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Why is the Interest in Blockchain Still on the Decline? Blockchain Challenges, Review, and Research Agenda

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ABSTRACT

Based on its technological elements (distribution, encryption, immutability, tokenisation, decentralisation, and smart contracts), blockchain has drawn considerable attention in various industries and verticals. Still, the strategic adoption of blockchain is in its early stages because of the current barriers and challenges in the areas of 'customer experience', 'business models', and 'operational processes.' This work delivers a comprehensive synopsis of the fundamental challenges faced by blockchain adopters in their digital journey, based on a literature survey. The authors leveraged MAXQDA software and the theory, context, characteristics, and methodology (TCCM) framework to develop themes, findings, and evidence for adoption barriers. The research evaluates the literature on blockchain adoption challenges and offers research insights and managerial agendas for future inferences.

Keywords: Blockchain, Smart Contracts, Digital Transformation (DT), Decentralisation, MAXQDA, TCCM

Ⅰ. Introduction

Digital transformation (DT) is the response to present and future business changes and shifts by leveraging digital technologies (such as blockchain) to change/modify an organisation's "business models, customer experiences, and operational processes" (Hess et al., 2016; Saurabh et al., 2021; Singh and Hess, 2017; Warner and Wäger, 2019). Fitzgerald et al. (2014, p. 2) define DT as a "process of improving/creating a new business model (BM), enhancing customer experience (CE), and streamlining the op-

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erational process (OP)" using digital technologies such as blockchain. Singh and Hess (2017, p. 124) and Hess et al. (2016) highlight that "transformation" is more than just the "change" in any organisational setting for the consensus-based DT pillars of BM, delightful CE, and accountable/transparent OP. Digital technologies disrupt and trigger changes for any organisation to create value and manage business models, customers, and processes (Chirumalla, 2021; Saurabh et al., 2021; Sebastian et al., 2017; Tian et al., 2021; Vial, 2019).

Digital technologies such as blockchain influence DT positively by creating and restructuring business models to develop the products and service offerings targeting markets tokenised cost models and safeguarding interests (Kraus et al., 2021). Trust, privacy, complexity, and ease of use are the fundamental reasons for the success of a DT journey from the customer experience perspective. Blockchain can responsibly handle data and security requirements while reducing complexity and providing ease of use for customers' in-network transactions (Tandon et al., 2020). Organisational governance, transparency, and streamlined workflows characterise well-defined operational processes. Blockchain can help design, implement, and integrate accountable and rational workflows to drive successful DT (Korpela et al., 2017; Kraus et al., 2021; Lee and Choi, 2019; Yakovenko et al., 2019).

This research investigates the current state of DT pillars (business models (BM), customer experience (CE), and operational processes (OP)) driven by blockchain technology. There is a need to understand the blockchain implementation challenges under each DT pillar when blockchain is chosen as the accelerator tool for DT. The business model DT pillar underlines the challenging aspects of the channel ecosystem, strategy, and market segments enabled by blockchain (Verina and Titko, 2019; Westerman et al., 2014). The customer/user experience DT pillar encompasses the challenges of security and privacy, complexity and compatibility, and ease of use and usefulness powered by blockchain (Matt et al., 2015; Yakovenko et al., 2019). The operational processes DT pillar highlights the challenges of organisational design, governance, and integration characteristics driven by blockchain (Biswas and Dasgupta, 2020; Korpela et al., 2017; Yakovenko et al., 2019).

This paper emphasises the theory of the building blocks of the DT pillars, research contributions, and blockchain challenges influencing the DT journey. Section 1 of the paper uses rich content to understand various challenges and allows researchers and practitioners to work against DT blockchain challenges in a structured way using "Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)" (Moher et al., 2009). Section 2 of the paper conducts content and thematic analyses of 41 clustered and mapped papers for the themes of blockchain DT challenges according to our requirements using MAXQDA software. Section 3 presents a detailed review of DT blockchain challenges to understand their role in DT implementation in terms of how customers leverage the platforms, their alternatives, and their influence on organisational business models and operational processes. Finally, Section 4 leverages the framework of theory, context, characteristics, and methodology (TCCM) as per the literature review (Kumar et al., 2019). TCCM forms the basis for the future research agenda on DT blockchain challenges and recommendations (Paul and Rosado-Serrano, 2019). The TCCM framework is leveraged to weave theory, concept, development, evidence, research and management implications and discuss the study's limitations (Paul et al., 2021; Terjesen et al., 2013).

The primary objective of this research is to investigate the following questions: 1) Why is the interest in using blockchain to enable successful digital transformation still declining? 2) What are the challenges in adopting blockchain technologies that enable successful DT journeys? Overall, this research delivers the levers to examine the theoretically sequenced characteristics (themes) of the DT pillars with practical blockchain implementation implications for research and managerial practices.

Ⅱ. Method

2.1. Literature Review

A PRISMA statement complied scientific method-based literature review was conducted to produce transparent, fair, and inclusive results. The steps were adapted based on specific attributes from similar prior work suggested in the literature (Briner and Denyer, 2012; Moher et al., 2009). The literature review was initially conducted from November to December 2020 without filters on the timeframe. The literature review was again conducted in March 2021 and August 2021, and the same process was followed to get the latest literature. Science Direct, Web of Science, Google Scholar, and Scopus databases were used to source articles for the literature survey. An additional search was conducted by choosing the appropriate references of shortlisted papers to get more relevant literature. Literature from several databases was included based on a search using keywords such as 'blockchain + digital transformation', 'blockchain + challenges', 'blockchain + digital transformation + challenges', 'blockchain + challenges + business model', 'blockchain + challenges + customer experiences', 'blockchain + challenges + operational processes', 'digital transformation', etc. with various permutations and combinations. <Figure 1a> represents the search string combination.

2.2. Article Selection

We followed four steps based on bibliographic search: identification, screening, eligibility, and inclusion (<Figure 1b>), apart from keyword-based search, and performed bibliographic trail search using references. A bibliographic trail was used to navigate the problematic research territories from one source

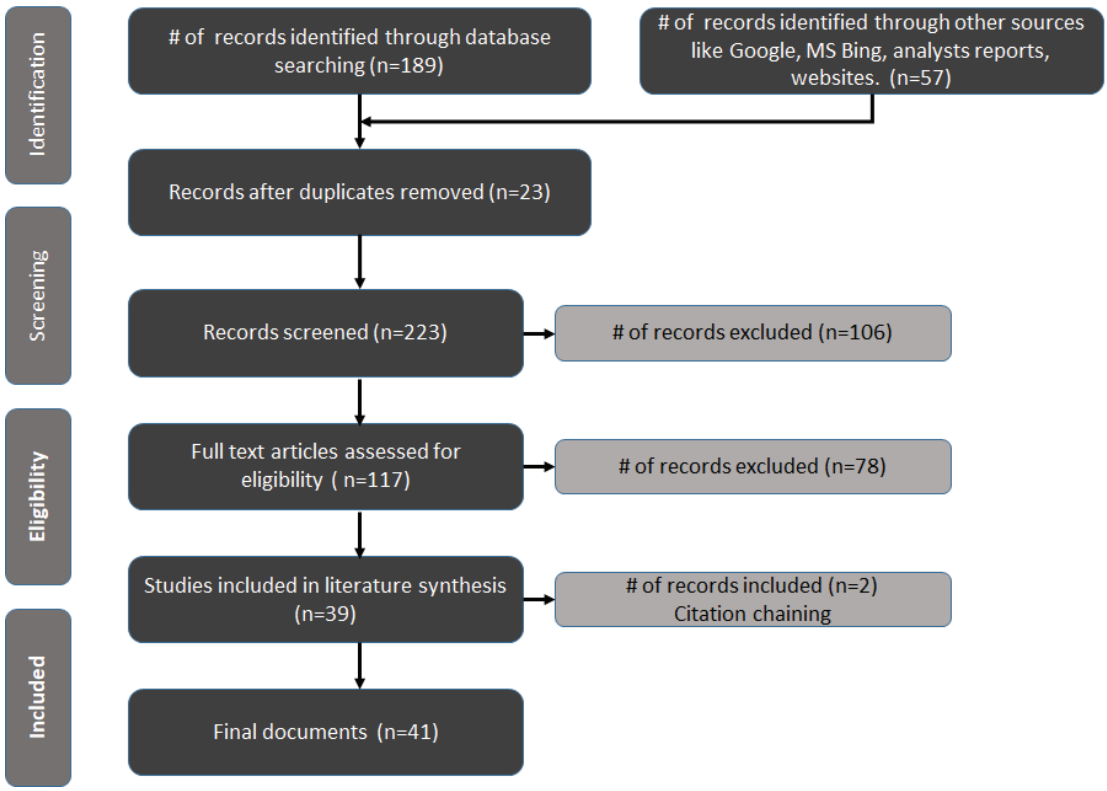
Search string 1:

("blockchain" OR "digital ledger technology" OR "DLT" OR "digital ledger" OR "database" OR "blockchain challenges" OR "DLT challenges") AND ("digital" OR "transformation" OR "digital transformation" OR "digitization" OR "blockchain digital transformation")

Search string 2:

<Search string 1> AND ("concepts" OR "industry" OR "business model" OR "adoption" OR "customer experiences" OR "governance" OR "integration" OR "operational processes" OR "interoperability" OR "privacy " OR " security" OR "strategy" OR " market segments" OR "complexity" OR "compatibility" OR "ease of use" OR "Organization design")

<Figure 1a> Search Strings



<Figure 1b> PRISMA Literature Survey Workflow (Moher et al., 2009)

to another, and this process continued until satisfactory results were obtained. Online catalogues and database features were used to search other sources cited references, keywords, and surveyed literature. This technique of indexing citations is like following a bibliographic trail, forward or backwards- a process of tracking down research papers from the reference list found in a paper (Sherman et al., 2009). The following are the inclusion, exclusion, and quality assessment criteria for screening relevant search results-based articles.

