Blockchain Innovation and Information at HHH University: Issues of Methodology

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Introduction. Blockchain is an electronic ledger system that available to the public as an open-source technology (Dogru, Mody, & Leonardi, 2018). The ledger system allows disparate users to make electronic records of their transactions through a time-stamping system that links each transaction to previous and next transaction in a chronological manner (Dogru et al., 2018). Each electronic record of a transaction is termed as a block and is liked to a particular user. The linked system allows several users to record transactions in a controlled yet open manner. The ledgers can only be updated after the participants in the transactions reach a consensus (Dogru et al., 2018). Further, all the data entered into the system cannot be erased ensuring that the system retains an authentic and verifiable record, or all the transactions made by the users. The system is secured through cryptography and the networked nature of transactions (Dogru et al., 2018). The nodes of a distributed ledger do not trust each other and independently verify the validity of the transaction record before applying them to new transactions. The encryption used in blockchain transactions utilizes a digital fingerprint generated through the use of a hashing function (Dogru et al., 2018). Each block on the chain is connected to the next by a hash value. The nodes that connect the chain verify the validity of a transaction by automatically determining its conformity to the rules set in the smart contract. Blockchain platforms differ by the confirmation process used to enter new transac- tions to the ledger.

Methodology and literature review. The diffusion of innovation theory (DIT) explores the mechanisms that shape the adoption of a new con- cept, product, practice or perspectives. It was popularized by Everett Rogers (Sahin, 2006). Rogers argued that only a few people are open to new ideas and are willing to adopt them for real life applications. As the early adopters influence more people to adopt the technology a critical mass of adopters develops, and the innovation gets diffused amongst the population until it reaches a saturation point (Sahin, 2006). Rogers classified the adopters into five distinct categories. The innovators are technology enthusiasts and appreciate technology for its sake (Lyytinen & Damsgaard, 2001). The early adopters are visionar- ies who adopt the technology and act as opinion leaders. They are natural trendsetters and are attracted to high-risk high reward investments. They are not particularly cost sensitive (Lyytinen & Damsgaard, 2001). The early majority are the pragmatists who adopt innovations that make business sense and have proven reliability. They abhor complexity and only take advice from trusted friends. The late majority is

very conservative but adopts technology due to peer pressure and economic necessity (Lyytinen & Damsgaard, 2001). They are very skeptical, cost-sensitive and only adopt innovations in order to keep up with the competition. The laggards are very skeptical of innovations and prefer the status quo and only invest in a technology if there are no viable alternatives (Lee, 2009). The theory asserts that the innovators make 2.5% of the users while early adopters make 13.5% of the users (Lyytinen & Damsgaard, 2001). Early and late majority users comprise 34% respectively while the laggards comprise 16 of the users. The theory aims to streamline innovations such that they meet the needs of all the five categories of users. The theory considers peer networks to be an important component of the adoption of an application as it is through these networks that innovators and early adopters stimulate mass adoption of the tech- nology. Rogers (cited in Lyytinen & Damsgaard, 2001) identified five predictors of the success of an innovation. The predictors are the relative advantage offered by a technology, observability, compatibility, complexity and trialability (Teo, 2011; Lyytinen & Damsgaard, 2001). Relative advantage is the potential of an innovation to be perceived as better than the technology it replaces. Compatibility is the degree to which an application is perceived to be compatible with the prevailing conditions, experience and the needs to potential users. Complexity relates to the degree to which an innovation is considered difficult to comprehend and use (Lyytinen & Damsgaard, 2001). Trialability is the degree to which an application can be tested and modified. Observability relates to quality of the innovation having high visibility such that it stimulates discussions among peers (Sanson-Fisher, 2004; Venkatesh et al. 2014). Rogers opined that the five factors account for 49-87% of the variations that exist among different innovations.

Analysis. *Technology Acceptance Model (TAM).* Changes in technology disrupt the established business models threatening the existence of some busi- ness while offering new approaches for doing business (Taherdoost, 2018). Typically, the established firm seeks ways of harnessing new technologies to improve their competitive position. The adoption of the new technology is dependent on several factors including its availability, convenience, security and customer needs (Taherdoost, 2018). The rate of adoption of a technology is dependent on the interaction between speed of technological change and natural barriers to technology acceptance. The technology acceptance model (TAM) (Figure 1) is a theory of technology adoption developed by Fred Davis and attempts to model user acceptance of new technologies. Theory tests technologies based on the two parameters of perceived usefulness (PU) and perceived ease of use (PEU) (Targowski, 2003; Surendran, 2012). Perceived usefulness tests the subjective likelihood of a user benefiting from the use of a new technology. The perceived ease of use tests potential users' expectation that the use of the new technology will be effortless. However, other factors also influence the user's perception of the new technology. Venkatesh and Davis (cited in Surendran, 2012) found that the

two constructs of perceived usefulness and perceived ease of use had a direct influence on user behavior.

