the extended model of UTAUT

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***Abstract*— The purpose of this study is to measure the behavioral intention to adopt blockchain technology (BT) among SME managers based on the theory of "Unified theory of acceptance and use of technology" (UTAUT).**

The study was conducted among SME managers in Iraq who adopted blockchain technology. The study deployed the quantitative method and the purposive sample technique was used. The data collected by questionnaires and the valid questionnaires was 192 analyzed by Smart-PLS after ensuring the validity and reliability of the proposed model.

The results indicated that performance expectancy, facilitating conditions, technology readiness, and blockchain transparency positively and significantly impact SME managers' intention to adopt blockchain technology. On the other hand, social influence has an insignificant impact on BI's decision to adopt the blockchain among SME managers.

Keywords*— *blockchain, UTAUT, SME, technology readiness

I. INTRODUCTION

Information and communication technologies are constantly changing, and different business sectors are finding that using and applying these technologies is becoming more and more critical to their managerial and operational effectiveness to their ability to compete [1].

Human resources are essential to digital transformation because managers who do not understand the benefits of using cutting-edge solutions could make it harder to use technology and its benefits.

SMEs are critical to the economic growth of the majority of Middle Eastern countries, particularly Iraq. The traditional technique used by SMEs is insufficient to maintain current international commercial operations. A new encrypted and protected technology called blockchain, has emerged to ensure transparency in business transactions. As a result, SMEs can implement this technology to enhance their performance [2]. While the environment maintains up with accelerating technological improvements in monetary operations, new technologies like blockchain technology (BT) are gradually grabbing people's attention[3].

Given that blockchain needs time to spread widely and might be helpful for SMEs, we expect that SMEs in Iraq currently lack an understanding of the blockchain and are still late and behind the regional SMEs.

SMEs in Iraq face several challenges in adopting the new technology. SMEs owners in Iraq continue to have a poor attitude toward technology adoption [4]–[6]. Doing business in Iraq is not easy due to the country's situation, such as the political situation, security situation, and economic situation that placed Iraq 172 out of 190 on the ease of doing business rank [7]. SMEs in Iraq might be able to solve some of these problems by using blockchain technology. Blockchain is a revolutionary financial technology that offers high confidentiality, transparency, and accuracy levels [8]. Despite this good opportunity for Iraqi SMEs to enhance their performance by implementing blockchain technology due to this technology provide several benefits, such as smart contracts, financial services, Crowdfunding, and supply chain management.

There is a lack of studies that measure the behavioral intention (BI) to use blockchain technology among Iraqi SMEs. However, The previous work focuses more on measuring the blockchain in the Supply Chain Management area [9]–[11].

The Model of UTAUT considers one of the most common models which explains the Behavioral Intention (BI) to use new technology. The core elements of this model are "Performance Expectancy" (PE), "Effort Expectancy" (EE), "Social Influence" (SI), and "Facilitating Conditions" (FC) [12]. The current study extended this model by adding two other factors to a suite of the context of this study, which are technology readiness (TR) and blockchain transparency (BT). However, the EE was taken out of the proposed model because previous studies on blockchain either didn't include this factor [9], [13] or reported that EE wouldn't affect BI to adopt the blockchain [10], [14]–[16].

This study aims to examine the impact of BI on adopting blockchain technology in the context of Iraqi SMEs. As well as extending the UTAUT model by including two new factors technology readiness and blockchain transparency to the proposed model.

II. LITERATURE REVIEW

A. Blockchain and SMEs

First, 2008 marked the beginning of blockchain technology and cryptocurrency (often known as “cryptos”). That year, Satoshi Nakamoto published a paper named “Bitcoin: A Peer-to-Peer Electronic Cash System” [17].

Without the need for third-party intermediates, peer-to-peer transactions may be carried out on a platform provided by a blockchain. Business transactions are validated using cryptographic techniques, with the parties involved functioning as the nodes [14].

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Even though there is no need for a central database because this technology works on computers controlled by volunteer networkers, security and dependability must be ensured by public and encrypted community self-interest [11].

A decentralized ledger stored and shared by all the participating entities contains all the documents related to these transactions. There is no need for a central authority to validate the transactions because they are verified and kept by a distributed consensus [9]. Blockchain technology is sometimes known as meta-technology since it integrates with various other technologies, including cryptographic and database technologies and many software applications [14].

The process of embracing and utilizing blockchain technology to provide services and improve administrative procedures is called blockchain adoption [18]. Using blockchain to manage digital reputation and identification might raise income and enhance security.