Inclusion criteria

- Publication Type: Journal articles with full text are only considered. The initial level screening was performed on title, abstract, and keywords. The publication language must be in English only, and the citation should be available in previously selected literature.
- Research directly related to blockchain, digital transformation, digital ledger technology, digital ledger, business model, customer experiences, operational processes, integration, interoperability, complexity, compatibility, ease of use, and organisation design.

Exclusion criteria

- Non-peer-reviewed articles, books, reviews, dissertations, white papers, technical papers, and non-English papers are not considered.
- Repeated research articles in search criteria outputs and digital transformation papers not directly targeting blockchain or digital chal-

lenges on people and society,

Quality assessments

- Reputed publisher, databases searched, and the research questions targeted in an article.
- Articles highlighting the challenges of using blockchain in driving digital technologies

The authors discussed among themselves to reach a consensus regarding the final set of articles under consideration. The search criteria were refined using various database-based search refinement features to search for relevant articles. Initially, the abstracts were analysed to cluster the papers based on themes, and finally, specific full text-required articles were retrieved. The consensus rate for including relevant articles and clustering them into relevant themes was approximately 80%. According to eligibility, 246 papers (189 papers from databases and 57 papers from bibliographic trail search) related to the anticipated work theme of blockchain challenges and DT pillars were included. The papers were searched based on various criterion keywords using the search strings mentioned in <Figure 1a>. After the first step, 23 records were identified and removed from the study. In the next phase, articles were excluded based on the exclusion, inclusion, and quality assessment criteria. 78 papers were filtered and excluded from the study in the next iteration. Finally, 41 articles were included for literature synthesis.

The final 41 articles shortlisted for the study were considered the body of knowledge adapted from the literature regarding blockchain adoption challenges. <Tables 1-6> listed in the following section lay down the foundation for thematic analysis (heading 3. code and thematic analysis using MAXQDA), DT and blockchain literature survey (heading 4. DT blockchain challenges), literature evidence and proposition support (5. research framework), and research and managerial implications (heading 6. and 7.). <Table 1> depicts the bibliographic journal sources from which the papers were identified with their frequencies (with percentage). It also shows how the surveyed articles were published in diverse areas and provides a glimpse of various vertical research contributions. <Table 2> represents the objectives and findings of the papers related to blockchain challenges, with their author details. <Table 2> is the foundation of paper as it becomes the body of knowledge referred to wherever a reference is given in the paper to support any statement or proposition. <Table 3> presents the industry-wise details of the study, with author details. Freight logistics-supply chain is the apparent frontrunner in all the industries with the challenges literature. Surprisingly, the tourism and hospitality industry has taken the second spot while discussing the adoption challenges of blockchain, followed by the visible adoption challenges of the finance industry. Healthcare, telecom, government and utilities, and real estate are the industries where blockchain challenges need to be addressed. <Table 4> highlights the mapping of the themes and subthemes of the challenges of blockchain, with respective papers and author details. This is the most highly cited table in the entire paper as it links the themes (T), subthemes (ST), and formed propositions (P) to provide a logical flow in sections 4, 5, 6, and 7. <Table 5> talks about the commonly used methods adopted by different authors in studying blockchain challenges. The results and interpretations of <Table 5> are heavily used in comprehending the used methodologies in discussing the 'methodology' part of the TCCM framework. A detailed description with results is provided in Section 5 under the heading 'Methodology'. <Table 6> summarises the theories used by different authors in specific papers. The literature survey confirms

<Table 1> Bibliographic Sources of Blockchain Challenges Literature

Bibliographic Source	Articles Considered for Review	Total %
International Journal of Information Management,	6	14.6
Transportation Research Part E: Logistics and Transportation Review	2	4.9
Telematics and Informatics	2	4.9
White Paper	2	4.9
Frontier in Blockchain	2	4.9
International Journal of Production Economics	1	2.4
Journal of International Technology and Information Management	1	2.4
Sustainability Journal	1	2.4
Journal of Business Venturing Insights	1	2.4
Journal of Medical Systems	1	2.4
Computers in Industry	1	2.4
Logistique & Management	1	2.4
Journal of Cases on Information Technology (JCIT)	1	2.4
Cryptocurrencies and Blockchain Technology Applications	1	2.4
Business Transformation through Blockchain, Palgrave Macmillan, Cham	1	2.4
Journal of Organization Design	1	2.4
Journal of Network and Computer Applications	1	2.4
Computers & Security	1	2.4
Mechanical Systems and Signal Processing	1	2.4
Enterprise Information Systems	1	2.4
Deloitte White Paper	1	2.4
Journal of Governance and Regulation	1	2.4
Journal of Industrial Information Integration	1	2.4
Security and Privacy	1	2.4
Concurrency and Computation: Practice and Experience	1	2.4
International Journal of Scientific & Technology Research	1	2.4
IEEE Transactions on Computational Social Systems	1	2.4
International Journal of Accounting Information Systems	1	2.4
Information Systems Management	1	2.4
Business Horizons	1	2.4
Information Systems Management	1	2.4
Automation in Construction	1	2.4
Total	41	100.0

Note: Author's own compilation.

<Table 2> Objective(s) and Finding(s) of Previously Published Works

Author(s)	Objective(s)	Finding(s)
Janssen et al. (2020)	The paper proposes a framework to consolidate organisational challenges and issues when blockchain is adopted as a solution.	The paper presents the PIMT framework for integration, institution, market and technology.
Clohessy et al. (2018)	Significant technological, organisational and environmental (TOE) challenges while adopting blockchain technologies. Areas to be considered are complexity, relative advantage, privacy, security, and compatibility.	Research emerged with three organisational considerations: top management support, organisational readiness, and organisational support.
Orji et al. (2020)	The research proposes (TOE) critical factors based theoretical framework. The target industry is logistics-supply chain. Challenges and considerations are prioritised using the analytic network process (ANP).	The findings will help to overcome the challenges of the successful adoption of blockchain to gain organisational competitiveness. The results demonstrate that government and state agencies can get many benefits in the supply chain by eliminating the challenges.
Upadhyay (2020)	The research investigates multiple blockchain domain challenges and adoption endeavours. The study proposes an organisational and user acceptance-based integrated framework of the blockchain innovation adoption process	The paper offers 23 propositions related to the challenges of innovation, organisational characteristics, and environmental and user acceptance characteristics.
Kouhizadeh et al. (2020)	The paper investigates blockchain adoption barriers using the TOE framework and force field theories. Comprehensive literature review to manage sustainable supply chains barriers.	Similarities and differences of opinion among researchers and practitioners in perceiving blockchain barriers. Exploratory study reveals interesting relative importance and interrelationships of barriers in the supply chain environment.
Queiroz and Wamba (2019)	To study blockchain adoption behaviour and challenges of the logistics and supply chain field in India and the USA. The study uses network theory, technology acceptance models (TAMs), and unified theory of acceptance and use of technology (UTAUT) to develop the model.	The study highlights the influence of facilitating conditions on supply chain professionals and highlights the importance of performance expectancy w.r.t behavioural intention. Recommendations are provided to involve CIOs and top managers involved in blockchain projects.
Woodside et al. (2017)	To review acceptance and future of blockchain technology. To provide a framework for how blockchain can be utilised in large-scale enterprise environments.	The paper highlights the potential drivers and drawbacks of blockchain technology. The paper highlights the theoretical contributions for identifying the blockchain diffusion innovation curve.

<Table 2> Objective(s) and Finding(s) of Previously Published Works (Cont.)

Author(s)	Objective(s)	Finding(s)
Nuryyev et al. (2020)	The research highlights the adoption challenges of cryptocurrency payments among SMEs in the tourism and hospitality industry.	Strategic orientation, senior management personal characteristics, and social influence heavily to overcome adoption challenges of blockchain. Multiple mediation analysis is also discussed better to understand perceived usefulness and ease of use constructs.
Chen and Bellavitis (2020)	The paper highlights the potential challenges and limits of decentralised finance. Identifies existing business models and evaluates the use of blockchain led business models.	The findings of the paper present the landscape for entrepreneurship and innovation using decentralised finance. The paper showcases the promises and challenges of decentralised business models.
Yue et al. (2016)	The paper highlights the importance of patient data, ownership, privacy, control, and sharing based on the blockchain application. The authors propose a potential application to improve the intelligence of healthcare systems using blockchain systems.	The paper presents a purpose-centric access model for healthcare data. A simple unified Indicator-Centric Schema (ICS) with MPC (Secure Multi-Party Computing) is proposed as a solution to control privacy and authentication.
Tandon et al. (2020)	The paper talks about privacy protection and security of data management processes in health care systems. It also provides the extant limitations of proposed model performance, constraints, and costs associated with blockchain implementation.	An integrated framework to manage regulatory compliance, system architecture, data protection using blockchain.
Wamba and Guthrie (2020)	The paper proposes a model using process innovation and relational innovation to achieve active performance in the supply chain.	Performance impacts of blockchain adoption and use in the supply chain. Partial least squares modelling is used to test the proposed model.
Casino et al. (2019)	The paper aims to highlight how "business-as-usual" practices can be revolutionised using blockchain applications. Multiple domain-based applications are explored based on SLR.	Paper presents a blockchain-enabled applications classification in diverse sectors. It highlights the challenges of IoT, privacy, and data management with its key themes and trends
Mehar et al. (2019)	The paper talks about the famous DAO experiment failure and its challenges. It also raises questions of autonomous execution of the transactions and settlements between investors and companies.	The paper's findings highlight the violation of ledger immutability and question the "code is law" ethos.
Hsieh et al. (2018)	The paper studies organisation design and strategy changes using blockchain led DAO democratic voting process. How to approve and activate agreements needed to meet the organisational level?	Commentaries of invited organisation scholars for organisation design using DAO works. Peer-to-peer, decentralised, and disintermediated payment system-based organisation design.

