

Blockchain Technology Adoption in the Context of Saudi Arabia: An Empirical Analysis for a Future Outlook

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Abstract

Cutting-edge technologies are leveraging businesses value chain in order to advance their competitive advantage, from this standpoint blockchain technology (BCT) gained a relative pace over the recent years demanding for more research cases. The present study aims to contribute in understanding the customers' acceptance of BCT in Saudi Arabia and tested through Technology Acceptance Model (TAM). Although empirical support for TAM varies depending on the context, it remains a popular and effective conceptual framework for analysing aspects that contribute to technological adoption or rejection. This study was validated with the response from 740 respondents involved with BCT adoption in companies listed in Tadawul (The Saudi Stock Market) in Saudi Arabia through the Structural Equation Modelling (SEM) regression technique using AMOS software. The path analysis results revealed that a reasonable fit for the model: χ^2 (2476.851), χ^2 / DF (3.057), RMSEA (0.054), CFI (0.829), and TLI (0.904). Four main factors (Perceived Ease of Use, Perceived Usefulness, Attitude Towards Use, and Intention to Use) were identified as a determinant of Actual use of BCT. All factors show average variance explained greater than 45%. The research findings help understanding User's adoption of BCT for researchers, regulators and developers and providing supported evidence on factors contributing to the adoption of BCT in Saudi Arabia. The study is restricted to firms based in Saudi Arabia. Future study will concentrate on various countries' BCT adoption to assess for the multi-group analysis impact on the model.

Keywords: Blockchain Technology (BCT), Technology Acceptance Model (TAM), Technology Adoption, Saudi Arabia.

I. INTRODUCTION

Technology adoption is putting businesses and governments under continuous and rapidly growing pressure. Researchers developed many models and theories to understand technology adoption of consumers in order to achieve acceptance of new or enhanced technologies, and advance their competitive advantage. Technology Adoption Model (TAM) was used in this study to explain the general determinants of computer acceptance that lead to explaining users' behavior in the case of BCT adoption in Saudi Arabia. BCT introduced a novel method of safeguarding data and transaction records for usage by numerous parties that did not rely on a trusted central authority, this proposition inspired businesses and

governments in multiple sectors to develop ICT solutions based on BCT such as financial, sport, healthcare, retail, oil and gas, pharma, tourism and education. Although there are concerns with blockchain implementations such as data security, cost/budget limitations, regulatory concerns, and uncertainty. There are several present cases that have strong evidence that BCT is driving digital transformation in organizations and generating new business value.

II. LITERATURE REVIEW

This literature review is divided into four main parts to cover the research topics: 1- Technology Adoption, 2- Distributed Ledger Technology and Blockchain, 3- Blockchain Technology Adoption, and 4- Blockchain Adoption in Saudi Arabia.

Rapid advancements in information technology are pressuring businesses and governments to adopt relevant technology in order to maintain growth through system development, which is largely dependent on a struggle between rapid technological change and natural barriers to new product or service acceptance. There are numerous technology adoption models and theories, including but not limited to the Theory of Diffusion of Innovations (DIT), the Theory of Task-technology Fit (TTF) [1], the Theory of Reasonable Action (TRA) [2], the Theory of Planned Behavior (TPB) [3], the Technology Acceptance Model (TAM) [4], [5]. Various researchers have utilized the TAM, TRA, TPB, TAM2, TAM3, and UTAUT over the years to describe adoption technology systems.

DIT describes the method through which an invention is communicated to members of a social system over time through certain channels. Diffusion is the process through which members of a social system transmit an invention through certain channels over time. According to the idea, invention and adoption occurred after multiple steps of knowledge, persuasion, choice, implementation, and confirmation, which resulted in the formation of an S-shaped adoption curve of innovators, early adopters, early majority, late majority, and laggards [6]. TTF considered that a strong fit between task and technology increases the chance of utilization as well as the performance effect since the technology more closely matches the task demands and wants of users [1].

