Original Article

Blockchain Technology Adoption in Canadian Pharmaceutical Sectors: An empirical analysis for a future outlook

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Abstract

There are many calls in the literature to investigate the Blockchain technology adoption (BCT) in Canadian Organizations and its impact on boosting enterprises' competitive advantages. Although the literature requires more research cases, it is more timely and relevant that the analysis be done as early as today. Various empirical supports for Technology Acceptance Model (TAM) are available depending on situation specifics. TAM remains a widespread and convenient theoretical framework for examination of aspects contributing to technology acceptance. This study aims to find the driving forces that effectively illustrate the blockchain technology adoption in Canadian Pharmaceutical Organizations and to be able to face the challenges associated with the process of adoption. This study examined BCT application using contacts from Canadian Companies Capabilities directory (CCC) and applied SEM regression using AMOS software with 750 respondents from pharmaceutical businesses using TAM framework. Path analysis results were good: chi2 (4918.592), chi2 / DF (5.513), RMSEA (0.049), CFI (0.753), and TLI (0.804). Perceived ease of use, Perceived Usefulness, attitude towards use, and intention to use predicted BCT utilization, yet two relationships (i.e., PEOU->PU and PU->IU) were rejected in the tested model as they show negative conformity results. All components explain more than 50% of variation, hence presenting a reasonable fit between the data examined and the research model. These findings will help in understanding of pharmaceutical organizations' adoption of BCT for researchers, regulators and developers and providing supported evidence on factors contributing to the adoption of BCT in Canadian Organizations.

Keywords: Blockchain, Technology Acceptance Model (TAM), Technology Adoption, Driving Forces, Challenges, Canadian Pharmaceutical Organizations, Canada.

INTRODUCTION

Blockchain is a fascinating new technology with several uses. Blockchain technology, similarly acknowledged as Distributed Ledger Technology (DLT), works devolution and cryptographic hashing to make digital asset histories unalterable and accessible. Blockchain technology is increasingly being used, and its applications span from data security to shared pieces of information, and from secrecy to openness [1]. BCT provided a new way of securing data and transaction records for use by multiple parties without relying on a trusted central authority; this proposition inspired businesses and governments in a variety of sectors to develop ICT solutions based on BCT, including financial, sport, healthcare, retail, oil and gas, pharmacy, tourism, and education. The Technology Adoption Model (TAM) was utilized in this study to describe the broad factors of computer acceptance that lead to understanding user behavior in the example of Blockchain Technology (BCT) adoption in Canadian Organizations. This paper provides current examples demonstrating that BCT is a fundamental driver of digital transformation in organizations and a source of new economic value generation.

Following 2008, blockchain gained a lot of scientific and media attention, as well as people's enthusiasm for its possible uses and role in decentralizing society as well as the consequent independence from central authority [2]. According to [3,4] people's interest has been stirred by the positive or disruptive effects that broad adoption of this technology will bring to our society. Because Bitcoin is the most extensively used and important blockchain technology with the largest user base, the majority of research is focused on the Bitcoin ecosystem. There are also ongoing studies that raise concerns about Bitcoin's long-term viability, taking into consideration the environment, social issues, and economic aspects of the blockchain-based infrastructure. Alsaed, et al. [5] examined the role of blockchain in controlling and mitigating the COVID-19 situation. Similarly, [6] stated

that the health industry is one among the most sectors affected by the COVID-19 dilemma, and blockchain technology offers attributes that enable it to transform numerous industries. Furthermore, the European Parliamentary Research Service (EPRS) considers blockchain to be a vital tool in the battle against COVID-19.

Literature Review

Technology Adoption Models

Today, blockchain technology is a prominent issue and has helped numerous businesses. According to [7], a literature analysis was undertaken to describe the adoption frameworks used to research blockchain adoption and identify the commercial segments where these prototypes have been utilized. By dividing articles into five key categories—supply chain, industries, finance, cryptocurrencies, and miscellaneous studies—a research of 56 publications on blockchain adoption models was conducted (excluded from the former fields). The TAM, TOE, and new conceptual frameworks were the most commonly discussed models in the research. Other popular models were those based on the technology acceptance model (TAM). There has been a lot of discussion about how blockchain technology is being employed in various supply chains and businesses recently.

