Block Chain Technology Adoption Using TOE Framework

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Abstract: This research explores the acceptance of BlockChain Technology (BCT) in Banking services. BCT has changed from traditional centralised system to decentralized ledger which is a total 360 degree change .Adoption of BCT is a challenge and hence this research scrutinies the adoption of BCT using the Technology-Organization-Environment framework theory. The study highlighted that blockchain technologies hold the potential to store tempered proof data, i.e. append-only database and consensus-based on a distributed ledger system. For blockchain technologies to become the foundation stone for banking and financial services, an understanding of BCT adoption in Indian banks is essential. Therefore, the researcher explored the antecedents of BCT adoption and its outcomes. This study investigated Information Technology officers, bank managers and bank employees of banks in India about BCT adoption through a structured questionnaire. Data collected was analyzed using the PLS-SEM. In conclusion, BCT infrastructure, BCT knowledge, relative advantage, transaction cost, perceived security, organizational scope, consumer readiness, competitive pressure, government policies and bank partner readiness are the factors that affect the Blockchain technology adoption . This study provides valuable insights into bank managers/employees and technology vendors. It also gives suggestions to government officials involved in the 'Digital India' initiative of Government of India (GoI).

Index Terms: Block Chain Technology, banking services, Technology-Organization-Environment, Distributed ledger, PLS-SEM

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1.INTRODUCTION

Blockchain technology is becoming the driving forces in the business world of innovation. It has revolutionized various industries such as finance, healthcare, mobile application, retail etc. [1] [2] [3] [4].This research study is specific to how the convergence of blockchain technology will change the face of the banking and financial services industry. Block chain is the distributed Leger or Open ledger technology or decentralised digital ledger [5].Block chain is nascent technology which has potentially disrupted financial service sector by making it cost effective, secured, and visibly more transparent [6]. In short, it is decentralized distributed and public digital ledger capable of recording transactions across multiple computers so that the record cannot be modified or deleted. [7], [8] [9]. BCT is the distributed ledger with privacy ,quality of unchangeable object, Security and transparency. In blockchain, data in the distributed ledger is immutable that is irreversible. In case of any technical mistake there should be a process to revoke that mistake or the process of undo shall be there. Undo is the ability to check the integrity of the data. If any breach happens due to the misuse of any user credentials then there shall be the   property of reversibility hence reversibility becomes the biggest challenge. [10], [11]. Transaction in this technology cannot be deleted only modified or altered. This traditional banking transaction like letter of credit process, lending taking weeks has transformed the process into days increasing the efficiency. It is linking the records or blocks with the chain of all synched with matching sequence. The storage devices for the database are not attached to common processor and each block is a ordered record having a timestamp and a address of previous block. Cryptography implemented allows users to edit parts of the blockchain having their ownership through the private keys necessary to append to the file. All users' copy of the distributed

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blockchain is synchronized. [12]

2.RESEARCH GAP

Being a developing economy like India there is dynamic growth of service sector. Also, digital initiative in banking and finance sector had evolved the technology. Block chain is one of the Technologies in the forefront. Block chain in Banking has reduced processing cost and given BFSI sector a global network solution [13]. About 77% of Fintech is expected to adopt blockchain in their production system by 2020. (2017). So, in comparison to existing studies, our research focuses on Technology-Organization-Environment framework (TOE) of BCT in Banking and Finance to explore if the environment is conductive of adoption of technology.

RQ: Identify the factors that impact Blockchain tenology adoption in banking and financial services provided Indian Banks.

3.LITERATURE REVIEW

3.1 Banking and financial Services
BFSI is the significant constituent of service sector in India. The share of BFSI has multiplied from 2.78% from 1980 [14].According to the RBI the growth rate of this sector is predicted to be around 6.3%.