Figure 1. TAM model
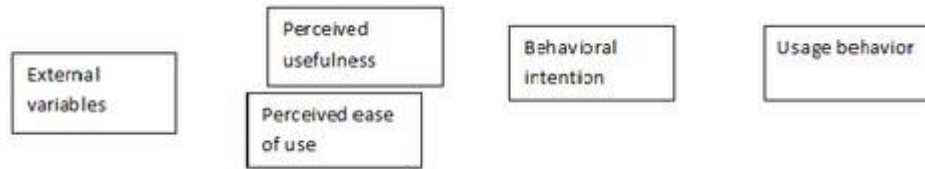
Davis proposed six items four of which are most commonly used on PU (Lai, 2017). These factors are the effect of the technology on productivity, impact of the technology on job performance, impact of the technology workplace effectiveness, overall usefulness of the technology in relation to one's job (Lai, 2017). All the four factors have been found to have an acceptable degree of internal consistency. Similarly, four items are commonly used to assess the PEU parameter (Chuttur, 2009; Lai, 2017). These items are ease of using the technology, ease of manipulating the application, difficulty in interacting with the system and overall ease of employing the technology (Chuttur, 2009). These four factors have been found to have an acceptable level of internal consistency. Overall, TAM has been used on many empirical studies and found to employ reliable tools that produce reliable results. Instructively, the influence of some factors varies with the stages of the imple- mentation process (Davis, 1985). Irrespective of the variables used, the TAM model never goes beyond explaining 40% of the variance in the use of new applications (Chen et al. 2017). Finally, most of the studies involve self-reported use.

Blockchain Technology (TAM and DIT). A promising template for the adoption of the blockchain technology is the adoption of the internet. The blockchain technology builds on the peer-to-peer network that has been very successful on the internet. Just like email was the first application of the internet, the Bitcoin is the first application of blockchain (Swan, 2015). The email facilitated bilateral communication the same way Bitcoins facilitate bilateral financial transactions. Further, the blockchain is an open and distributed network just like the internet (Swan, 2015). For the blockchain to gain widespread adoption by firms, it must portend economic advantages for those firms as envisaged in TAM. Firms were incentivized to adopt the internet due to its capacity to substantially lower the cost of communication (Iansiti & Lakhani, 2017). Similarly, for blockchain to be adopted by firms, it has to substantially lower the cost of transactions. This will stimulate its adoption by firms as the preferred system for recording transactions (Swan, 2015). Such a shift will stimulate the emergence of firms that offer blockchain based applications that will facilitate the widespread adoption of the technology. Blockchain has huge potential for lowering transaction costs as most

organizations incur high costs in reconciling transactions (Swan, 2015). A typical transaction may take weeks to be verified and ap- proved as parties to the transaction cannot verify the transaction automatically and have to rely on in- termediaries who act as guarantors of asset transfer (Iansiti& Lakhani, 2017). With blockchain, ledgers are duplicated on several databases that are run by parties to a transaction. When one ledger is altered, the other ledgers are updated concurrently. This means that the ledgers are updated instantaneously as the records of value and assets change hands. This approach eliminates third-party intermediaries who are needed in the traditional set up to verify or endorse the transfer of ownership.

Information Technology Management. The adoption of the blockchain technology is consistent with the technology diffusion theory. The first stage in the adoption of blockchain is the development of a single-use and highly focused application that is favored by innovators. This has already happened with the development and adoption of crypto- currencies that offer alternative payment methods (Swan, 2015). The second stage of adoption involves implementing applications with a few users to extract instant value for the organization. This stage will involve the creation of localized private networks that connect organizations through a distributed ledger system by the early adopters (Swan, 2015). Indeed, several firms in the financial sector have already adopted the technology on a pilot scale and use it to process and validate financial transactions. Meanwhile, Canada is experimenting with a cryptocurrency to be used for interbank transfers (Iansiti & Lakhani, 2017). Financial experts anticipate that there will be a proliferation of private blockchain networks in several industries. The third phase of adoption involves applications that have widespread mass market utilization (Iansiti & Lakhani, 2017). In the case of cryptocurrencies, their widespread adoption will need to overcome challenges posed by decentralizing currency transactions and changing consumer behavior. The final stage involves the transformation of the existing systems after widespread adoption. Smart contracts are by far the most transformative blockchain application (Swan, 2015). They will automate payments and asset transfer once terms are agreed. For instance, smart contracts can be used to execute payment once shipments have been delivered. A widespread adoption of smart contracts has the potential to transform traditional organizational structures and processes. The transformation will have the effect of eliminating intermediaries such as lawyers and auditors while the role of managers will change drastically (Swan, 2015). It is at this stage that the late adopters and the laggards will have no choice but to embrace the technology.