The technology adoption models are the available theories and frameworks that can possibly make the business organizations accept or employ advanced technology. They explain how individuals make use of the recent technology for purposes which include businesses, health, education, communication and others. The adoption of technology builds confidence among users who utilize the appropriate models. Scholars presented Several technology adoption models to determine the reasons for technology adoption. This technology motivates the business organizations to freely employ technology due to its importance through the course of time [8].

Various supports are readily available regarding Technology Acceptance Model depending on the specifics and the natural barriers present during the adoption [9]. Also, Rogers stated that the diffusion of innovation includes five stages of modern revolutionary technology categorized as first movers, early utilizers, early mainstream, late mainstream, and followers. Different organizations benefit with Digital Object Identifier (DOI). Article [10] described eight factors such as authorization, production timeliness, compatibility, reliability, ease of training, relationship with users, locateability, and quality. In addition to utilization, [11] stated that the theory of Task-Technology Fit (TTF) measure, is found to be an important predictor of user reports of improved job performance and effectiveness that was attributable to their use of the system under investigation.

According to [12], the Theory of Reasoned Action (TRA) suggests that an person's action is the result of his or her aim, and this intent, in turn, is what the community to which he or she belongs sees. Similarly, [13] emphasizes TRA in the Theory of Planned Behavior, in which every action is motivated by a social purpose, which is influenced by attitudes, subjective standards, and acknowledged behavioral control. However, [14] claimed that valid evaluation procedures are insufficient, and that whatever is accessible in connection to the system being used must be validated before it can be acceptable to computer users.

Blockchain (BC) was originally presented to the public by [15] in the year 2008, and it is presently getting the attention of a great number of companies owing to the significance it has in altering the operations of enterprises. According to the primary attributes of BCT, such as smart contracts, transparency, traceability, and cyber protection, this technology is not only used for its primary application as a cryptocurrency, but it is also applicable in a variety of other areas, such as healthcare, government elections, supply chain management, identity management, logistics, and so on. BCTs primary application is as a cryptocurrency, but it is also applicable in a variety of other areas [16]. Because of the widespread use of blockchain technology over the course of the last decade, a wide variety of frameworks and platforms have been available. These infrastructures addressed concerns such as smart contracts, the Internet of Things (IoT), and bitcoin in order to develop blockchain.

The blockchain framework was given and summarized as follows by [17-19]. As an open-source technical structure, Ethereum enables the creation of un-centralized internet services as well as decentralized programs based on smart agreements. The Ethereum virtual machine (EVM), un-centralized programs, framework performance parameters, and smart agreements are the four key components of this platform. Another structure supported by IBM and the Linux systems is the Hyper-ledger. This architecture might be used to build blockchain technology in a variety of businesses. Furthermore, Bitcoin, the most prominent

and well known cryptocurrency system, was founded in 2009. The Corda platform is yet an additional structure that was created for two primary programs: legal agreements and data distribution among communally trusted enterprises. This also allows for the development of several apps based on interoperability on a particular network.

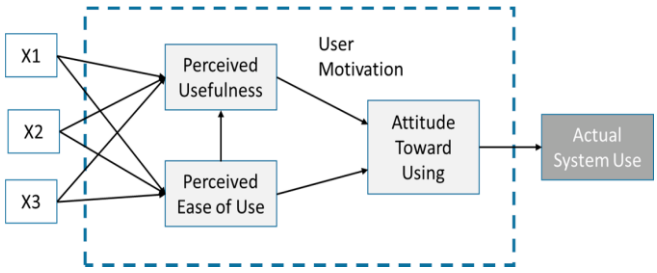
EOS is another BC technology that has the potential to be used in both the public and private sectors. This platform is able to cater to the particular requirements of the firm, such as speed that leads the market, safe app processing, and role-based permissions for security. The next framework is going to be the Internet of Things applications (IOTA) system, which was introduced in 2016 as a small transaction settlement for Internet of Things applications. Activities on this platform may be executed via the use of a one-of-a-kind peer-to-peer mechanism that is referred to as tangled [20]. This particular platform does not have the typical blockchain architecture, in contrast to other platforms. Another kind of architecture that may be used for currency conversion and payment networks is known as Ripple (XRP), which was formerly known as OpenCoin Ripple. The XRP Ledger, which is a distributed ledger database, serves as the foundation for the network known as RippleNet. This framework intends to bring together payment providers, digital asset exchanges, and banks in order to accelerate and lower the overall cost of global financial transactions.