The behavioral intention of the person's attitudes toward that conduct is determined by TRA. Attitude is defined as an individual's appraisal of an item; belief is defined as a link between an object and some attribute; and conduct is defined as a consequence or goal. Attitudes are emotional in nature and are founded on a set of beliefs about the target of conduct [2]. TBP is made up of three major elements that influence behavior intention and actual behavior adoption: attitude, subjective norms, and perceived behavior control [3].

TAM is essentially a version of TRA, designed particularly for modeling consumers' acceptance of information systems or technologies [5]. Based on perceived ease of use and usefulness, TAM has been frequently utilized to forecast consumer acceptance and adoption. However, in order to create successful user acceptance training interventions, it is vital to better understand the antecedents and drivers of key acceptance characteristics [7].

TAM seeks to explain the general factors of computer acceptance, which lead to an understanding of user behavior across a wide range of end-user computing systems and user groups. The TAM model included and tested Perceived Usefulness (PU), which is defined as the potential user's subjective likelihood that using a certain system will improve his/her action, and Perceived Ease of Use (PEU), which is the degree to which the potential user expects the target system to be simple. Both PU and PEU impact a person's Attitude Toward Use (ATU) and Intention To Use (ITU) until the individual uses a system. Other factors known as external variables in TAM can impact PU and PEU.

From the standpoint of distributed ledger technology and blockchain, the reliance on financial institutions acting as a trusted third party for Internet commerce to process electronic payments works well enough for most transactions, but it still suffers from the inherent weaknesses of the trust-based model. Because financial organizations cannot avoid settling conflicts, completely irreversible transactions were not truly conceivable. Transaction costs rise as a result of mediation and the inability to make irreversible payments for irreversible services. These fees and payment risks may be avoided in person by using actual cash, but there was no method in place to conduct payments through a communications channel without the assistance of a trusted third. To allow any two willing parties to interact directly with each other without the requirement for a trusted third party, an electronic payment system based on cryptographic evidence rather than trust was required from this point on. Transactions that are computationally infeasible to reverse would protect sellers from fraud, while regular escrow systems may be simply added to safeguard purchasers [8]. Bitcoin was created for this reason; however, Distributed Ledger Technologies (DLTs) now provide a new method of safeguarding data and transaction records for usage by numerous parties without relying on a trusted central authority. In terms of development and acceptance, DLT is still in its infancy [9].

An analysis of the OECD Forum for the Future Conference on 21st Century Technologies found that pursuing socio-technical dynamism rather than preservationist is required to realize the full potential of tomorrow's technologies in order to contribute to human well-being, with the ability to embrace dynamic change playing a significant role. According to the World Economic Forum (WEF) [10], Blockchain technology will enhance a \$9 trillion industry by 2028. Experts and executives in the information and communications technology sector predicted that by 2025, at least 10% of global GDP will be held on Blockchain systems [11], [12]. As a result, private sector operators' use of technologies such as IoT, AI, big data analytics, and blockchain will boost digital transformation and enable SMEs to participate in the value chains of critical services [13].

Satoshi Nakamoto envisioned an electronic transaction system that does not need on trust [8]. The study presented a solution to the problem of double-spending that had plagued prior attempts at virtual currencies, as well as a solution to the Byzantine Generals' dilemma, assuring the security and actionability of transmitted messages, making digital currencies truly possible. The concept envisioned a cryptographically enabled distributed ledger, generally known as the "blockchain" produced by Bitcoin. This is a disintermediating and decentralizing notion that relies on consensus for authentication rather than a trusted third

party to guarantee counterparties or transactions. Blockchain technology is a peer-to-peer networking technique that uses a distributed database system to keep a verifiable digital ledger of all transactions across a particular network by any one computer on said network, eliminating the need for a centralized authority or server (see Fig 1). Any of these unique computers, also known as network 'nodes,' has access to the complete database and a history of transactions dating back to the first block, known as the 'genesis block.'