<Table 2> Objective(s) and Finding(s) of Previously Published Works (Cont.)

Author(s)	Objective(s)	Finding(s)
Morrisonm et al. (2020)	The paper reviews the case of the DAO "attack", its challenges, and response in its time of crisis. How can DAO be used for corporate and IT governance?	Proposes the emergence of trust-based organisations in decentralised autonomous organisations (DAOs) way. The legality of job designs, smart contracts when DAO is used for corporate and IT governance.
Makhdoom et al. (2019)	The paper assesses the challenges while adopting blockchain's viability for IoT. The paper presents the peculiarities of the IoT security and performance requirements and progression of blockchain technologies.	The paper identifies the gaps of security and performance factors inferred by blockchain technologies. The author discovered practical issues in IoT devices integration with blockchain.
Hammi et al. (2018)	The objective was to propose a trust-based decentralised system ensuring robust identification and device authentication.	The paper obtained results to satisfy IoT security challenges and prove its efficiency.
Jentzsch (2016)	Much discussed first white paper on Decentralized Autonomous Organization (DAO) implementation as management of a trust.	Practical white paper was written in Solidity on the Ethereum blockchain platform using smart contracts.
Mistry et al. (2019)	An in-depth survey of 5G-enabled IoT devices as a backbone industrial automation using blockchain applications. Multiple verticals were discussed for various use cases like smart homes, healthcare, agriculture, supply chains, and autonomous vehicles.	Challenges and open issues of IoT devices for blockchain-based Industrial automation.
Janssen et al. (2020)	To propose a framework capturing the challenges and issues that organisations face when adopting blockchain technology.	Integrated Process, Institutional, Market, Technology (PIMT) Framework for Blockchain Adoption Review factors affecting blockchain adoption: institutional factors, market factors and technical factors
Clohessy et al. (2018)	Significant technological, organisational and environmental (TOE) challenges while adopting blockchain technologies Areas to be considered are complexity, relative advantage, privacy, security and compatibility.	Research emerged with three organisational considerations: top management support, Organisational readiness and organisational support.
Orji et al. (2020)	The research proposes (TOE) critical factors based theoretical framework for blockchain adoption in the freight logistics industry. Challenges and considerations are prioritised using the analytic network process (ANP).	Finding will help to overcome the challenges of the successful adoption of blockchain to gain organisational competitiveness. It is beneficial for federal agencies, freight logistics firms and service providers.

<Table 2> Objective(s) and Finding(s) of Previously Published Works (Cont.)

Author(s)	Objective(s)	Finding(s)
Upadhyay (2020)	The research investigates multiple blockchain domain challenges and adoption endeavours. The study proposes an organisational and user acceptance-based integrated framework of the blockchain innovation adoption process	Paper offers 23 propositions related to challenges of innovation, organisational characteristics, environmental and user acceptance characteristics.
Kouhizadeh et al. (2020)	Investigate blockchain adoption barriers using the TOE framework and force field theories. Comprehensive literature review to manage sustainable supply chains barriers.	Similarities and differences of opinion among researchers and practitioners in perceiving blockchain barriers. Exploratory study reveals interesting relative importance and interrelationships of barriers in the supply chain environment.
Queiroz and Wamba (2019)	To study blockchain adoption behaviour and challenges of the logistics and supply chain field in India and the USA. The study uses network theory, technology acceptance models (TAMs) and unified theory of acceptance and use of technology (UTAUT) to develop the model.	The study highlights the influence of facilitating conditions on supply chain professionals and highlighted the importance of the performance expectancy w.r.t behavioural intention. Recommendations are provided to involve CIOs and top managers involved in blockchain projects.
Woodside et al. (2017)	Review acceptance and future of blockchain technology. To provide the framework for how blockchain can be utilised in large-scale enterprise environments.	The potential drivers and drawbacks of blockchain technology. The paper highlights the theoretical contributions for identifying the blockchain diffusion innovation curve.
Nuryyev et al. (2020)	Research highlights the adoption challenges of cryptocurrency payments among SMEs in the tourism and hospitality industry.	Strategic orientation, senior management personal characteristics and social influence heavily to overcome adoption challenges of blockchain. Multiple mediation analysis is also discussed better to understand perceived usefulness and ease of use constructs.
Chen and Bellavitis (2020)	The paper highlights the potential challenges and limits of decentralised finance. Identify existing business models, and evaluate the use of blockchain led business models.	The findings of the paper present the landscape for entrepreneurship and innovation using decentralised finance. The paper showcases the promises and challenges of decentralised business models
Yue et al. (2016)	The paper highlights the importance of patient data, ownership, privacy, control and sharing based on the blockchain application. The authors propose a potential application to improve the intelligence of healthcare systems using blockchain systems.	Paper presents a purpose-centric access model for healthcare data. A simple unified Indicator-Centric Schema (ICS) with MPC (Secure Multi-Party Computing) is proposed as a solution to control privacy and authentication.

<Table 2> Objective(s) and Finding(s) of Previously Published Works (Cont.)

Author(s)	Objective(s)	Finding(s)
Karamchandani et al. (2019)	The paper aims to analyse enterprise blockchain perception in the service industry. Enterprise blockchain perceived usefulness is discussed based on knowledge of theoretical benefits.	The paper examines good perspectives for service industry managers in SCM using enterprise blockchain. The research model presented 5 factors to analyse as moderating effects.
Grover et al. (2019)	Identify diffusion of blockchain technology based on literature and social media (Twitter).	Findings include sector-wise diffusion in different verticals. The service industry is already in the implementation phase. The finance, insurance, and real estate industries are at the confirmation stage.
Grover et al. (2019)	Acceptance issues of blockchain using Twitter data based collective intelligence. The paper talks about the importance of security, privacy, transparency, trust, and traceability aspects.	Indication of blockchain technology acceptance based on its characteristics and benefits. Digital transactions are considered more secure, private, trustful, and transparent.
Greenwood et al. (2016)	Is blockchain a marketing buzzword? The paper focuses on the problems, issues, and capabilities of distributed ledger technology.	Blockchain might not be a practical solution but it is technically attractive. It is wrong to promote distributed ledger technology as creating a trust or democrat trust.
Atzori (2017)	It identifies the gaps for DAO governance which challenge current federal-state authority, democracy, and citizenship.	Risk of stateless societies and citizen disempowerment. The paper indicates the importance of centralised systems while discussing the pros and cons of decentralised and centralised systems.
Zwitter and Hazenberg (2020)	The argument of the inadequate dominant governance modes while working on digital technologies. The current immaturity of poorly equipped instruments is to conceptualise novel forms of governance such as (DAOs).	The study proposes a model using decentralised network governance. It shows how relationships are maintained among power and state actors in the digital ecosystem.
Viriyasitavat and Hoonsopon (2019)	Investigates blockchain characteristics in the context of the business process. Integration of Business Process Management (BPM) system components with blockchain led applications.	One of the first papers to show the integration of BPM with blockchain. Integration points can come from process areas such as auditability, disintermediation, and persistency to overcome multiple challenges.
Akram et al. (2020)	To consider and investigate the security and privacy factors for blockchain-based smart applications. Review of blockchain applications in Industry 4.0 settings.	Blockchain challenges in interoperability and governance. Realms of implementation and adoption of blockchain applications.
Schuetz and Venkatesh (2019)	To review blockchain-based financial inclusion in India to resolve exclusion problems. Posits the challenges related to inappropriate banking products, geographical access, financial illiteracy, and adoption.	Discusses the issue of financial exclusion in rural India. The solution is to connect rural India using a blockchain led supply chain network.

<Table 2> Objective(s) and Finding(s) of Previously Published Works (Cont.)

Author(s)	Objective(s)	Finding(s)
Jaradat et al. (2016)	The objective is to present a workflow-based capable decentralised orchestration system. Proposes the workflow language based on high-level data coordination with distribution engines with responsible roles.	To demonstrate scalability factors provided by decentralised orchestration over centralised one.
Parina and Chauhan (2020)	To highlight the impact on economies and societies when they implement and use DAOs as a technology driver to run the ecosystem.	To use democratic structures like DAOs to replace legacy systems. How to use DAO to solve the challenges of complex socio-economic problems.
Wang et al. (2019)	Presents research framework, trends, and characteristics of DAO. Presents DAO challenges in the areas of implementation and future use.	To demonstrate DAO challenges in the area of legal status, security and privacy. How DAO can overturn traditional hierarchical management model to reduce communication costs and overheads.
Alles and Gray (2020)	To develop the model for a business process when blockchain drives application transformation. To evaluate the business process based blockchain model concerning endogenous demand for auditing in the supply chain.	Demonstrates blockchain limitations to ensure the integrity of the supply chain of generic drugs. Minimises the first-mile problem by training auditors in professional scepticism.
Pelt et al. (2020)	To introduce a blockchain governance framework using six dimensions and three layers. Practically demonstrates the framework implementation using two case studies.	To use a triangulated form of surveys, interviews, and focus groups on developing the blockchain governance framework. Demonstrates validity and applicability of the BG framework in various settings.
Werner et al. (2020)	To investigate the impact of blockchain on firm competitive performance when it is operating inter-organisational ecosystems	Results indicate blockchain traceability and immutability characteristics influence firm competitive performance. Smart contracts help in managing the partner ecosystem to ensure flexibility and competitive performance.
Lee (2019)	Investigates how blockchain and cryptocurrencies are interconnected to develop a new business model for the token economy.	Presents blockchain business models as the legal and institutional basis for the token economy. Evaluates options for trading using blockchain tokens in the global market as an investment case.
Sarah Manski (2020)	To investigate alternative governance practices of value accounting and self-sovereign identity using distributed ledger technology. Present valuation technologies transform institute values and valuations with digital trust when working online.	The paper concludes the governance vision of novel value accounting systems for global actors such as technological activists, cooperative members, and entrepreneurs using distributed ledger technology.