3.2 Blockchain technology (BCT) adoption-
According to NASSCOM report –Avasant Block Chain Service report published in 2019 mentions that in India BFSI leads with 55% in adoption of blockchain although other industries like insurance, healthcare, retail, and manufacturing are catching up. [15].Apart from disturbed ledger other technology used is validation of land records, assets inventory audit, Healthcare agriculture. [1] [16]. It has reduced the middlemen or financial intermediaries, which in turn reduces the cost burden. Banks are eager to advantage of the reduction in transaction cost, paper saving, data handling, and disintermediation. [17]It is also predicted that investment banks could save up to $10 billion by using BCT for recovering and payment settlements. [18]

3.3 Banking and financial services BCT adoption

Financial sector technology or Fintech has made sizeable investment in range of BFSI sector. Blockchain became one of the revolutionary technologies which have an incredible possibility to transform financial sector in recent years. Main properties of block chain such as decentralisation, Transparency and Immutability are important characteristic of BCT. [9], [11]. [7].This has reduced fraud in the financial domain where up to 45% of financial intermediaries are seen having fraud and financial crimes. [5], [19]. In the era of cyber age, the vulnerability to attacks, privacy is very common [20].Block chain has thus reduced the money laundering process through Smart contracts, Blockchain have facilitated secured usage through private key encryption. [21], Banking services in India have started efficiently using KYC process accessible through this technology. SBI being pioneering in using BCT later private banks like HDFC, ICICI, Axis,Kotak followed the path. [22] [23], In-spite of extraordinary possibilities offered by BCT in BFSI sector but still are organisational environment ready for the adoption of the technology. This research explores to find the technology usage of the organisation.

3.4.Research Objectives

To confirm T-O-E factors relationship for blockchain technology (BCT) adoption for banking and financial services of Indian banks. To explore how BCT infrastructure, BCT Knowledge, Relative advantage, Transaction cost, perceived security, Organization competence, Customer readiness, Competitive pressure, Partner bank readiness and Government policies contribute towards BCT adoption in Indian banking and financial services.

3.5 Literature Review And Hypothesis

Organizational technology adoption

Technology-organization-environment (TOE) theoretical framework has been employed by technology adoption studies at organizational level [24] because these three represent "both constraints and opportunities for technological innovation". TOE framework addressed EDI (Electronic Data interchange) adoption [25, 25] [26] [27], ERP (Enterprise resource planning) [28],IS (Information systems) ([29], 1999), open system

adoption [30], MRP (material resource planning) [31], mobile reservation system for hotels [32]and Electronic business adoption [33] [34]. However, studies for blockchain technology adoption using any theoretical framework at organization level are at nascent stage.

3.6 Conceptual Framework

Technological context

The technological context consists of technology equipment, infrastructure and processes. Blockchain is distributed ledger technology having potential to transform the banking and financial services industry to lower costs, reduce paper work and increase their efficiency. BCT is decentralized and exists among multiple servers not owned by single organization. BCT will facilitate banking organizations to complete payments speedily and without any errors and reduce transaction costs. Processes for letters of credit, lending, that take weeks to complete a transaction can be fastened. Banks should employ the BCT infrastructure necessary to create and operate BCT global network. BCT in banking industry would need to handle an extraordinarily large data set, therefore scalability is very important. BCT knowledge is essential to transform the way people exchange value as transactions recorded on the blocks cannot be altered once they are added. Participants can see their ledger of transactions through cryptography making payments more secure through BCT. Shared databases and cryptography in BCT allows multiple users from different cities/states or countries to have concurrent rights to the regularly revised digital ledger [35]. Currently transferring money takes more time and mostly requires process intermediaries, charging a service charge and requires stronger regulation and more cost because of the possibility of fraud occurrence. Blockchain eliminates intermediaries thereby improving security, lowering transaction and processing costs. BCT can lead to more trust between trading bank partners as they can access shared records and the security characteristics. Transactions in real-time lead to speedy money transactions and capital investments. Smart Contracts can automatically implement terms of multi-party agreements depending on matching of terms, authenticated by transaction parties without the an intermediary. As per the above discussion researcher proposes following hypotheses:

H1: BCT infrastructure positively impacts BCT adoption in BFSI.
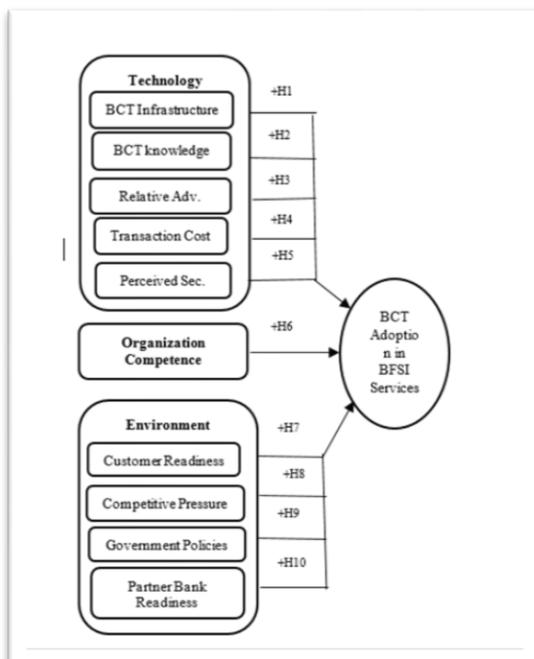H2: BCT knowledge positively impacts BCT adoption in BFSI.
H3: Relative advantage of BCT positively impacts BCT adoption in BFSI.
H4: Transaction costs for BCT positively impacts BCT adoption in BFSI.
H5: Perceived Security of BCT positively impacts BCT adoption in BFSI.

Organization competence

The organizational competence considers the industry resources, human resource, centralized decisions, and formalization of processes, organization structure, and relations among employees. [36], [37].BCT use is on priority list for banking executives leading payments businesses. Bigger organizations have supplementary resources to expedite BCT adoption, make higher investments, have large number of processes and operations, and can pursue banking partners to adopt technologies [34] [38], [39]

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As per the above discussion researcher proposes following hypothesis:
H6: Organization competence positively impacts BCT adoption in BFSI.

Environmental context
The environment consists of the competitors in banking industry, the macro environment, and the government regulations. Industry competition and market uncertainty forces banks to aggressively adopt technology [30].Trade partners can interact with a trustworthy conversation, by just using a shared truth version on the blockchain, which increases the efficiency and access funding time will be saved throughout the trade process. BCT can be used for transfer of funds, book keeping and other related functions [40]. BCT as a innovative technology will help to replace centralised international trade finance procedure to an digital decentralized ledger that gives all the stakeholders, including banks, the ability to access a single source of information. Thus monitoring of all records and validating or certifying the possession of assets digitally in actual run- time enviornment can be done. BCT enables money in form of Bitcoin and other cryptocurrencies which could be challenging to central banks' control of monetary policy in traditional the banking. Individuals and corporations can transact directly, without legacy payment networks, proprietary bank systems or bank accounts and thus without banks. BCT will offer customers different ways of paying with a decrease in consumer banking costs therefore customers' readiness shall allow banks to adopt BCT [33].The BCT that would be used by banks would need to comply with privacy laws and need to ensure the safety of the data. The regulatory policies for this new technology need to be framed by the government.

As per the above discussion researcher proposes following hypotheses:
   H7: Customer readiness positively impacts BCT adoption in BFSI.
   H8: Competitive pressure positively impacts BCT adoption in BFSI.
   H9: Government policies positively impacts BCT adoption in BFSI.
   H10: Partner bank readiness positively impacts BCT adoption in BFSI.

4.RESEARCH METHOD
Researcher conducted empirical research using survey for quantitative analysis. Interviews of bank and financial institution employees were undertaken to comprehend their attitudes towards BCT adoption, to know the existing information and communication technologies employed for banking processes.

4.1.Measures
The Scale to measure enablers for BCT adoption was adapted from T-O-E ([41], [33] [34] [25]; [42]. Banking employees' responses was quantified using a five-point Likert scale.