In addition to the systems already stated, the Waves structure is a distributed and open platform that enables designers to create apps that use new currency. Application developers may be able to build all blockchain-based applications utilizing a software system that offers a variety of utilities and tools if this blockchain platform has the claimed unique attribute that allows them to do so. In addition, the design of the Quorum blockchain was employed in order to address the primary challenges that are linked with the utilization of decentralized registries and smaller contractual applications within the financial industry. J.P. Morgan created this platform with the goal of increasing the number of transactions conducted by institutions. Through the use of the Quorum architecture, restricting access to the transaction history while maintaining system transparency is possible. The ultimate platform, also known as the emerging business movement (NEM or XEM), was built with the goal of achieving high speed as well as scalability. This private platform incorporates a proof-of-concept (POI) method, which is a ground-breaking compromise technique that can add a chunk to the BC and is used to evaluate network users.

In the past, discussions have been held on various blockchain-related concepts, applications, and general frameworks. The important finding of this paper is to examine the adoption of BCT in various businesses. This allows the researchers to create a comprehensive list of the modeling techniques that may be adopted for BC acceptance. This contribution is based on the usage of BC technology in various domains. In addition, the findings of this study provide adoption models that vary according to the fields of investigation, which may imply that not enough industries have been investigated. In the following parts, we will discuss the many acceptance models that are important, as well as the significance of researching blockchain adoption. After that, publications that examined blockchain adoption in a variety of settings will be evaluated (in the methodology section), and this will lead to the identification of research topics such as "the models applied in blockchain adoption" and "the industries of study." In conclusion, a discussion of the results will be held in order to explain the value of blockchain technology in a variety of organizations.

Another theoretical framework is Technology Acceptance Model. Articles [14,21] first proposed this approach, which is based on the TRA framework, to overcome the ambiguity of psychometric and theoretical standards in TRA by eliminating subjective norms. As one of the most often referenced frameworks, the TAM covers ease of use and perceived utility as the major considerations. According to TAM, not only does it include BI, but it also considers two important concepts (perceived ease of use and perceived utility) that have an influence on users' attitudes toward the system, which are analyzed as favorable and unfavorable against it.

Figure 1: Technology Acceptance Model [21].



Perceived usefulness in figure 1 is directly influenced by ease of use in this paradigm, whereas attitudes and business outcomes are influenced by the perceived usefulness indirectly. External factors such as system characteristics, user training, user participation, etc. are also taken into account by this approach.

Blockchain Adoption in Canada

Blockchain (BC) is a decentralized digital database that is publically reachable to be utilized and shared at the same time. Article [16] stated many firms are concentrating on blockchain, which was originally invented by [15] in 2008, because of its importance in changing operational procedures. Furthermore, [22] asserted that blockchain technology is useful in a broad range of sectors, including government votes, healthcare, pharmaceutical, transportation, identity management, and supply chain, according to important qualities such as traceability, transparency, smart contracts, and security.

BC was first presented in 2008 by [15], and it is now a priority area for many firms including pharmaceutical companies because of its significance in transforming operational procedures. Traceability, transparency, smart contracts, and security are just a few of the many uses for blockchain technology that go beyond its primary role as a cryptocurrency.

According to [23] Walmart Canada utilized bockchain in order to resolve incompatible enterprise systems resulting from the use of multiple information systems between Walmart Canada and its carriers including drug suppliers. Vast data discrepancies in the invoice required expensive auditing processor and delayed payments without mentioning the time-consuming manual later to complete the data, so the leaders resorted to suggesting the use of automating process.

Another study conducted by [24] incorporated diffusion of innovation theory with TAM while studying block chain technology. They propose new lessons on the features driving acceptance to remediate lack of application of advanced statistical methods studying integration of blockchain technology for e-learning or electronic in higher education.