<Table 2> Objective(s) and Finding(s) of Previously Published Works (Cont.)

Author(s)	Objective(s)	Finding(s)
Yang et al. (2020)	To investigate the challenges of blockchain adoption in construction practices. Use case study-based approach to propose system architecture design of blockchain software for the construction industry.	The pilot indicates the challenges of adopting private vs public blockchain solutions in the construction industry. Two business process-based cases are discussed in the purview of the public/private blockchain system architecture design with advantages and disadvantages.
Lacity (2018)	The paper investigates standards and regulations, and shared governance models problems of block adoption.	The paper describes strategies followed by supply chain giants to address the challenges that impede progress.
McGhin et al. (2019)	The paper aims to investigate the vulnerabilities and issues of blockchain implementation. It talks about the problems related to mining incentives, attacks, and digital key management.	The findings recommend solutions to face challenges in the healthcare domain suggested by experts based on the survey.
Biswas and Gupta (2019)	The study focuses on developing a framework for investigating adoption barriers. Literature and expert opinions are taken to discuss various challenges.	The findings are related to the challenges of risk and scalability. High sustainability cost and poor economic infrastructure also influence adoption level.

<Table 3> Industry-Wise Literature Context

Industry	Authors
Freight logistics, Supply chain	Karamchandani et al. (2019); Kouhizadeh et al. (2020); Orji et al. (2020); Queiroz and Wamba (2019); Wamba and Guthrie (2020).
Tourism and Hospitality	Nuryyev et al. (2020).
Finance	Chen and Bellavitis (2020); Schuetz and Venkatesh (2019); Werner et al. (2020).
Healthcare	Alles and Gray (2020); Manski (2020); Tandon et al. (2020); Yue et al. (2016).
Telecom- Industrial Automation	Mistry et al. (2019).
Government and Utilities	Atzori (2017).
Real estate- Construction	Yang et al. (2020).

Note: Author's own compilation.

<Table 4> Blockchain Theme/Subtheme Mapping with Relevant Literature

Theme	Sub-theme	Author(s)
DT Business Model (T1)	Channel Ecosystem (T1S1)	Clohessy et al. (2018); Janssen et al. (2020); Kouhizadeh et al. (2020); Orji et al. (2020); Queiroz and Wamba (2019); Upadhyay (2020).
	Strategy (T1S2)	Alles and Gray (2020); Nuryyev et al. (2020); Pelt et al. (2020); Queiroz and Wamba (2019); Woodside et al. (2017).
	Market Segments (T1S3)	Chen and Bellavitis (2020); Queiroz and Wamba (2019); Tandon et al. (2020); Wamba and Guthrie (2020); Yue et al. (2016).
DT Customer/User Experience (T2)	Security & Privacy (T2S1)	Anand and Chauhan (2020); Casino et al. (2019); Hammi et al. (2018); Hsieh et al. (2018); Jentzsch (2016); Makhdoom et al. (2019); Mehar et al. (2019); Morrison et al. (2020); Upadhyay (2020).
	Complexity and Compatibility (T2S2)	Kouhizadeh et al. (2020); Mistry et al. (2019); Orji et al. (2020); Queiroz and Wamba (2019); Wamba and Guthrie (2020).
	Ease of use and usefulness (T2S3)	Greenwood et al. (2016); Grover et al. (2019); Grover et al. (2019); Karamchandani et al. (2019); Nuryyev et al. (2020); Orji et al. (2020).
DT Operational Processes (T3)	Organisational Design (T3S1)	Akram et al. (2020); Atzori (2017); Morrison et al. (2020); Norta (2015); Orji et al. (2020); Schuetz and Venkatesh (2019); Singh and Shiho (2019); Viriyasitavat and Hoonsopon (2019); Wang et al. (2019); Zwitter and Hazenberg (2020).
	Governance (T3S2)	Alles and Gray (2020); Cuccuru (2017); Hoonsopon (2019); Morkunas et al. (2019); Pelt et al. (2020); Viriyasitavat and Hoonsopon (2019).
	Integration (T3S3)	Lee (2019); Manski (2020); Upadhyay (2020); Werner et al. (2020); Yang et al. (2020); Yang et al. (2020).

Note: Author's own compilation.

that innovation theory/diffusion of innovation, technological, organisational, and environmental (TOE) theoretical framework and technology acceptance model (TAM) is the most accepted frameworks used in the surveyed literature. Theories such as the unified theory of acceptance and use of technology (UTAUT), conceptual model, meta-ethnography, network theory, contract theory, and institutional theory register

<Table 5> Commonly Applied Methods

Method	Author(s)	Percentage
Literature Survey and Survey Method	Akram et al. (2020); Atzori (2017); Casino et al. (2019); Casino et al. (2019); Clohessy et al. (2018); Hammi et al. (2018); Hsieh et al. (2018); Janssen et al. (2020); Makhdoom et al. (2019); Manski (2020); Mehar et al. (2019); Mistry et al. (2019); Parina and Chauhan (2020); Upadhyay (2020); Viriyasitavat and Hoonsopon (2019); Zwitter and Hazenberg (2020).	43.24
Multi- criteria decision making/ analysis (MCDM/A) methodologies	Orji et al. (2020).	2.70
Decision-Making Trial and Evaluation Laboratory (DEMATEL)	Kouhizadeh et al. (2020).	2.70
Partial least squares structural equation modeling (PLS-SEM)	Karamchandani et al. (2019); Nuryyev et al. (2020); Queiroz and Wamba (2019).	8.11
Triangulation	Woodside et al. (2017).	2.70
Case Method	Alles and Gray (2020); Morrisonm et al. (2020); Pelt et al. (2020); Yang et al. (2020).	10.81
Implementation paper	Jaradat et al. (2016); Jentzsch (2016).	5.41
Social Media Analytics	Grover et al. (2019)	5.41
Narrative Synthesis	Schuetz and Venkatesh (2019).	2.70
Interview	Pelt et al. (2020).	2.70
Mixed-Methods Approach	Werner et al. (2020).	2.70
Thematic content analysis	Casino et al. (2019).	2.70
Gap Analysis	Makhdoom et al. (2019).	2.70
Conceptual Model	Norta (2015); Wang et al. (2019).	5.41

Note: Author's own compilation.

<Table 6> Commonly Applied Theories

Theory	Author(s)
Institutional Theory	Janssen et al. (2020).
Innovation theory/Diffusion of Innovation	Clohessy et al. (2018); Mehar et al. (2019); Woodside et al. (2017).
(TOE) theoretical framework	Clohessy et al. (2018); Kouhizadeh et al. (2020); Orji et al. (2020).
Unified theory of acceptance and use of technology (UTAUT)	Queiroz and Wamba (2019).
Technology acceptance model (TAM), Perceived usefulness, Perceived ease of use	Grover et al. (2019); Karamchandani et al. (2019); Nuryyev et al. (2020)
Conceptual Model	Wamba and Guthrie (2020); Yue et al. (2016).
Meta-ethnography	Tandon et al. (2020).
Network theory	Zwitter and Hazenberg (2020).
Contract theory	Mehar et al. (2019).

Note: Author's own compilation.

their presence in the surveyed literature.

Ⅲ. Code and Thematic Analysis using MAXQDA

Content and thematic analyses are conducted using MAXQDA software. We finally clustered and mapped 41 papers for the blockchain DT challenges themes according to our requirements.

3.1. Data Processing; Data Analysis

MAXQDA Analytics Pro software was leveraged for the data analysis of the literature survey. All 41 papers were imported into the software at the first level. After rigorous review, 3 main themes were identified for this research work. Once the main themes were identified, the researchers worked on the subthemes. Two researchers agreed on the subthemes. The two researchers were used as reviewers before putting the subthemes under each theme into the software MAXQDA Analytics Pro. Axial coding was leveraged to refine the subthemes and relationships. This helped to validate the themes and subthemes based on the literature survey observations (Heung et al., 2011). All sources of bias were rejected by eliminating the probabilities of prejudice to have better data consistency (Fischer, 2009). MAXQDA helps to visualise relationships using codes. The developed thematic codes and subthemes can be shown in the workspace as code maps. Code maps provide the foundations and relationships of the thematic codes based on the frequency of the codes. The codes help bring hidden relationships that are not apparent in the frequency tables to the foreground.