Each "digital twin" of an individual object has a unique cryptographic code or serial number. This code or serial number is a cyber-physical link between the physical product and its digital identity [14]. With the buyer and seller's consent in digital form, the ownership of the goods changes and is recorded on the blockchain. Due to the lack of a product's digital counterpart, the blockchain prevents counterfeit items from accessing the cyber-physical world [14].

Most Middle Eastern countries, including Iraq, depend heavily on SMEs for their economic development. However, SMEs typically have resource limitations in local and foreign markets compared to larger firms. In addition, since 1988, the SMEs in Iraq have faced several issues and challenges due to the country's situation. blockchain is becoming a significant export engine in the context of the global network economy.

Global operations do constitute a significant development path for SMEs, who stand to benefit from engaging in cross-border business. Thus, SMEs may benefit from new technologies created to enhance company operations by investing in and using blockchain [8]. Additionally, blockchain includes improvements that lower purchasing time and overhead expenses.

There are a number of applications of blockchain that can be adopted in SMEs. Such as smart contracts which is a computer systems that automatically carry out a contract's conditions. They have the power to alter how companies' operations transact fundamentally. Smart contracts that utilize blockchain technology can assist in transforming organizations from their current forms into smarter ones and maintain a decentralized registry of transactions that identifies who owns what in the network [18]. These agreements can decentralize the actual network of dependable third parties and eliminate costs for brokering services [19]

Using financial services and cryptocurrency payments might be another way for SMEs to use blockchain. Blockchain makes it easier to figure out credit upfront because there are fewer transactions and more transparency throughout the process [18].

Crowdfunding is another blockchain application that could be used in the context of SMEs. Eliminating a central middleman entity is achievable thanks to blockchain technology. In this method, start-ups may generate money by developing their digital currency and selling supporters cryptographic shares [20]. Investors get shares in the start-up they support due to the crowdfunding campaign [18].

Blockchain and supply chain management Identifying who is doing what operations and determining the time and place of activity are advantages of integrating blockchain in supply chain management.

B. UTAUT

The Model of UTAUT considers one of the most common models among a number of the theory that explains the BI to use of new technology, particularly blockchain [9]–[11].The current study extended the model of UTAUT by adding two new factors to align with the context of the study technology readiness and blockchain transparency. Regarding the EE, several previous studies emphasize that EE statistically does not affect behavioral intention [10], [15]. However, several previous studies that measured the impact of UTAUT dimensions on BI to use blockchain has been dropped the EE from the study [9], [13].

C. Performance Expectancy

PE is how users expect using a particular system will lead to improving their work performance [12]. In the context of this study the PE describes how much managers believe utilizing blockchain technology would increase their SMEs' performance. We believe that blockchain adoption in Iraqi SMEs will increase job performance, and outcome indicators like satisfaction and retention rates will also rise.

Applications based on the blockchain can improve the effectiveness and standard of the services offered, increasing expectations by enhancing the current conventional methods [13], [21]. PE determine an individual's inclination to utilize and accept technology. The user's desire to adopt and use the new technology is tied to how he or she thinks the technology will help with his or her daily work tasks [9], [13]. Therefore, blockchain applications have given SMEs much hope that their operations, including productivity, product quality, and efficiency, will all improve. The success of adoption blockchain highly depend on PE [9], [20].

Empirically, several studies reported the PE increase the BI to adopt the blockchain in several context SMEs [2], [14], [22], Shipping industry [13] supply china [9], and accountancy firms [15].

H1:PE has positive and significant value on BI to adopt blockchain among SME managers.

D. Social influence

SI is the extent to which a person believes that other people find it vital that they utilize the new system [12], [19]. SI in the context of SMES is measures how willingly mangers will accept new technologies because other SMEs already utilize blockchain. SI is composed of inquiries on the potential effects co-workers, family, and others may have on embracing blockchain [9]. The SI will be used to describe how well managers understand the significance of why other people think they should embrace blockchain technology [13], [20].

This study makes the case that managers in SMEs who seek out extra information, raise their level of awareness, and experience social pressure before using new technology are more likely to be influenced by the opinions of other members on the usage of BT. The favourable outlook of inventors and

early blockchain users may be claimed to enhance this technology's social spread [22].

Statistically, There are previous inconsistent findings; some previous studies reported that the SI is able to improve the BI to adopt the Blockchain and has a significant impact in SMEs [22]and other sectors [13], [15]. However, while other studies report it, the SI has a no-significant impact on BI to adopt the Blockchain [2], [9], [14], [19], [20].