Research Instrument design
Adapted scale measuring 10 constructs through 36 variables for BCT infrastructure, BCT knowledge, relative advantage, transaction costs, perceived security, organization competence, customer readiness, competitive pressure, trading bank readiness, Government policies and BCT

adoption was developed. Construct validity and scale reliability was checked [32]. Face validity for all constructs was confirmed by taking suggestions from five experts from blockchain technology , middle level and top level bank employees, advisors and academicians. PLS SEM was used for the analysis .Sample of 150 was the pilot Sample. Cronbach's alpha (α) ensured the reliability of the data. The operationalized constructs are as shown in Table 2.

4.2. Data Collection
Data was collected from middle level and top-level bank employees in Pune city. Secondary data was obtained through the online database, reference books, journals papers, white papers, company reports. Sample size calculated was ten times the item numbers of the most important construct BCT adoption [33]. Therefore the sample size calculated was 340 . The sampling frame consisted of bank employees knowing about technologies in Pune city. The bank employees participated in research voluntarily, only if they had knowledge about the advantages and requirements of the BCT. Anonymity and confidentiality of employees was protected. Six hundred twenty questionnaires were sent online or filled face to face. However 447 bank employees responded. 407 responses were completely filled for the data analysis. In short 91% of sample were considered for the study [43]. Harmans' test was conducted to address common method bias([44] and Organ, 1986).

5.DATA ANALYSIS
Structural equation modelling(SEM) was done using Partial least square (PLS) data analysis software. This research extends the T-O-E framework hence PLS-SEM was used [46]. Smart PLS 2.0 software tool specified outer and inner model [45]

Table I. Sample Profile

Category	No of Respondents	Percentage
Public sector	98	23.96
Private sector	102	24.94
Financial Institution	76	18.58
Co-operative Bank	58	14.18
Non-Banking financial Institution	75	18.34
	409	100

5.1. Measurement model
Table II shows the reflective constructs measured in the conceptual framework. Factor loadings calculated [46] and Cronbach's alpha computed were higher than 0.7 for all the constructs indicating constructs reliability. Composite reliability values of all constructs ensured internal consistency as the mentioned in Table II. Average Variance extracted (AVE) was more than 0.5 ensured convergent validity.

Table II. Constructs validity

Construct	Items	Adapted
BCT Infrastructures AVE-0.634 CR-0.812 α=0.724	The technology infrastructure in the bank supports BCT	[32]
	BCT is compatible with my bank IT infrastructure.	
	BCT requires heterogeneity in hardware and software.	
	Formal policies and	

Construct	Item	Reference
	standards required for BCT usage in banks.	
	BCT consisted of requirement analysis, systems design, coding, testing, documentation, and conversion.	
BCT Knowledge AVE-0. 651 CR-0.836 α=0.782	Bank executives/ employees know about BCT.	[47] [32]
	We might use BCT if we know what it can do for our bank.	
	The technical knowledge and skills are essential to start using BCT.	
Relative advantage AVE-0. 678 CR-0.857 α=0.725	BCT will lead to overall banking process optimization.	[48] [49]
	Functionality improvements are likely in the banking services.	
	Banking Services innovations are likely.	
	BCT will enable banks to process payments more fastly and without errors	
Transaction Costs AVE-0. 674 CR-0.854 α=0.762	BCT can lower transaction costs, reduce paper work	[50] ([49]
	Transferring money will not requires financial intermediaries eliminating service charges.	
	Smart contacts reduce the intermediaries leading to reduce transaction costs.	
Perceived Security AVE-0. 637 CR-0.883 α=0.823	Participants can see their ledger of transactions through cryptography.	[51] [27])
	BCT makes payments more secure due to transparency of transactions.	
	Exchange value/ transactions recorded on the blocks cannot be altered once they are added.	
Organization competence AVE-0. 611 CR-0.858 α=0.728	Bank Managers are interested in adopting the BCT to achieve competitive advantage	[32] [50]
	Bank has the financial resources to adopt BCT.	
	Bank services requires lot of information to sell and use.	
	De-centralized decisions allow BCT adoption.	
	Degree of formalization in banks allows BCT adoption.	
Consumer Readiness (CR) AVE-0.746 CR-0.628 α=0.711	Bank customers are willing to use customized products and services.	[52]
	Customer feedback can be incorporated through BCT	
Competitive Pressure (CP) AVE-0.722 CR-0.832 α=0.751	The bank faces competitive pressure to implement BCT	[52]
	The competition among banking industry is very intense	
	Many bank products/services are different from our bank but have same functions.	
	Our bank customers switch to other bank for similar services/products easily.	
Partner banks' Readiness (TP) AVE-0.673 CR-0.634 α=0.791	The major banking partners of our bank recommended BCT implementation.	[53] [54]
	Banking partners put pressure on our industry to adopt BCT	
	Banking partners providing BCT applications, influence our bank's decision to adopt BCT	
Government Policies AVE-0.754 CR-0.671 α=0.772	Facilitate CT infrastructure development.	[55],
	Provide financial assistance towards BCT adoption.	
	Provide technological assistance towards BCT adoption	
	Promote Cashless Economy.	
BCT Adoption AVE-0.713 CR-0.636 α=0.793	BCT adoption strategy had been developed.	[29]
	BCT strategy had been approved by top management.	
	Financial resources are been approved.	