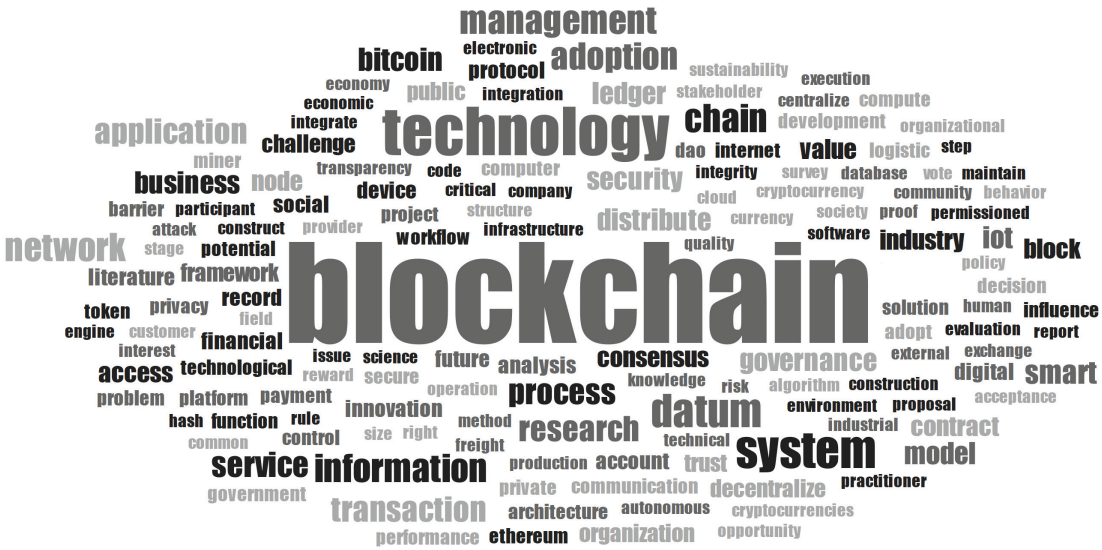
3.2. Word cloud

MAXQDA provides the powerful feature of a word cloud that helps to represent the frequency of words visually over the workspace. <Figure 3> shows the visual word cloud developed using the keyword-based dataset during the process of literature survey (Sinclair and Cardew-Hall, 2000).

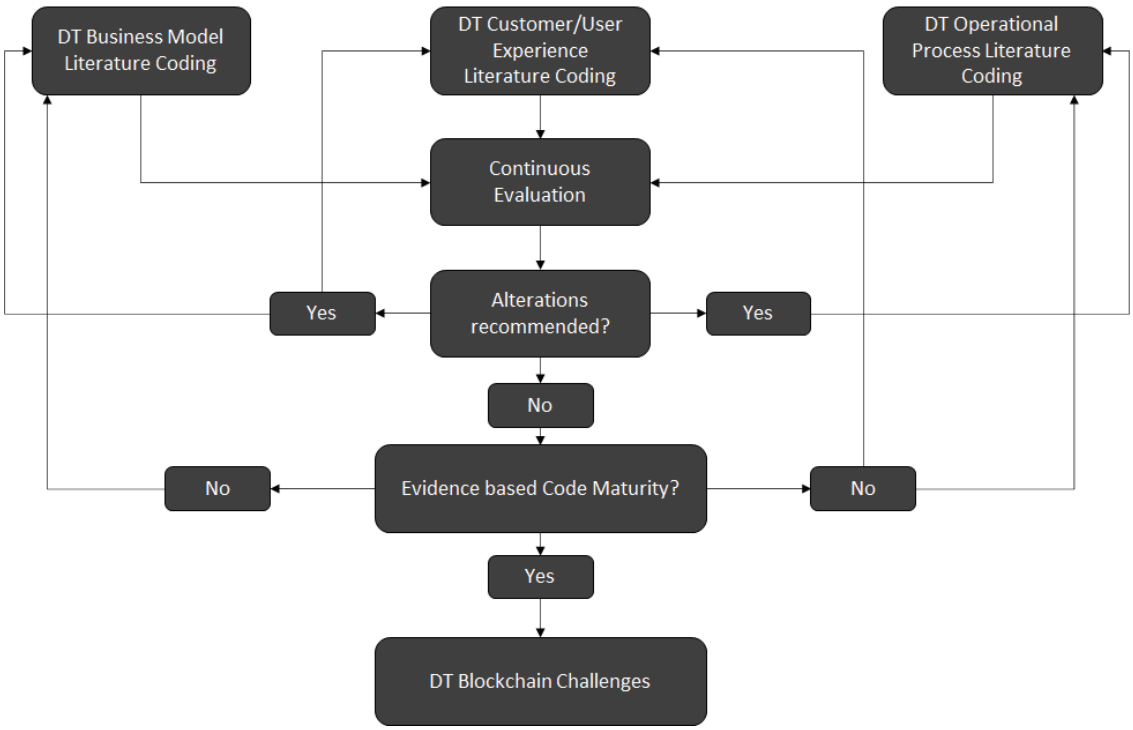
The formed word cloud (<Figure 2>) is the cluster of blockchain challenges of the DT journey that developed based on the discussed research literature imported to the software. The word frequencies are the results of the occurrences of the words in the given papers. The font size of a word represents its frequency. The smaller the font size in the word cloud, the lower is the frequency. It is simple to comprehend that words such as blockchain, technology, adoption, consensus, information, access, privacy, barrier, governance, risk, issue, problems, control, challenge, and attack, rule the word cloud and are hence visualised in bigger font size as their frequency is more in the surveyed literature because of regular use by the research fraternity in various articles.

3.3. Themes and Subthemes Study

We analysed the textual data using the imported literature survey papers in MAXQDA. We started the process by breaking the data of each paper into discrete code and labelled it. The process is termed as open coding. The objective of the labelling was to continuously analyse the associated events throughout the text in all papers. We developed the connections between the labelled codes at the next level and organised them as part of the axial coding step (Braun and Carke, 2006). The process was repeated until we reached the precise organisation of



<Figure 2> Word Cloud



<Figure 3> Coding Process

the supporting codes categories. Categories were created based on the existing labelled codes encompassing multiple codes. Lastly, all the categories were connected to the central theme of the paper DT blockchain challenges under the last step of selective coding. This step helps to elevate the specific category among other axial coding or the new category to map it to the central theme (Holstein and Gubrium, 1997).

The blockchain-led DT challenges based themes and subthemes were developed to explore technology barriers as a thematic code leveraging the literature survey. This research compares and evaluates the relationship between the codes and analyses it accordingly. <Figure 3> demonstrates the three-step coding process (Singh and Dey, 2020). The themes were coded as per the pillars of the DT model- BM, CE, and OP. The literature was analysed based on the theoretical background of the DT literature in the context of blockchain challenges (using selected papers), and the discrete codes were divided between developing the relationship. The process was iterative, and finally, the main code of the DT blockchain challenge was selected to capture the core of the research.

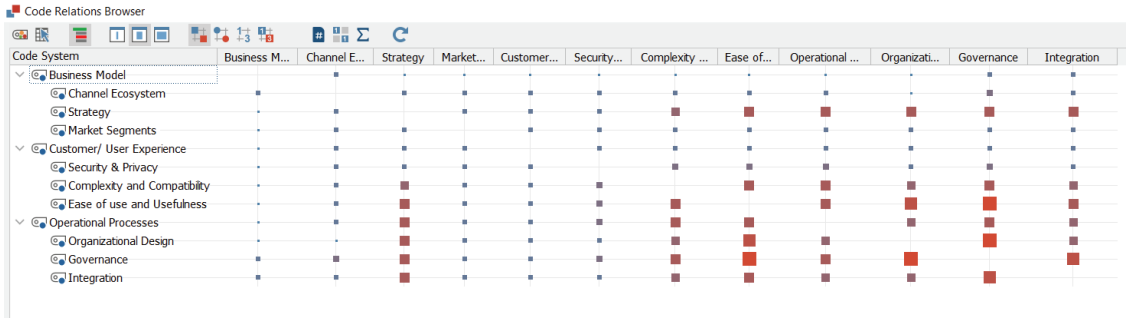
In qualitative research, themes lay down the foundation of the data unit to provide the kernel of the concept or phenomenon. The theme-based coding process helps focus on the insights, purpose, and intention of adopting blockchain challenges in the DT journey. Data description, field characteristics, and literature survey content interpretation help finalise the themes (Braun and Carke, 2006; Holstein and Gubrium, 1997).

<Table 7> lists all the themes/subthemes used in the content analysis coded in the selected literature. The authors worked on 3 themes and 9 subthemes in this study. The most ubiquitous subthemes indicated by all content analysis are 'Operational Processes\Governance', 'Customer/User Experience\Ease of use and Usefulness', 'Operational Processes\Organizational Design', and 'Operational Processes\Integration'.