H2:SI has positive and significant value on BI to adopt blockchain among SME managers.

E. facilitating conditions

The degree to which a user thinks the system has the proper technological and organizational infrastructure to make it easy to use [12]. In our study context, the FC relates to how well-informed managers are about the tools SMEs have at their disposal to enable the adoption of blockchain. FC got questions about how companies' infrastructure is designed to accommodate blockchain transactions [9], [19]. According to the UTAUT paradigm, a user's perception of conducive circumstances affects how well they perceive the use of technology. Depending on the situation, the user's surroundings either promote or compels them to refuse adoption [2], [20].

The previous findings reported it the FC has statistical values on BI to adopt the blockchain, and the FC plays a significant role in improving the adoption of blockchain [2], [9], [10], [16], [19].

H3:FC has positive and significant value on BI to adopt blockchain among SME managers.

F. Technology Readiness

TR refers to people's proclivity to adopt and use new technologies to achieve goals in their personal and professional lives [23], [24] . TR means that a company has the resources and confidence in its skills to do the job [16].

TR relates to how the technology is seen to help boost performance; a favorable perception results in a better BI since the user is more willing to employ the technology [16](Wong et al. 2016). TR refers to the capacity of a company to embrace new technology that depends on having the necessary equipment, software, and skilled personnel available [25]. The organization should have the information, training, experience, and abilities to integrate new technologies.

TR has significant impact on BI to adopt the blockchain and the TR able to enhance the BI regarding adoption of blockchain [16], [24], [25].

H4:TR has positive and significant value on BI to adopt blockchain among SME managers.

G. Blockchain Transparency

BCTR Refers to the ways in which a SMEs managers tells its stakeholders what it is doing and reports on it, so that its operations are more visible at all levels. However, the transparency able to improve the performance of SME.

BCTR uses a distributed data architecture and decentralized governance to make sure that transactions are safe and transparent in a number of different settings [11]. thus, the BCTR The ways a company communicates with and reports to the people in its network make it possible for everyone to see how it works [9].

BCTR refers to a product's price, quality, and features, which refers to the product's visual features. On the side of communications, the warranty and contact are considered part of the transparency that is provided by the blockchain. Lastly, blockchain transparency's transaction characteristics ensure activities' privacy and security [26].thus, this is possible due to the decentralized governance system used by BT, which permits direct transactions without needing a third-party intermediary. Empirically, the BCTR has statistical value on BI to adopt the blockchain [9], [11], [27].

H5:BT has positive and significant value on BI to adopt blockchain among SME managers.

III. METHODOLOGY

The study applied the quantitative method to examine the proposed model in the context of SMEs in Iraq. Since the current study's purpose is to examine several factors that affect BT adoption, the study proposed five hypotheses; thus, the study applied the deductive reasoning method.

The target population of this study is the SME managers who adopted blockchain technology in Baghdad. The reason behind choosing Baghdad is that most of the SMEs are located in this city, which is logically due to this city being the capital city of Iraq.

The purposive sample technique was used in this study because the study's target population is SME managers and other staff and members in the SME, not the study scope.

300 questionnaires were distributed among SME managers, and only 197 was returned. Therefore, only 192 was valid for analysis after conducting the data screening. The valid questionnaires has been analyzed by Smart-PLS.

A. Instrument

All of the items were adapted from previous works. The original items were written in English but translated into Arabic to make them more understandable to the respondents. The questionnaires were divided into two sections: the first regarding the demographic questions and the second, which consisted of variable items, the number of items for each variable, and the source depicted in Table 2. The questionnaires were measured by the 5-point Likert Scale and sent to seven experts from public universities in the field of blockchain and technology. Only four experts responded, and all their comments and suggestions followed.

IV. RESULTS

A. Demographic Information

The personal information depicted in Table 1 showed the majority of responded gender was male, with 82% and 18% female. The age of managers surveyed was 51 % their age between 31 to 40 years old and 27 % between 41 to 50 years old, the managers aged between 21 to 30 years old was 12 % and close to this 10 % managers aged above 60 years old only 10% and no mangers was less than 20 years old.

The qualifications managers showed that most of them held bachelor's degrees 80%, 13 % held master's, 2% held diplomas and Ph.D. while another was 3%.