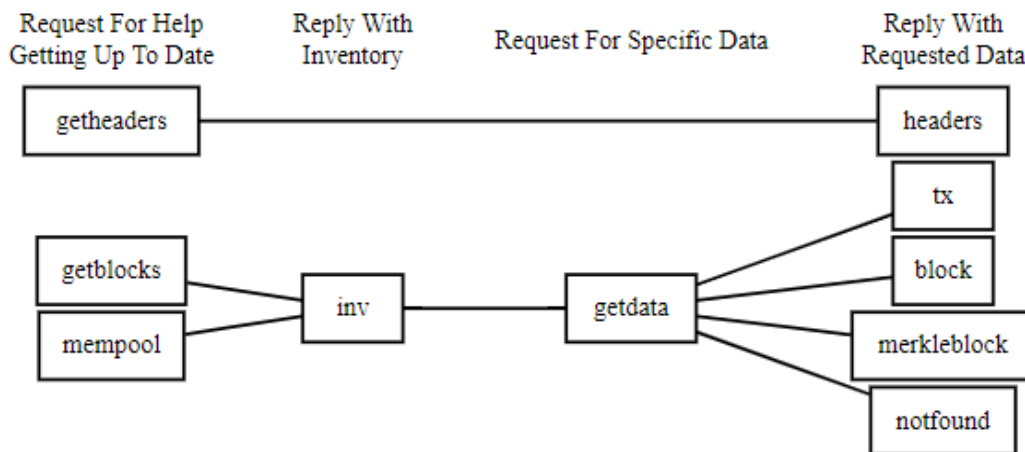


Fig. (1) Overview of P2P Protocol Data Request and Reply Messages [14].

A blockchain is a linked collection of 'blocks' made up of a block header, the hash of the previous block header, and the merkle root. For each new block, a duplicate of the transaction information is produced, which is then hashed, coupled with another hash, hashed again, paired again, and hashed once more, leaving the 'merkle root' [15]. Cryptography is used to ensure the integrity and chronological order of the block chain. The signature also stops anyone from changing the transaction once it has been issued. No group or individual has the ability to manipulate what is included in the block chain or to alter sections of the block chain in order to roll back their own expenditures.

Blockchain has quickly acquired popularity in financial sectors. Countries, on the other hand, are creating DTL-based solutions for a broader variety of activities, including as transportation, energy, and government services. DLTs enable the instantaneous and safe digital movement of value and ownership within a network while maintaining complete transparency. As a result, they have the potential to significantly alter economic interactions. The technology possesses all of the features of a general-purpose technology, which implies it is widespread, improvable through time, and enables for supplementary advancements [16].

Following bitcoin, there were over 900 crypto currencies till 2014 [17], after which the number expanded drastically to approximately 5,392 cryptocurrencies being traded with a total market value of \$201 billion as of April 22, 2020 [18]. The majority of CEOs and technology experts at the World Economic Forum in Davos, Switzerland (January 20-23, 2016) predict governments would be using blockchain to collect taxes by 2023 [19]. Bitcoin's fundamental weakness is that it is vulnerable to quantum computing. As a result, developers and Bitcoin consumers must reconsider bitcoin adoption for business purposes [20].

In terms of Blockchain technology adoption, the use of information technology typically results in major changes to a company's business practices [21]. As the modifications get more complex, rivals find it increasingly difficult to reproduce them and gain a strategic competitive advantage. For over a decade, blockchain technology has gotten a lot of interest throughout the world. Since the technology's inception, researchers' focus has switched to investigating the technology's findings [22]. According to IDC Market Scape Worldwide Blockchain Services Vendor Assessment report several consultancy companies introduced solutions for BCT such as IBM, Accenture, EY, Infosys, and others [23]. It is also important to mention that The Linux Foundation introduced Hyperledger Grid, a new project to help build and deliver supply chain solutions, early 2019 [24]. Since blockchain is a budding technology, different types of applications require different types of blockchain. Industries adopting BCT need to invest huge initial cost for the infrastructure in order to implement BCT solutions to offer promising features in various domains. Companies in industries as diverse as finance, sports, health care, retail, oil and gas, and pharma are engaging in a wave of blockchain experiments [25].