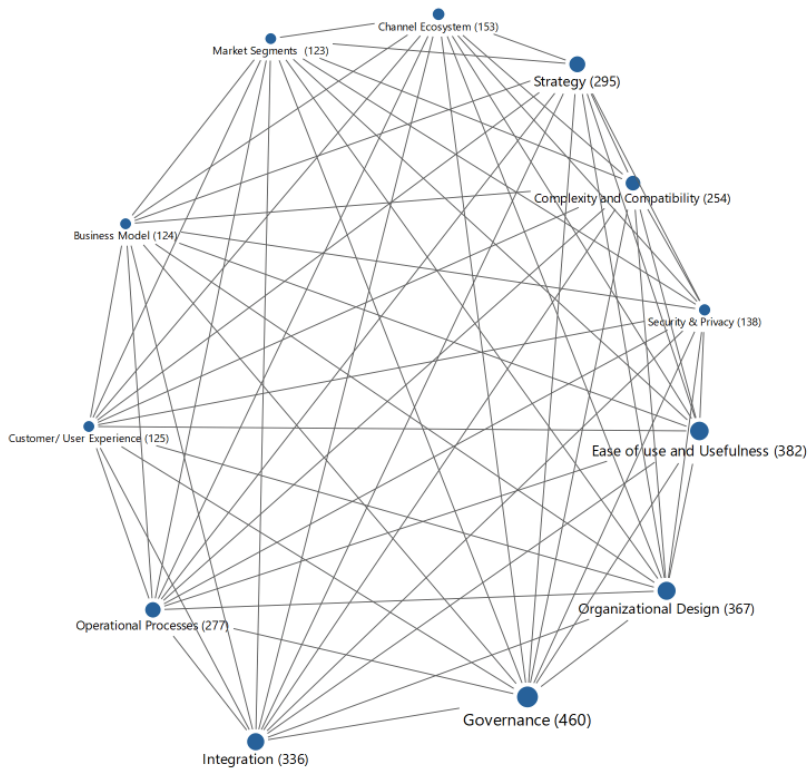
The MAXQDA code matrix browser (<Figure 4>) helps visualise the document in the form of the code to authenticate, connect, and compare relationships. Code Matrix Browser demonstrates the distribution

<Table 7> Frequency Analysis [MAXQDA Code. seg. (all documents)]

Themes and Subthemes	Frequency	Percentage
Operational Processes \ Governance	460	15.16
Customer / User Experience \ Ease of use and Usefulness	382	12.59
Operational Processes \ Organizational Design	367	12.10
Operational Processes \ Integration	336	11.07
Business Model \ Strategy	295	9.72
Operational Processes	277	9.13
Customer / User Experience \ Complexity and Compatibility	254	8.37
Business Model \ Channel Ecosystem	153	5.04
Customer / User Experience \ Security & Privacy	138	4.55
Customer / User Experience	125	4.12
Business Model	124	4.09
Business Model \ Market Segments	123	4.05



<Figure 4> Code Matrix Browser



<Figure 5> Code Maps

of the thematic codes developed in the research. Each cell is constituted using the intersection of the columns and rows to form the matrix. The analysis is centrally focused on overall themes in multiple documents, while documents are analysed separately from each other. Code Matrix Browser helps analyse the distribution of codes across documents and visualise them as a square. The size of the square reflects the information of the code segments and their contribution to the literature. The codes are compiled synoptically in the coded segments. <Figure 4> represents the theme-based code browser which is devel-

oped on the code frequencies or occurrences in the studied research papers. For example, 'Governance' and 'Ease of use and Usefulness' have contributed significantly and apparently, and their square sizes are bigger because of their frequency in the surveyed literature.

This paper uses the network model within the code maps to demonstrate the complexity of the codes within the surveyed literature. The thematic codes, memos, tables, and frequencies existing in the surveyed literature were analysed to demonstrate the comprehensive challenges faced by blockchain implementation during DT journeys. For example, governance, ease of use and usefulness, and organisational design are the most discussed themes within the literature. These need to be taken care of while strategising blockchain-based DT in any organisation. Code maps represent the relationships in the network model, and the noteworthy point is to understand that no direction is indicated in <Figure 5>.

Ⅳ. DT Blockchain Challenges

The literature review indicates the challenges the blockchain ecosystem faces while achieving digital transformation. A careful investigation of the literature gives in-depth insights and provides a common discussion thread. It is interesting to study the maturity of literature on blockchain challenges. A trend was observed, and there exist multiple areas of study concerning DT. Initially, the studies were more focused on cryptocurrency and its uses in finance. Later, the literature highlights many studies that focus on its applications in different verticals. The literature review results helped to understand the challenges faced in different arenas of DT.

The digital transformation uses digital technologies such as 'blockchain' to create/modify/automate existing BM, CE, and OP (Eder, 2019; Riasanow et al., 2018, Riasanow et al., 2020). Still, blockchain as an enabler of DT technology faces many challenges in the areas of BM, CE, and OP (Jain and Chowdhary, 2021; Matt et al., 2015; Verina and Titko, 2019; Westerman et al., 2014). In this study, most challenges were aggregated and categorised into clustered themes based on the pillars of the digital transformation model —BM, CE, and OP (Korpela et al., 2017; Yakovenko et al., 2019).

We consolidated and mapped the blockchain challenge themes, challenge sub-themes, literature review discussion/relationship points, and reference literature. The blockchain challenge themes and their details are discussed below and referred to in the literature review results. The literature review results became the foundation for developing the propositions and providing evidence supporting the literature in the later sections. Each of the themes-business models (T1-code), customer experience (T2-code), and operational processes (T3-code) —are now discussed based on their literature references provided in <Table 4>. As suggested by the reviewers, the unique theme codes (T1-T3) and subtheme codes have been provided, as depicted in <Table 4>, to better reference the surveyed literature and provide evidence using thematic codes. This will help link the previous literature with the discussion in the subsequent section to ensure logical flow (for example, T1S1 should be read as 'theme 1, subtheme 1' from <Table 4>, and so on).

The blockchain DT business model (BM) is clustered into ecosystem channel, strategy, and market segment challenges. Blockchain challenges related to technological, organisational, and environmental (TOE), institutional, market and technical channel partners and communication impact ecosystem channels (Janssen et al., 2020; Clohessy et al., 2018; Orji

et al., 2020; Upadhyay, 2020; Kouhizadeh et al., 2020; Queiroz and Wamba, 2019) (<Tables 2, 4>, T1S1). Literature is available to strategise the challenges based on PEST (political, economic, social, and technological) factors, strategic orientation, and social strategic influence requirements (Woodside et al., 2017; Nuryyev et al., 2020; Queiroza and Wamba, 2018) (<Tables 2, 4>, T1S2). Most technology platforms are governed and regulated by globally recognised standardising agencies for the cloud, such as the National Institute of Standards and Technology (NIST), but blockchain still needs it. It is required to set the benchmarking standards and characteristics of blockchain market segments, market size, growth and trends, industry-specific solutions, investment criteria, and composite reliability, which still do not exist (Chen and Bellavitis, 2020; Queiroz and Wamba, 2019; Tandon et al., 2020; Wamba and Guthrie, 2020; Yang et al., 2020; Yue et al., 2016) (<Tables 2, 4>, T1S3).

Blockchain DT customer/user experience (CE) is clustered into challenges of security and privacy, complexity and compatibility, and ease of use and usefulness. One of the biggest concerns of blockchain is security and privacy (Anand and Chauhan, 2020; Casino et al., 2019; Hsieh et al., 2018; Mehar et al., 2019; Upadhyay, 2020) (<Tables 2, 4>, T2S1). If used legitimately, blockchain provides the most secure platform and ensures privacy. However, it poses challenges related to data management, privacy and security, synchronised s/w upgrade, compliances, and valid signatures when it reaches the wrong hands. Literature-based evidence talks about the newer challenges of device protection, decentralised WikiLeaks, decentralised autonomous organisation (DAO) attack, and philosophers' zombies and robots (Anand and Chauhan, 2020; Casino et al., 2018; Hammi et al., 2018; Hsieh et al., 2019; Jentzsch, 2016; Makhdoom et al., 2019; Mehar et al., 2019; Morrison et al., 2020; Upadhyay, 2020). Practitioners and researchers are finding blockchain technology cumbersome and incompatible as existing ecosystem solutions are complex to deploy, the trial is difficult, skills are in dearth, and observable results are unclear (Kouhizadeh et al., 2020; Mistrya et al., 2019; Orji et al., 2020; Queiroz and Wamba, 2019; Wamba and Guthrie, 2020) (<Tables 2, 4>, T2S2). Perceived value, perceived usefulness, and perceived ease of use constructs have been researched and found to be challenging in the blockchain literature (Grover et al., 2019; Karamchandani et al. 2019). Blockchain solutions also face problems and non-acceptance concerning customer relationships, information and service quality, and delivery reliability. Blockchain infrastructure requires enormous volumes of storage and faces heating problems, coupled with challenges related to training, skills, and cloud marketplace (Greenwood et al., 2016; Grover et al., 2019; Nuryyev et al., 2020; Orji et al., 2020) (<Tables 2, 4>, T2S3).

Blockchain DT operational processes (OP) cluster organisational design, governance, and integration challenges. Blockchain elements of intelligent contracts and decentralisation impact organisation design if implemented. Decentralised autonomous organisation (DAO) attack on blockchain raises many questions on the ongoing research on stateless society, decentralised organisation structures, scalability, institutional trust, borderless businesses, and zombies and robots (Akram et al., 2020; Atzori 2017; Diallo et al., 2018; Duan et al., 2019; Jaradat et al., 2016; Morrison et al., 2020; Orji et al., 2020; Parina and Chauhan, 2020; Schuetz and Venkatesh, 2019; Singh and Shiho, 2019; Viriyasitavat and Hoonsopon, 2019; Zwitter and Hazenberg, 2020) (<Tables 2, 4>, T3S1). Governance challenges are also highlighted at different levels, such as stakeholders onboarding, regu-

lations, blockchain governance layers, consensus building and algorithms, auditability and intermediation (Alles and Gray, 2020; Cuccuru, 2017; Kalliopi et al., 2017; Morkunas et al., 2019; Pelt et al., 2020; Viriyasitavat and Hoonsopon, 2019) (<Tables 2, 4>, T3S2). Blockchain systems should talk to other ecosystem platforms and require integration with them. Integration-wise, there are challenges related to data standardisation, system interoperability, accessibility, and business process integration (Lee, 2019; Upadhyay, 2020; Werner et al., 2020; Yang et al., 2020) (<Tables 2, 4>, T3S3).