The manager's working experience showed 46% has working experience between 6 to 11 experience, 19% from 11–15 years and close to this percentage 18% has working

experience between 16–20 years, from 2 to 5 working experience was 11%, only 6% Over 20 years working experience and no manager has experience work less than one year.

TABLE I. DEMOGRAPHIC INFORMATION

Classification	N.	Percentage
Gender		
Male	158	82%
Female	34	18%
Age		
Less than 20 years	0	0%
21 years to 30 years	23	12%
31 years to 40 years	98	51%
41 years to 50 years	52	27%
More than 60 years	19	10%
educational level		
Diploma	4	2%
Bachelor	154	80%
Master	24	13%
Ph.D.	4	2%
others	6	3%
working experience		
Less than one year	0	0%
2–5 years	21	11%
6–10 years	89	46%
11–15 years	36	19%
16–20 years	34	18%
Over 20 years	12	6%

B. Measurement model

This step makes it possible to assess the item loadings, which should be 0.7 and above [28]. Table 2 depicted all the items exceeding 0.7, except FC3 and BCTR2, which showed less than 0.7 and have been removed.

The other step that should be conducted is measuring the Cronbach's Alpha (CA) and Composite Reliability (CR). The purpose of these criteria is to assess the internal consistency of Construct. The cut-off level of this criteria is 0.7 and above [28]. Based on Table 2, all the CA and CR values above 0.7 indicate no issue in Construct internal consistency.

The other step is to assess the "convergent validity", which is assessed by Average Variance Extracted (AVE). The minimum level of this criteria is 0.50 and above. Table 2 shows that all the constructs' AVE is above 0.5; thus, this criterion has no issue.

TABLE II. CONSTRUCT RELIABILITY AND VALIDITY

Construct	Outer Loadings	CA	CR	AVE	Reference
BI					
BI1	0.790				
BI2	0.880	0.898	0.925	0.712	[2], [11]
BI3	0.883				
BI4	0.862				
BI5	0.800				
PE					
PE1	0.868				
PE2	0.869	0.887	0.922	0.747	[2], [11]
PE3	0.865				
PE4	0.854				
SI					
SI1	0.823				
SI2	0.882	0.890	0.922	0.748	[2], [11]
SI3	0.865				
SI4	0.887				
FC					
FC1	0.895	0.849	0.909	0.768	[2], [11]
FC2	0.901				
FC4	0.832				
TR					
TR1	0.840	0.818	0.891	0.732	[11], [25]
TR2	0.884				
TR3	0.843				
BCTR					
BCTR 1	0.838				
BCTR 3	0.838	0.845	0.893	0.677	[11]
BCTR 4	0.747				
BCTR 5	0.863				

The last step is to assess the "discriminant validity". There are several criteria for this step, and this study uses the “Heterotrait-Monotrait Ratio” (HTMT) to assess the “discriminant validity”. The HTMT should be less than 0.90 based on Table 3. All HTMT values are less than 0.9 [28], so there is no issue with the “discriminant validity”.

TABLE III. HTMT

	BCTR	BI	FC	PE	SI	TR
BCTR						
BI	0.595					
FC	0.371	0.469				
PE	0.555	0.492	0.477			
SI	0.076	0.163	0.187	0.147		
TR	0.333	0.327	0.082	0.152	0.095	

C. Structural model

This step has been run by bootstrapping with 5000 subsamples as recommended by Hair et al. [28]. The R2 for this model was 0.406, indicating that the variation in the BI and other independent variables is 40%, which is considered moderate[29]. Therefore, the Q2 should be greater than zero [28], and the Q2 value of this model was 0.275, so there is no issue with Q2.

The study proposed five hypotheses, and the results showed that four hypotheses were supported, and one hypothesis was not supported. The supported hypotheses should be a p-value <0.05 and a t-value >1.96, as depicted in Table 4 and Figure 1. The p-value was (0.024, 0.002, 0.023, 0.000) <0.05 and the t-value (2.24, 3.11, 2.28, 5.01) >1.96. Thus, performance expectancy, facilitating conditions, technology readiness, and blockchain transparency positively and significantly impact BI adoption of blockchain technology among SME managers. H1, H3, H4, and H5 are supported. While the SI showed a nonsignificant impact on BI adoption of blockchain technology among SME managers, the p-value was 0.219 > 0.05 and the t-value 1.229 < 1.96; thus, H2 was not supported.