Although there are concerns with blockchain implementations such as data security, cost/budget limitations, regulatory concerns, and uncertainty. The 2019 Industry IT & Communications Survey showed that 51% from a total of 2769 firms said that blockchain will drive digital transformation within their organizations [26]. Blockchain expectations are well grounded; it is anticipated that blockchain may provide up to \$3.1 trillion in new corporate value by 2030, with half of it generated by 2025 with applications aimed for operational improvement. On the other hand, a survey of 2871 chief information officers (CIO) respondents, done by Gartner's 2019, 3% of them said they have a live and operational blockchain for their business, 8% said they are in short term planning or pilot execution, and only few are fully implementing. Blockchain's technological immaturity, coupled with the conservatism inside many organizations, combine to create the current market solutions in centralized environments [25].

Many factors may influence technology adoption, including a lack of managerial support, employee knowledge in the general information technology context, product characteristics, deficiencies in the firm's online infrastructure, a reluctance to change the current business model, associated costs as reasons for avoiding the leap into online sales, the development of internal organizational processes, the use of e-business tools rather than traditional business tools, and security concerns [21]. As a result, there is a growing future requirement to understand what influences BCT adoption technology in every organization. TAM's capacity was superior than TRA and TPB due to its ease of application across multiple research contexts, and it is widely utilized in forecasting information technology adoption [5]. As a result, it is advantageous for the use of identifying the uniqueness technology such as Block Chain Technology (BCT).

In the context of BCT adoption in Saudi Arabia, it is estimated that Saudi Arabia's share for BCT would amount to \$250 billion [11]. The Saudi government BCT Laboratory was one of the National Transformation Program initiatives in 2016 to test and experiment with ideas and solutions to develop and improve the government's procedural services, as well as to

develop a plan to improve the quality of government services provided to citizens using BCT [27]. As a result of the initiative multiple government agencies had adapted BCT; Saudi Customs, with its IT partner, Tadawul, integrated its unified digital platform for the import and export system (FASAH) with TradeLens, a blockchain-enabled global shipping solution jointly developed by Maersk and IBM [28]. TradeLens employs blockchain technology to digitize supply chains, allowing for improved industry innovation, less trade friction, and, eventually, increased global commerce. The platform-based solution enables many trade partners to interact by creating a single shared view of a transaction and its associated documents without jeopardizing specifics, privacy, or secrecy [29].

The Saudi Arabian Monetary Authority (SAMA) has joined the RippleNet allied banking blockchain network to assist domestic banks in making safe monetary transfers faster and cheaper with regional banks [30]. SAMA and the UAE initiated Project Aber to investigate the feasibility of a unified dual-issued digital currency as a tool for internal and cross-border settlement between the two nations. The project successfully launched a first-of-its-kind, dual-issued central bank digital currency, established a new DLT-based solution for real-time cross-border interbank payments between commercial banks without the need to maintain and reconcile nostro accounts with each other, peer-to-peer payments between commercial banks could be executed without the active involvement of central banks, and finally, the Aber Protocol handled the safety, privacy, and security concerns [31].

SAMA established the Fintech Saudi (fintechsaudi.com) project in conjunction with the Capital Markets Authority (CMA) in aim to convert Saudi Arabia into an innovative fintech center with a vibrant and responsible fintech ecosystem. Riyadh Bank invested SR100 million (\$26.7 million) in a venture capital fund in fintech. SABB and HSBC banks used a blockchain-based technology to perform an international trade transaction involving the transfer of homogenized aluminum billets from Aluminium Bahrain to Saudi Arabia's Altaiseer Aluminium Corporation [32]. Following their successful graduation from the SAMA Regulatory Sandbox, SAMA certified two digital wallet companies: Bayan Payments (Bayanpay) and Halalah [33].