Block Chain Technology and Security. Blockchain is more than just an electronic record of transactions as it also has a feature called smart contracts which enables users to transact without downtime, minimal risk of fraud and censorship. By far the most popular application of the blockchain technology is in the digital currencies such as the

Bitcoin (Benton & Radziwill, 2017). However, blockchain has several other applications in commerce and social transactions such as creating digital records of asset ownership (Glaser, 2017; Mendes-Da- Silva, 2018). The use of blockchain in such transactions and record keeping will be stimulated by the fact that transaction data is distributed, and the cryptographic system makes the system rather tamperproof.

Blockchain systems are synonymous with the Bitcoin and other cryptocurrencies because of their notoriety as the first widely accepted currency that is not under the control of a central authority. This application has attracted diverse reactions from different stakeholders but has most importantly represented a paradigm shift in the approaches used to make networked transactions and track changes (Mougayar & Buterin, 2016; Benton & Radziwill, 2017). The technology had the effect of transferring user trust in currencies and important transactions from humans to machines. Bitcoins use algorithms that run on machines spread around the world that integrate transactions in the chain using a process that requires intense computing work otherwise known as mining (Benton & Radziwill, 2017). Bitcoin mining has become a sector on its own evolving companies that specialize in mining. The miners are rewarded for scrutinizing transactions for their validity through a proof of work mechanism. Once all transactions have been confirmed there exists a consensus among the nodes such that all blocks are aligned in a continuous chain (Benton & Radziwill, 2017). The blockchain ledger cannot be altered or deleted once the transaction has been confirmed by all the chains. Therefore, blockchain is reputed for its integrity.

Conclusion. The blockchain technology has a huge potential for applications in systems requiring a reliable yet accessible distributed record system has can be used to service delivery in networked systems (Vo, Kundu, & Mohania, 2018). Furthermore, most economic and social systems in the modern world re- quire system administrators to create and maintain client records. Blockchain can be used in the health, financial, social security and educational institutions to create and maintain client records (Vo, Kundu, & Mohania, 2018). Currently, most of these institutions use the services of third parties to store and maintain client records exposing them to corruption either through mischief or failures in the storage system. Such problems could be mitigated through the use of blockchain systems. Mixed method research involves the use of both qualitative and quantitative methods in the same study. A major challenge of mixed method research is integrating the findings of the qualitative and quantitative research during data analysis and interpretation (Harrison et al., 2017). For a study to be classified as a mixed method research, it must integrate quantitative and qualitative methods at the design, analysis, interpretation and presentation phases (Madu, 2003). Mixed method research is used for research topics or questions that are best explored using methods that are more comprehensive than either qualitative or quantitative methods used in

isolation (Schmee & Oppenlander, 2010; Harrison et al., 2017). The method is used for research questions that are complex and multifaceted. It seeks to benefit from the strengths of both methods while moderating their weaknesses to produce a balanced interpretation of a phenomenon.

References.

Benton, M., & Radziwill, N. (2017). Quality and Innovation with Blockchain Technology. Retrieved from https://arxiv.org/abs/1710.04130

Chen, H., Rong, W., Ma, X., Qu, Y. & Xiong, Z. (2017). An Extended Technology Acceptance Model for Mobile Social Gaming Service Popularity Analysis. Mobile Information Systems, 1-12. doi:10.1155/2017/3906953

Chuttur, M. (2009). Overview of the Technology Acceptance Model: Origins, Developments and Future Directions. All Sprouts Content. Retrieved from http://aisel.aisnet.org/sprouts_all/290

Davis, F. (1985). A technology acceptance model for empirically testing new end-user information systems: theory and results [PhD thesis]. Sloan school of management.

Dogru, T., Mody, M., & Leonardi, C. (2018). Blockchain Technology & its Implications for the Hospitality Industry. Boston Hospitality Review. Retrieved from www.bu.edu/bhr/2018/02/13/blockchaintechnology-its-implications-for-the-hospitality-industry/

Girasa, R. (2018). Regulation of Cryptocurrencies and Blockchain Technologies: National and International Perspectives. Cham, Switzerland: Palgrave Macmillan. doi:10.1007/978-3-319

Glaser, F. (2017). Pervasive Decentralisation of Digital Infrastructures: A Framework for Blockchain enabled System and Use Case Analysis. Proceedings of the 50th Hawaii International Conference on System Sciences. Academic Press. 10.24251/HICSS.2017.186

Greene, J. (2007). Mixed methods in social inquiry. New York, NY: Jossey-Bass.