TABLE IV. HYPOTHESES RESULTS

H	Path	Original Sample	Sample Mean	T Values	P Values	Supported
H1	PE -> BI	0.169	0.168	2.257	0.024	Yes
H2	SI -> BI	0.076	0.085	1.229	0.219	No
H3	FC -> BI	0.210	0.207	3.111	0.002	Yes
H4	TR -> BI	0.145	0.145	2.280	0.023	Yes
H5	BCTR -> BI	0.352	0.354	5.016	0.000	Yes

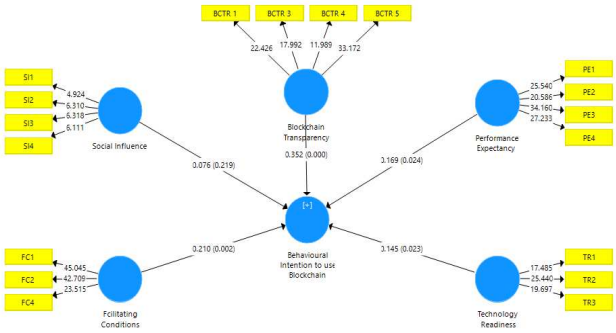

Fig. 1. Structural Model

V. DISCUSSION

By extending UTAUT, this work aims to analyse the determinants of blockchain adoption for SMEs in Iraq experimentally.

The Performance Expectancy empirically able to enhance and improve the BI to adopt blockchain, this result supported by several previous findings [2], [14], [20], [22]. This implies that aspects of BT functional values PE are important in determining SME managers' decision to employ BT. However, the findings of this study supported the notion that using BT has improved their SME performance. This finding shows that every improvement in SMEs' expectations for blockchain performance could enhance managers' motivation to adopt this technology. This result also shows that managers think the use of blockchain-based methods in SME operations will lead to a significant boost in performance.

Social influence has insignificant impact on BI to adopt blockchain, this result supported by several previous findings [2], [9], [14], [20]. That means the opinions of other users or competitors on current blockchain technology are unimportant to the management of SMEs. However, the findings of this study showed that SME managers have a great deal of expertise and understanding of new technologies, and they do not consider other members' or competitors' influence in deciding to adopt BT or not. Additionally, the managers in SMEs are less likely to rely on their social networks for help since they are more aware of and skilled at using new technology.

The facilitating conditions empirically able to enhance and improve the BI to adopt blockchain, this result supported by several previous findings [2], [9], [10]. The findings show that the skills, infrastructure, and resources needed to adopt BT are causing more anxiety to the SME managers who participated in this survey. When a cutting-edge technology is compatible with the current environment, the adoption of BT will be simple. As a result, we may conclude that favorable circumstances and FC are essential in persuading SME managers to adopt BT. It may be that SMEs are able to recognize suitable levels of technology and infrastructure in SMEs, as well as network and human support, to promote blockchain adoption in their SMEs.

Technology Readiness statistically has significant impact on BI to adopt the blockchain. This result supported by previous findings [16], [24], [25]. For SMEs that utilize or are thinking about adopting BCT to address the TR of managers, the significance of technological readiness is essential. The BI produced while employing BCT is higher the more technologically readiness the managers. Therefore, SME managers should work to increase the technology readiness of all employees, particularly employees with low technology readiness, in addition to the cautious approach of developing and recruiting managers with greater technology readiness. SMEs that are tech-ready are more likely to use blockchain technology, and the SMEs' managers understanding of the benefits of blockchain technology facilitates its adoption.

Blockchain Transparency statistically has significant impact on BI to adopt the blockchain. This result supported by previous findings [9], [11], [27]. BCTR leads to precisely documenting the origin of the goods and services, which can play a direct role in SMEs to make them traceable and enable a better-integrated flow, leading to a more efficient collaboration between the parties to transactions. Blockchain transparency will enable superior solutions, making it a more appealing alternative to choose over SMEs.

VI. CONCLUSION

Blockchain technology is in the first stages among Iraqi SMEs, where new technologies are gaining traction in SME operations, and blockchain technology may improve performance and effectiveness. The current work proposes an extended UTAUT theory model by involving technology readiness and blockchain transparency. The results indicated that performance expectancy, facilitating conditions, technology readiness, and blockchain transparency positively and significantly impact SME managers' intention to adopt blockchain technology. On the other hand, social influence has an insignificant impact on BI's decision to adopt the blockchain among SME managers. The findings provide insight into the variables influencing behavioral intention and anticipation among the SMEs in Iraq to use blockchain technology that is not discussed in the existing Iraqi literature.

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