Saudi Arabia has also entered into a collaboration agreement with IBM and Elm to examine ideas for offering government and commercial services using blockchain [30]. King Abdullah University of Science and Technology (KAUST) and Learning Machine Technologies (LMT) are collaborating to issue digital certificates to graduates using the Learning Machine Issuing System blockchain-anchored credentials known as "Blockcerts." Blockcerts is a global open standard for portable, safe, and digital documents that can be confirmed as authentic for a lifetime at no cost, created in collaboration between the MIT Media Lab and Learning Machine [34].

It is anticipated that BCT usage in Saudi Arabia would broaden to include smart cities, health, and tourism. The Ministry of Municipal and Rural Affairs (MOMRA) has stated its intention to build 10 smart cities. This would improve municipal administration efficiency, attract local and foreign investment, provide job opportunities, and increase BCT demand. The digitization of the medical sector is increasing demand for blockchain solutions to

preserve and retain sensitive patient data. BCT can promote tourism by enabling the gathering of points and prizes across numerous sites and attractions via a universal platform for loyalty and incentives [35].

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III. THE RESEARCH MODEL

The research model has five variables based on TAM theoretical framework: (1) Perceived Usefulness (PU); (2) Perceived Ease of Use (PEOU); (3) Attitude Towards Use (ATU); (4) Intention to Use (IU); and (5) Actual Usage of Block Chain Technology (AUBCT)—this is the model outcome variable and the theoretical contribution to the existing TAM model addressing issues related to the characteristics of the firms adopted BCT. AUBCT predicts the BCT successful use of a firm based on the antecedent variables of PU, PEOU, ATU, and IU. That is, both the user's attitude and intention become the mediators between the new technology usage and its perceived useful characteristics.

This study evaluates the following six hypotheses (see Fig. 2) in the Saudi Arabian context: (H1) There is a positive correlation between the PEOU and the PU; (H2) The PU variable is positively correlated with the ATU variable; (H3) The PEOU variable is positively correlated with the ATU variable; (H4) There is a positive correlation between the PU and IU variables; (H5) The ATU is positively correlated with ITU variable; and (H6) There is a positive correlation between the ITU and AUBCT variables.

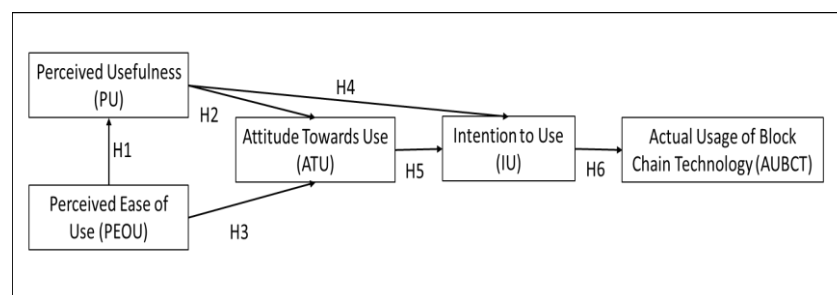


Fig. 2 The research proposed model of BCT adoption based on TAM theoretical model.

IV. METHODOLOGY

This study focuses over Saudi business firms using BCT and hence a comprehensive questionnaire has been designed to collect data. A Likert scale of 7 (1-Extremely poorly, 2-Poor, 3-Somewhat poor, 4-Uncertain, 5-Somewhat high, 6- High and 7-Extremely high) used to assess the level of development in the responding firms in the questionnaire. There were about 1500 firms targeted in which around 200 firms were identified from Tadawul (Saudi stock market) and the remaining 1300 surveys were sent to Yanbu University College's Alumni. Out of the sent surveys, only 740 valid responses were collected and analyzed which is 58% response rate. The questionnaire designed and sent electronically to the respective firms and Alumni. A descriptive statistical method chosen to describe the attributes of the respondents and regression and correlation analysis used to explain the results. Cronbach's Alpha applied to the test the validity of the data collected.