As per Table III off-diagonal values, i.e., the correlation coefficient between the measured constructs indicate discriminant validity [56] because the value of AVE is more than shared variance.

Table III Discriminant Validity

Construct	BCTI	BCTK	RA	TC	PS	OC	CR	CP	GP	PBR	BCTA
BCTI	.79										
BCTK	.32	.8									
RA	.34	.29	.82								
TC	.28	.31	.22	.82							
PS	.35	.24	.27	.31	.79						
OC	.23	.34	.18	.15	.25	.78					
CR	.22	.26	.28	.31	.36	.41	.86				
CP	.12	.16	.24	.35	.16	.19	.26	.85			
GP	.42	.26	.21	.15	.36	.27	.23	.46	.87		
PBR	.21	.37	.21	.23	.38	.14	.13	.24		.82	
BCTA	.34	.26	.14	.48	.56	.19	.27	.24	.27	.18	.84

Structural model

The path analysis is type of multiple regression statistical analysis is performed to assess associations among the constructs and the path coefficients (PC). Calculation of predictive accuracy R^2 values [57]and predictive relevance Q^2 was done [58]. The R^2 values and the Q^2 of the endogenous latent construct BCT adoption is as shown in Table IV

Table IV. Predictive accuracy R2 and predictive relevance Q2

Endogenous latent constructs	R2	Q2

BCT Adoption	.674		.293		

Table V Structural relationships and results of hypothesis testing

Hypo	Path	Path Coeff.	Std. error	T stat	Decision
H1	BCTI - BCTA	0.267	0.056	2.835***	Supported
H2	BCTK- BCTA	0.326	0.056	2.731***	Supported
H3	RA - BCTA	0.257	0.034	2.678***	Supported
H4	TC - BCTA	0.347	0.038	2.328**	Supported
H5	PS - BCTA	0.261	0.026	2.367**	Supported
H6	OC- BCTA	0.377	0.028	2.576***	Supported
H7	CR - BCTA	0.298	0.042	2.657**	Supported
H8	CP - BCTA	0.312	0.039	2.674***	Supported
H9	GP - BCTA	0.347	0.045	2.853**	Supported
H10	PBR - BCTA	0.382	0.043	5.713***	Supported

6.RESULT AND DISCUSSION

H1 path coefficient = 0.267, t-statistics = 2.835 indicates, BCTI significantly predicts BCT adoption. Technological competence due to bank's internal resources like IT infrastructure and internet providing foundation for BCT adoption ([34]

H2 path coefficient = 0.326, t-statistics = 2.731 indicates, BCTK significantly predicts BCT adoption. BCT knowledge is the significant predictor for BCT adoption [34] [59]

H3 path coefficient = 0. 257, t-statistics = 2.678 indicates, RA significantly predicts BCT adoption. BCT adoption in banking and financial services depends on the attributes of innovative technology like relative advantage and perceived security [60]Relative advantage is the perceived technological benefits provided by BCT to the banks [61]

H4 path coefficient = 0. 347, t-statistics = 2.328 indicates, TC significantly predicts BCT adoption.