Ⅴ. Research Framework

We propose to use the theory, context, characteristics, and methodology (TCCM) framework as per the literature review (Kumar et al., 2019). TCCM will form the basis of the future research agenda on blockchain challenges and recommendations (Paul and Rosado-Serrano, 2019; Terjesen et al., 2013). First, the propositions based on constructs and conceptual work will be developed using available literature. Each proposition will be reviewed based on the literature and whether the evidence supports or refutes it.

5.1. Theory (T)

Technology acceptance, innovation theories, UTAUT theory etc., are extensively used in similar studies, as described in <Table 6>. Researchers have leveraged many classical theories to understand the phenomenon of technology adoption and behavioural intention. This study is about understanding the challenges faced by consumers, which lead to lower acceptance, usage, and behavioural intention while working on blockchain technologies in DT areas. A thematic qualitative analysis of the literature has been conducted using MAXQDA, where challenge characteristics are well encompassed using the UTAUT theory (<Table 4 and 7>). The mapping of themes with UTAUT is described in four propositions (P1-P4) developed in the next section. UTAUT theory is an overarching theory covering most of the constructs, themes, and subthemes used in the literature survey/papers. The UTAUT model is suitable for understanding the blockchain challenges faced in DT areas while working on usage behaviour. UTAUT was stated by Venkatesh et al. (2003) to understand and elaborate the individual intentions to use technology and its usage behaviour. In this paper, the challenge factors that influence blockchain technologies' adoption and usage behaviour in the DT area have been investigated. UTAUT model constructs are borrowed from previous technology adoption theories and models (Slade et al., 2013). The UTAUT model proposes four adoption behaviours and usage predictors: performance expectancy, effort expectancy, social influence, and facilitating conditions. Model constructs fortify its generalisability in studying why a specific technology is not flourishing in organisational and non-organisational settings (Venkatesh et al., 2012).

In this study, the performance expectancy construct has been categorised as the predictor construct to study the challenges of blockchain technology where users are looking for perceived usefulness, attaining gains, outcome expectation, and job fit. Gender and age play an essential role in performance expectancy, as young generations look for extrinsic rewards from blockchain technologies in the DT journey. The effort expectancy constructs have been leveraged to study the challenges of DT blockchain technology where users expect the desired level of perceived ease of use and complexity. The social influence construct has helped to understand the challenges of DT block-

chain technology based on subjective norms, societal factors, and image. Technological impacts directly determine individual behavioural intention influenced by surrounding groups' voluntariness and experience. The facilitating conditions construct was leveraged to investigate the challenges of DT blockchain technology infrastructure availability, professional services support/guidance, system compatibility, and safety to gauge acceptance and usage of technology. Now, the propositions will be built to study the thematic blockchain challenges with the literature evidence under the TCCM approach.

Proposition development

P1: Facilitating condition construct positively influences DT business model based blockchain challenges to its adoption intent.

Favourable facilitating condition construct helps use the technology effectively. According to the UTAUT model, it positively influences the intention to use the technology (Queiroz and Wamba, 2019). The more the challenges in facilitating conditions, the more the decline in blockchain adoption intent. Consistent support for both 'business models' is needed to reduce challenges in blockchain adoption intent.

P2: Social influences construct directly influences operational processes based blockchain challenges to its adoption intent.

Social influence construct notions can be explicit or implicit in different situations. It is based on beliefs, laws, regulations, customs, and societal acceptance; thus, it is believed on how others will view the technology (Venkatesh et al., 2003; Venkatesh, 1999; Venkatesh and Davis, 1996). Social influence constructs directly influence the DT operational processes. The more the challenges concerning the social influence construct in DT operational processes, the more the decline in blockchain adoption intent.

P3: Performance expectancy construct positively influences DT customer/user experiences based on blockchain challenges to its adoption intent.

Performance expectancy construct predicts technology usage intentions, and the outcomes from the studies are consistent in almost all models (Agarwal and Prasad, 1998). Concerning the present study, the performance expectancy construct is the measure where anybody observes that using DT-based blockchain will help any individual attain an advantage in job performance and perceived usefulness. The more the challenges concerning performance expectancy construct in DT customer/user experiences, the more the decline in blockchain adoption intent.

P4: Effort expectancy construct positively influences DT customer/user experiences based on blockchain challenges to its adoption intent.

The effort expectancy construct is significant in almost all cases, whether voluntary or mandatory usage. The relevance of the effort expectancy construct is significant during the initial time of the project execution and becomes insignificant in the long run (Venkatesh et al., 2003). The construct behaviour is not analogous to other acceptance models where it is consistent over the entire period (Agarwal and Prasad, 1997; 1998; Davis et al., 1989). At the embryonic stage, effort expectancy is more prominent in DT customer/user experiences to the "degree of ease associated with the use of blockchain system." The more challenges the effort expectancy construct in DT customer/user experiences, the more the decline in blockchain adoption intent.

5.2. Context(C)

<Table 3> presents the industry-wise details of the study with author details. Different industry contexts present different challenges in adopting blockchain as a DT tool. The text below discusses the proposi-

tion-wise context with the literature evidence.

P1: Facilitating condition construct positively influences DT business model based blockchain challenges to its adoption intent.

Literature evidence and context: Clohessy et al. (2018); Janssen et al. (2020); Orji et al. (2020); Queiroz and Wamba (2019) talk about contextual facilitating conditions construct influenced by ecosystem channel, strategy, and market segments (<Table 4>). The literature talks about 'ecosystem channel' challenges in the area of TOE, institutional conditions, and channel partners (<Table 4>, T1S1). Woodside et al. (2017); Nuryyev et al. (2020) present the 'strategy' dimension barriers in PEST, strategic intentions, and influence (<Table 4>, T1S2). Chen and Bellavitis (2020); Tandon et al. (2020); Wamba and Guthrie (2020); Yang et al. (2020); Yue et al. (2016) point out the blockchain barriers in the 'market segments' dimension in terms of market size, growth, industry solutions, turbulence, investment cost, and reliability (<Table 4>, T1S3).

P2: Social influences construct directly influences operational processes based blockchain challenges to its adoption intent.

Literature evidence and context: Blockchain social influence construct is influenced by organisational design, governance, and integration corresponding to DT operational processes (<Table 4>). Atzori (2017); Hughes et al. (2019); Orji et al. (2020); Viriyasitavat and Hoonsopon (2019); Zwitter and Hazenberg (2020) talk about the beliefs, laws, regulations, customs, and societal acceptance concerning organisational design and integration (<Table 4>, T3S1, T3S3). Stakeholder onboarding, governance layers, consensus building, auditability, and intermediation are the adoption challenges of the governance dimension (Alles and Gray, 2020; Aste et al., 2017; Morkunas et al., 2019; Pelt et al., 2020; Viriyasitavat and Hoonsopon, 2019) (<Table 4>, T3S2).

P3: Performance expectancy construct positively influences DT customer/user experiences based on blockchain challenges to its adoption intent.

Literature evidence and context: Blockchain performance expectancy construct is influenced by security and privacy, and usefulness corresponding to DT customer/user experiences (<Table 4>). Data management, compliances, valid signatures, device protection, decentralised WikiLeaks, illicit market DAO attack, and mythical managers such as robots and zombies are the adoption barriers of the security and privacy dimension (Mehar et al., 2019; Morrison et al. 2020; Upadhyay, 2020) (<Table 4>, T2S1). Perceived ease of use, incremental productivity, customer relationship, and service quality and reliability are the adoption barriers of the usefulness dimension (Grover and Kar, 2019; Karamchandani et al., 2019; Nuryyev et al., 2020) (<Table 4>, T2S3).

P4: Effort expectancy construct positively influences DT customer/user experiences based on blockchain challenges to its adoption intent.

Literature evidence and context: Blockchain effort expectancy construct is influenced by complexity and compatibility corresponding to DT customer/user experiences (<Table 4>). Adoption challenges related to the 'complexity and compatibility' dimension are partner pressure, the ease with which a proof of concept (POC) can be tried and experimented with, availability of specific blockchain tools, and capabilities of human resource barriers (Kouhizadeh et al., 2020; Orji et al., 2020; Queiroz and Wamba, 2019; Wamba and Guthrie, 2020) (<Table 4>, T2S2). 'Ease of use' barrier dimensions are knowledge sharing, storage and heating, training and skills, and cloud marketplace barriers (Grover et al., 2019; Karamchandani et al., 2019; Nuryyev et al., 2020) (<Table 4>, T2S3).

5.3. Characteristics (C)

The literature survey confirms 'governance' as the blockchain characteristic that is the most discussed topic in enterprise settings with the highest frequency and percentage (460, 15.16%, <Table 7>). Audit, risk, compliance, consensus, and agency problems are the widely discussed topics under the governance dimension (Alles and Gray, 2020; Pelt et al., 2020). The majority of the papers stressed the importance of the ease of use and usefulness of blockchain technologies as some of the barriers to adoption, with considerable frequency and percentage (382, 12.59%, <Table 7>). Variables such as perceived ease of use, incremental productivity, customer relationship, and service quality and reliability under 'ease of use and usefulness' have been studied in detail (both empirically and qualitatively) with established theories (Grover and Kar, 2019; Karamchandani et al., 2019; Nuryyev et al., 2020). Organisation design and integration also played a vital role (frequency more than 300, <Table 7>) in studying the blockchain challenges to roll out blockchain as the enterprise technology. Challenges related to organisational beliefs, laws, regulations, customs, and societal acceptance have been highlighted in the literature surveyed (Atzori, 2017; Orji et al., 2020). Variables such as strategy, operational processes, and complexity stand second with the frequency ranging between 200 to 300 in the surveyed literature (<Table 7>) and require considerable attention to manage blockchain challenges. The variables security and privacy, user experience, business model, and market segment barriers require a heavy push within enterprise settings discussed significantly within the literature (frequency 100-200, <Table 7>).