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V. RESULTS AND DISCUSSION

In order to test the internal co-linearity and internal consistency among the variables used in the study, a reliability test Cronbach's Alpha employed. All values reported are higher than 0.88. Hence the study submits that the scale explains the research's TAM theoretical model and there is consistency found among the four described constructs of the model. Overall Cronbach's Alpha value for PU, PEOU, ATU, IU, and AUBCT found 0.921, 0.964, 0.889, 0.967 and 0.887 respectively.

SEM analysis in AMOS 21 revealed that all pathways were significant and positively linked. Overall correlation among the constructs PU, PEOU, ATU, IU, and AUBCT found significant positive and acceptable. This means all the constructs support each other in achieving the ultimate output of the model. Table 1 displays the correlation among the components of the research model and it reveals that there is acceptable positive correlation exists between PEOU and PU ($r=0.29$), PU and ATU ($r=0.58$), PEOU and ATU ($r=0.43$), PU and IU ($r=0.60$), ATU and IU ($r=0.25$), IU and AUBCT ($r=0.76$). Thus, all the proposed

hypotheses are supported.

Because the P value is substantial in each case, each variable is significant to the other variable. This indicates that the influence of PEOU on PU is positively associated, with an estimate value of 0.29. This suggests that in the specified paradigm, the PEOU has a beneficial influence over the PU about 29 percent of the time. Similarly, the association between PU and IU is shown to be strongly associated and extremely significant, as the value suggests that 60% (0.60) of the PU has a substantially beneficial influence on the IU. Similarly, the IU has an 80 percent beneficial influence on the AUBCT construct (0.80). This implies that all of the components help each other to achieve the model's final output. The GOF analysis yielded χ^2 (2476.851), DF (810), p-value 0.05, normal χ^2 (3.057), model CFI (0.829), TLI (0.904), NFI (0.875), and RMSEA (0.111). Based on the findings, the research determined that the model provided a good overall fit and accepted all of the presented hypotheses.

Table 1 Results of hypotheses analysis

Constructs	SE(r)	P-Value	State
PEOU->PU	0.29	<0.001	Accept
PU->ATU	0.58	<0.001	Accept
PEOU->ATU	0.43	<0.001	Accept
PU->IU	0.60	<0.001	Accept
ATU->IU	0.25	<0.001	Accept
IU->AUBCT	0.86	<0.001	Accept

VI. CONCLUSIONS, RECOMMENDATIONS AND FUTURE RESEARCH

This study attempting to provide evidence on the adoption of blockchain technology using the TAM model as the analysis framework in Saudi Arabia, we assessed the factors of Perceived Usefulness, Perceived Ease of Use, Attitude Toward Use, and Intention to Use. The study is tackling the following research question: What are the factors contributing to the adoption of BCT in Saudi Arabia? The aim of this study is to contribute to the literature on TAM and BTC adoption in Saudi Arabia while controlling for the possible differences in responders' behaviors against the research model. This study tests the relationship between the perceived ease of use of the BCT and the actual successful usage of the technology. The presented results confirm that components of TAM model helped on the successful BCT adoption, which indicate that increasing the level of the development of the model construct would prompt a higher number of technology-adopting firms (i.e., BCT adoption).

The examination additionally displays that there is higher and positive correlation even among the parts of the model's constructs in Saudi business firms. An SEM analysis applied to test the relationship between the research model constructs. Every one of the tested hypotheses has been examined and found positive and significant and thus accepted. The study revealed that with limited resources of firms, decision makers are encouraged to further develop and enhance their firm's internal awareness while adopting BCT to maintain great level of users perceived usefulness and ease of use of the BCT in order to target a successful

usage of the technology adopted. However, with more financial investment of on other functions (i.e., developing positive attitude and intention towards the BCT adoption among the users) would create greater advantages to the firms.

As the study conducted for the Saudi Business Firms, using BCT, to test the TAM model for the technology adoption, future direction may continue in multigroup analysis for these firms that adopted BTC under TAM model. Using other models, countries, and technologies are also recommended for future studies. Furthermore, the fact that each organization has just one key responder may contribute to common technique bias, which might be addressed in future studies.

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