H5 path coefficient = 0. 261, t-statistics = 2.367 indicates, PS significantly predicts BCT adoption. BCT provides operational benefits by improving banking functions in everyday processes like eliminating middlemen thereby reducing transaction costs, increasing data accuracy and security and higher transaction speed [62]

H6 path coefficient = 0. 377, t-statistics = 2.576 indicates, OC significantly predicts BCT adoption. BCT adoption and sustaining is possible only if banking organizations have enough organizational resources, funding, technical skills and motivation to innovate. Top management support, bank size and technological competence positively impact BCT adoption ([34]. Top management are the decision maker to create conducive environment for innovation adoption, securing resources and overcoming any resistance [63]

H7 path coefficient = 0. 298, t-statistics = 2.657 indicates, CR significantly predicts BCT adoption. CT adoption provides strategic benefits and development of corporate strategies through relation building with customers, competitors and banking partners thereby improving bank's image ([64].

H8 path coefficient = 0. 312, t-statistics = 2.674 indicates, CP significantly predicts BCT adoption.
    Pressure from competitors and banking partners are important predictor for BCT [65]; [66]).

H9 path coefficient = 0. 347, t-statistics = 2.853 indicates, GP significantly predicts BCT adoption. Pressure exerted by government policies on banks forces them to adopt innovative technology [50].

H10 path coefficient = 0. 382, t-statistics = 5.713 indicates, PBR significantly predicts BCT adoption. Partner bank readiness facilitates well-organized coordination throughout banking services life cycles [34].

7.IMPLICATIONS

This study established that T-O-E framework is applicable to identify the drivers of BCT adoption in Indian banks. This study goes beyond BCT and considers entire ecosystem of banking partners, competitors, customers, the workforce, and operational considerations to explain to explain large portion of variance in BCT adoption. Blockchain is disruptive technology capable of transforming the financial services industry by making transactions faster, cheaper, more secure and transparent. Block chain compared to driverless car. The cost reduction of driverless car bring equivalent idea can be implemented in terms of Banks. In case of driverless car freeing of driver's time, stress leading to innovation similarly in banking will help disintermediation, Transparency, provenance where data cannot be tampered, BCT eliminates the middlemen, increase transparency creating public record in the ecosystem. This also creates the chronology of the ownership, custody or location of a historical object. BCT can handle multiple data processing and transaction functions, however error free payments and strong security in payments is the highest priority. BCT can facilitate recoverability of loans granted by the banks. Smart contracts i.e. self-executing contract can automate workflows lowering processing time and reducing human errors. BCT has comply with privacy laws government regulations.

8.CONCLUSION

Three important characteristics of Blockchain technology are Decentralization, Transparency, and Immutability. CT could transform functionalities in digital currency, KYC, fraud detection, trade finance and cross border remittances, trade finance, Settlement of   payment and Credit card, thus improving and revolutionaries them. This will also increase the efficiency. However, the problems like directive, proficiency and safety will always be worrying factors. But the technological glitches can be removed. Therefore, the viewpoint of incorporating. Thus, Blockchain can be considered new troublesome force of digital technology is varying the business models and progressively becoming an essential factor around the world.

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9.LIMITATIONS AND FUTURE SCOPE OF STUDY

This paper describes the basics of blockchain application adoption in the banks. Author has studied BCT adoption but not BCT implementation and BCT continuance. It was limited to drivers like technical competence, organization competence, and Environment factors for BCT adoption. Future research to evaluate measures such as the effect of bank category like the public/private/co-operative can be studied. The study can be with respect to cost estimates of block chain implementation. The development and adaptation of digital technology by the government of India for implementation of its public policies and schemes using TOE technique can be elaborated.

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