Harrison, H., Birks, M., Franklin, R., & Mills, J. (2017). Case Study Research: Foundations and Methodological Orientations. Forum Qualitative Sozialforschung / Forum: Qualitative. Social Research, 18(1). doi:10.17169/fqs-18.1.2655

Iansiti, M. & Lakhani, K. (2017). The Truth About Blockchain. Harvard Business Review.

Lai, P. (2017). The literature review of technology adoption models and theories for the novelty technology. Journal of Information Systems and Technology Management, 14(1), 21–38.

Lee, R. (2009). Software engineering, artificial intelligence, networking and parallel, distributed computing. Berlin: Springer. doi:10.1007/978-3-642-01203-7

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. Information & Management, 40(3), 191–204. doi:10.1016/ S0378-7206(01)00143-4

Lyytinen, K., & Damsgaard, J. (2001). What's Wrong with the Diffusion of Innovation Theory? Springer. Retrieved from https://link.springer.com/content/pdf/10.1007%2F978-0-387-35404-0

Madu, C. (2003). Statistics easy as 1,2,3 with MExcel Windows. Fairfield, CT: Chi Publishers.

Mendes-Da-Silva, W. (2018). Individual behaviors and technologies for financial innovations. Cham, Switzerland: Springer.

Mkrttchian V., Gamidullaeva L., Finogeev A. (2022) Integrating Blockchain Platforms With Big Data Solutions for Regional Innovation Development, Research Anthology on Big Data Analytics, Architectures, and Applications, DOI: 10.4018/978-1-6684-3662-2.ch018

Mkrttchian V. (2021), Impact of Artificial and Natural Intelligence Technologies With Avatar-Based Teaching, Learning, and Research in Russian Modern Universities, Impact of AI Technologies on Teaching, Learning, and Research in Higher Education DOI: 10.4018/978-1-7998-4763-2.ch013

Monette, D., Sullivan, T., & DeJong, C. (2011). Applied social research: a tool for the human services. Belmont, CA: Brookscole.

Mougayar, W., & Buterin, V. (2016). The Business Blockchain: a primer on the Promise, Practice and Application. New York, NY: John Wiley & Sons.

Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technologyrelated studies based on Rogers' theory. JET, 5(2), 14–23.

Sanson-Fisher, R. (2004). Diffusion of innovation theory for clinical change. MJA, 180, 55–56. PMID:15012582

Schmee, J., & Oppenlander, J. (2010). JMP means business: statistical models for management. Cary, NC: SAS Institute.

Surendran, P. (2012). Technology Acceptance Model: A Survey of Literature. International Journal of Business and Social Research, 2(4), 175–178.

Swan, M. (2015). Blockchain: Blueprint for new economy. Sebastopol, CA: O'Reilly Media, Inc.

Taherdoost, H. (2018). A review of the technology acceptance and adoption models and theories. Procedia manufacturing, 22, 960-967.

Targowski, A. (2003). Electronic enterprise: strategy and architecture. Hershey, PA: IGI Global. doi:10.4018/978-1-931777-77-3

Teo, T. (2011). Technology acceptance in education: research and issues. Rotterdam: Sense Publishers. doi:10.1007/978-94-6091-487-4

Treleaven, P., Brown, R., & Yang, D. (2017). Blockchain technology in finance. Computer, 50(9), 14–17.

Venkatesh, V., & Davis, F. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. Management Science, 46(2), 186–204. doi:10.1287/mnsc.46.2.186.11926

Vo, H., Kundu, A., & Mohania, M. (2018). Research Directions in Blockchain Data Management and Analytics. Proceedings of the 21st International Conference on Extending Database Technology. Academic Press.

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Blockchain has become an epidemic and significant decision that organizations may make in the next few years, enabling institutions to integrate business functions, operations, and processes in a decen- tralized distributed ledger technology. This technology will transform the business world and economy in solving the limitations created by centralization and system inefficiency. Accordingly, with the high demand and complexity of growing economies such as the HHH University countries, the need for a typical solution technology is a game changer. This will lead GCC to a solid economic base. Blockchain technology can be applicable in many different fields such as Banking, education, Health, finance, government and trade. This article will address the literature review and methodology of Blockchain technology and innovation at the GCC, particularly in Saudi Arabia. Also, more research can be conducted in the future as the system may be integrated in these countries.