5.4. Methodology (M)

The literature survey presents exciting facts about the methodology used by the authors. <Table 5> presents the summary of the methodology used with its associated percentage. The literature survey and survey method are preferred to analyse blockchain characteristics with the highest percentage of 43.24 % (<Table 5>). The case method is also an accepted approach for conducting blockchain research as an analytical tool with a percentage of 10.81%. Partial least squares structural equation modelling (PLS-SEM) is also widely used, especially in industry setting-based papers with a percentage of 8.11 % (<Table 5>). Social media analytics and Ethereum blockchain implementation papers are also accepted as tools to analyse various blockchain research questions with a percentage of 5.41% (<Table 5>). Methods such as MCDM/A, DEMATEL, narrative synthesis, interview, mixed-methods approach, thematic content analysis, gap analysis, and triangulation are also used to depict the challenges and adoption levels of the blockchain ecosystem in the literature survey.

VI. Research Implications

This section discusses the research implications concerning the business model, customer/user experiences, and operating processes. Propositions (P), tables, theme(T) and subtheme (S) are linked together using the format of (P, Table, TS) to relate the previous literature with the discussion in the subsequent section to ensure logical flow.

6.1. DT Blockchain Business Model Challenges

This paper reveals a requirement of DT blockchain 'business model' (P1, <Table 4>, T1) research towards adopting channel ecosystem (P1, <Table 4>, T1S1), strategy (P1, <Table 4>, T1S2), and market segments (P1, <Table 4>, T1S3). Research is required to provide standard, sustainable, scalable, and favourable facilitating conditions for institutional TOE structures and channel partners support structures (P1, <Table 4>, T1S1). Research on DT blockchain strategic barriers is sought to analyse PEST, strategic intentions, and influences (P1, <Table 4>, T1S2). Proper benchmarks and institutionalised studies must set the market size, growth, industry solutions, turbulence, investment cost, and reliability standards. Social influences highly impact DT business models. There are many reservations related to the acceptance of the system in the mainstream (P1, <Table 4>, T1S3). Research must study the societal influence of laws, regulations, and policies and how they impact the ecosystem channel, strategy, and market segment barriers.

6.2. DT Blockchain 'Customer/User Experience' Challenges

The literature survey indicates that DT blockchain 'customer/user experience' (P3, P4, <Table 4>, T2) research is required to adopt security and privacy (P3, P4, <Table 4>, T2S1) and usefulness challenges (P3, P4, <Table 4>, T1S3). Further work must investigate the challenges in data management, synchronised s/w upgrade, compliances, and valid signatures. Significant research is required for device protection, decentralised WikiLeaks, illicit market and assassination markets, and DAO attack related security and privacy (P3, P4, <Table 4>, T2S1). Research is solicited for DT blockchain incremental perceived productivity, technology usefulness, and user-friendliness. It is essential to study the relationship, service quality, delivery reliability, and information availability barriers (P3, P4, <Table 4>, T2S3). Further complexity and compatibility research are required for partner pressure, the ease with which a proof of concept (POC) can be tried and experimented with, blockchain tools' general availability, and the capabilities of human resource barriers (P3, P4, <Table 4>, T2S2). Also, it is required to comprehend the barriers of knowledge sharing, storage and heating, training and skills, and cloud marketplace 'ease of use' challenges.

6.3. DT Blockchain Operational Processes Challenges

The literature survey confirms that DT blockchain 'operational processes' (P2, <Table 4>, T3) research is required to adopt organisational design (P2, <Table 4>, T3S1), governance (P2, <Table 4>, T3S2), and integration processes (P2, <Table 4>, T3S3). Research must understand how to facilitate conditions to develop a stateless society, blockchain DAO, and institutional trust (P2, <Table 4>, T3S1, T3S2). Further research is required for eradicating the challenges to run organisations with governance layers, consensus building, auditability, intermediation, data standardisation, interoperability, accessibility, and process integration.

Ⅶ. Managerial Implications

This section discusses the managerial implications concerning business models, customer/user experiences, and operating processes.

7.1. DT Blockchain Business Model Challenges

Evidence from literature confirms that practitioners must work on business models (P1, <Table 4>, T1) to get the relative advantage of DT blockchain. They should work as facilitators to identify key- partners, resources, activities, value propositions, customer- relationships, channels, segments, and finally, cost structures and revenue streams. Managers should be cognizant of the social influences that directly impact business models. Custom studies are solicited to gauge the ecosystem channel's interest, discussion with senior management for strategic intent, and the marketing segment's pulse concerning social aspects. It is important to predict the reaction of the users when adopting a DT business model driven in self-service mode rather than depending on intermediaries, middlemen, or government agencies.

7.2. DT Blockchain 'Customer/User Experience' Challenges

First, the responsibility of a manager is to make available a secure workplace and a system that establishes trust enhances the 'customer/user experience' and removes any inhibition w.r.t performance expectancy (P3, P4, <Table 4>, T2). Managers must expect and model intrusion free, fair, transparent, and ultimately secure user experience systems. Managers must highlight the relative advantage of the system in terms of how implementing the new system will reduce overall operating costs, expand market share, increase sales, increase revenues, reduce the cycle time, reduce time to access the resources, and create an accessible channel to communicate, to achieve a competitive advantage for their enterprise to ensure 'usefulness'.

Manager responsibility for effort expectancy and 'customer/user experiences' goes hand in hand. Managers should evaluate suppliers, stakeholders, and customers to accept the new transformation with the current values and culture. Practitioners should provide access to a free trial before making technology and business decisions and leveraging the platform in an as-a-service model to run the business in parallel before the production cutover. The most important thing is training and skills availability. Managers should provide ease of use with the required training and skills to ease intelligent contracts based on decentralised applications.

7.3. DT Blockchain Operational Processes Challenges

DT operational processes are heavily impacted by the managerial implementation approach as its outcome is directly dependent on how the processes are studied, developed, and achieved (P2, <Table 4>, T3). Practitioners should think about the internal stakeholders facilitating conditions when they are designing a decentralised organisation. It may be possible that certain parts of an organisation will still lie in the centralised zone. Therefore, integration with a decentralised system is a big task. To maintain a balance within operational processes, stakeholders should be trained and made aware of the cadence and governance system.

Practitioners should know the ground reality before implementing novel DT operational processes as it affects the entire society. The way people work anticipates a response from the agencies, and it requires acceptance from society. All the external stakeholders (representatives) can come together while designing a stateless society in the conversation regarding the integration of different parts of society and discuss how to adhere to laws, regulations, and trust-based

governance systems.

Ⅷ. Limitations

The main limitation of this study is the experimental design. Researchers and practitioners need empirical investigation to understand the causal relationship between BM, CE, and OP adoption barriers. Different representations, including from the government, NGOs, sector leaders, researchers, and practitioners, should be included in this study. Factor analysis can validate adoption challenges to cluster them together and study challenges sub-factors by assigning proper weights. Also, the propositions should be tested in different geographical and stakeholder settings because outcomes will change because of diverse businesses and social and operational ecosystems. This study has used a limited number of databases to search for relevant research papers. The database scope can be increased by including some more journals. Mainly, management journals were considered to give insights into the blockchain. Journals and publications from a technical software domain can also be considered to give a practical flavour. Timeframe-based blockchain challenge eradication roadmap is not discussed in the paper; future researchers can propose and consider this. The literature review-based methodology has various limitations because of biasedness, content availability, and empirical and exploratory interpretation studies. Most of the time, a positive flair of authorship is available in academic journals and publications as compared to a negative one. However, this paper is an exception (Kitchenham, 2004). We tried to make our study criteria wide enough to cover all the significant search results from various standard databases to avoid sample selection bias. One thing is clear; technical challenges account for only 20 per cent of the DT blockchain challenges; the rest of the challenges are mainly related to the DT dimensions of business model and organisation processes related to the partner ecosystem, market segments, organisation design, governance, and integration issues Mori (2016)'s. A case study approach can also be carried forward concerning DT blockchain challenge investigation from multiple verticals and industries.

Ⅸ. Conclusion

This study is mapped towards DT blockchain challenges and their influences. Even after 12 years, this technology is nascent with only technical literature evidence. Based on a literature survey, this research lays the foundation for understanding the BM, CE, and OP challenges of DT blockchain implementation. MAXQDA software has been used to analyse the literature survey data qualitatively. The PRISMA and TCCM frameworks have been leveraged for conducting systematic literature review to cover the extensive spectrum of blockchain challenges. Further, four propositions have been developed, mapped, and validated with literature evidence to resolve the links of adoption challenges with further research and empirical implications.

Blockchain is a breakthrough in digital transformation, apart from cloud computing, big data, AR/VR, and AI/ML technologies. Despite various advantages (distribution, encryption, immutability, tokenisation, decentralisation, and smart contracts) offered by blockchain technologies for digital transformation, it has not created the anticipated faith. Based on the MAXQDA qualitative analysis, propositions, and evidence, this study proposes a suitable research approach for DT blockchain challenges for digital transformation. Responding to the UTAUT

constructs “facilitating conditions, social influence, performance expectancy, and effort expectancy”, the challenges cover the entire gamut of blockchain requirements to implement digital transformation using blockchain. Both research and managerial implications are developed to map all the challenges with DT dimensions of BM, CE, and OP to assist researchers, practitioners, service providers, and administrators in precisely overcoming critical barriers.

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