Many scholars such as [24] stated that former studies advocated technology acceptance model (TAM) as the main method in order to illuminate adoption of information system (IS) and there is uncertainty whether this approach could be employed in assessing any case of information system acceptance. Furthermore, [24] reported that various experimental studies suggested that TAM could be incorporated with more theories such as Constructivism, Technology Readiness Index, Information and System Success in order to take care of swift alterations in dealing with data.

In reviewing the literature of blockchain technologies by [24] reveals that the majority of research focus on showing the benefits and drawbacks of deploying disruptive technology. The deployment of distributed ledger technology applications has received minimal attention. One of the primary studies has looked into the adoption of blockchain in the education industry. The goal of this study is to gain a thorough knowledge of the many decision-making variables that impact user intentions to utilize blockchain in education. The purpose of the presented model is to evaluate the applicability of TAM constructs in the context of diffusion of innovation theory.

In the field of education, a study conducted by [25] intends to close the gap by examining and assessing the experience of blockchain-based solutions adoption in academia from 2017 to 2020. It is perhaps the first research on DLT usage in science conducted within the context of blockchain adoption studies, and one that uses qualitative technique to analyze the experience from the actors'/players' perspective. Furthermore, [26] argued/claimed that blockchain has a good probability of bringing new options and outlets to science management. Yet, simply promising a better digital future is inadequate. DLT research programs must succeed in reaching out to individual scientists as well as the hundreds of fragmented academic "tribes" to reach the top. The study also shed light on National Research Council of Canada's pilot project as a successful example in the public division where Ethereum blockchain to proactively broadcast award and donation information in actual time.

As per [27], blockchain is a digital technology that is still in the process of growing and has very little impact on the economy and labor market of Canada. Building Canadian Consent investigates not just the present condition of the blockchain ecosystem in Canada but also its possible future applications. Before going on to discuss the labor market and opportunities for studying and working in blockchain, the Data and Telecommunications Technology Council (ICTC) provides an overview of the technology, the industries in which it is utilized, its applications, and regional differences.

The blockchain is a new technology that is still in its early phases, and the impact that it will have on the economy and job market in Canada is only starting to take shape. Building Canadian Consensus investigates the blockchain ecosystem in Canada

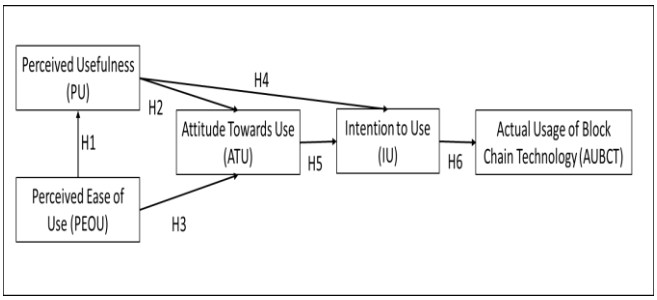
at the present time, documenting both its existing condition and its possible future applications. Before moving to the labor market and prospects for working and studying in blockchain, the Data and Telecommunications Technology Council presents an overview of distributed ledger technology, the sectors it is present in, its uses, and variances throughout Canada. This is done via in-depth talks with industry experts and a broad variety of data collecting.

The Research Model

The TAM model comprises five variables: (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 theoretical contribution to the existing TAM model addressing the characteristics of firms that adopted BCT. AUBCT forecasts BCT business success based on PU, PEOU, ATU, and IU. The user's attitude and purpose mediate the new technology's usefulness.

In Canada, this research assesses six hypotheses (see Figure 2) (H1) PEOU and PU are positively correlated; (H2) PU and ATU are positively correlated; (H3) PEOU and ATU are positively correlated; (H4) PU and IU are positively correlated; (H5) ATU is positively correlated with ITU; and (H6) ITU and AUBCT are positively correlated.

Figure 2. The research proposed model of BCT adoption based on TAM theoretical model (Created by the authors).



METHODOLOGY

This study focuses on Canadian pharmaceutical companies; hence a questionnaire was constructed. Using a 7-point Likert scale, we rated the firms' progress (1-Extremely badly, 2-Poor, 3-Somewhat poor, 4-Uncertain, 5-Somewhat high, 6-High, and 7-Extremely high). About three thousand pharmaceutical firms were targeted from CCC directory. Only 750 survey responses (25%) were legitimate. Regression and correlation to explain data. Cronbach's Alpha validated the findings.

Businesses and governments are pressured to use technology. For competitive advantage, researchers-built models and theories to study consumer tech adoption. This study used TAM to describe computer acceptance and user behavior in BCT adoption. BCT provided a revolutionary way for protecting data and transaction records without a trusted central authority. Businesses and governments in many areas, including finance, sport, healthcare, pharmaceutical, retail, oil and gas, pharma, tourism, and education, developed BCT-based ICT solutions. Blockchain implementation challenges include data security, cost/budget restrictions, regulatory issues, and uncertainty. BCT fosters digital transformation and delivers corporate value, according to many cases.

RESULTS AND DISCUSSION

Cronbach's Alpha was used to examine the variables' internal co-linearity and consistency. All values over 0.90 The study concludes that the scale describes the TAM model, and its five components are consistent. PU, PEOU, ATU, IU, and AUBCT had overall Cronbach's Alpha values of 0.90, 0.862, 0.959, 0,967, and 0.875.

Not all pathways were significant but all were positively related, according to SEM analysis. Positive and acceptable association

was discovered between PU-ATU, PEOU-ATU, ATU-IU, and IU-AUBCT. Two hypotheses were rejected as they were insignificant namely PEOU-PU and PU-IU. All the constructs help achieve the model's result even with the rejected hypotheses as they were serving as mediators with partial effect on the linked constructs and the other accepted hypotheses contributed in validating the model's constructs. Table 1 depicts the association among the study model's components and shows a positive correlation between PU and ATU (r=0.40), PEOU and ATU (r=0.33), ATU and IU (r=0.40), and IU and AUBCT (r=0.96).

Each variable is meaningful to the other since the P value is large. In this model, ATU and IU are significantly related and very important, as the value shows that 40% (0.40) of the ATU benefits the IU. IU has an 96% positive impact on AUBCT (0.96). This means that the model's components work together fairly. The GOF analysis produced chi2 (4918.592), DF (910), p=0.05, normal chi2 (5.513), model CFI (0.753), TLI (0.804), NFI (0.725), and RMSEA (0.049). According to the results, the model matched most of the assumptions.

TABLE I: RESULTS OF HYPOTHESES ANALYSIS

Constructs	SE(r)	P-Value	State
PEOU->PU	0.29	<0.003	Reject
PU->ATU	0.40	<0.001	Accept
PEOU->ATU	0.33	<0.001	Accept
PU->IU	0.11	<0.101	Reject
ATU->IU	0.40	<0.001	Accept
IU->AUBCT	0.96	<0.001	Accept

CONCLUSIONS, RECOMMENDATIONS AND FUTURE RESEARCH

This research measured perceived usefulness, perceived ease of use, attitude toward use, and intention to use to determine the adoption of blockchain technology in Canada. The study asks: Why has Canada adopted BCT in pharmaceutical sectors? This study aims to add to the literature on TAM and BTC adoption in Canada by adjusting for respondent behavior variations. This research examines the link between perceived and real BCT ease of use. The findings demonstrate that TAM model components aided in better understanding the BCT adoption in Canada, indicating that considering and deploying the outcomes of the model analysis will increase the number of technology-adopting pharmaceutical enterprises and enhance their adoption experience (i.e., BCT adoption).

The study also shows a favorable association between model constructs in Canadian pharmaceutical businesses in general while rejecting two hypotheses linking perceived ease of use with usefulness and attitude toward use with intention to use as they were showing negative association with the research model. SEM used to assess model construct relationships. Four out of six tested hypotheses were affirmative and accepted. With limited company resources, decision makers are urged to establish and expand their firm's internal awareness while implementing BCT to maintain a high degree of users' perceived utility and simplicity of use of the technology. More financial expenditure on other functions (e.g., building favorable attitudes and intentions towards BCT adoption among users) might produce higher benefits for organizations.

As Canadian Business Organizations were used in this study to assess the BCT adoption using the TAM model, future direction may include multigroup analysis for these firms. Future research should use additional models, nations, and technology. Each company having just one key responder may lead to common method bias, which should be addressed in future research.

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