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Technology assessment: Enabling Blockchain in hospitality and tourism sectors

Mahak Sharma[a,1], Rajat Sehrawat[b], Tugrul Daim[c,*], Amir Shaygan[c]

[a] National Institute of Industrial Engineering, NITIE, Mumbai, India
[b] Booking.com Headquarters, Herengracht 597 1017 CE Amsterdam, Netherlands
[c] Portland State University, Portland OR USA

ABSTRACT

The tourism and hospitality sector's inequitable environment demands an unassailable and disruptive technology that optimizes its operational efficiencies. Thus, this paper aims to explore the nature of blockchain technology under varying conditions for consumer benefits. Academic and press articles followed by interviews from industry experts were used to explore the nature of blockchain technology (BCT) for the hospitality and tourism sector (HTS). A hybrid research methodology is proposed to investigate the criticality of factors, their hierarchical model, and cause & effect relationships. 35 Employees from two geographies, namely India (N=17) and Netherlands (N=18) in hospitality and tourism firms, were interviewed. In the next step, the expert opinions were collected using the Analytic hierarchy process - Interpretive Structural Modeling- Decision-making trial and evaluation laboratory (AHP-ISM-DEMATEL) technique. A forward-looking approach was adopted by considering the implications of barriers and drivers on the adoption of BCT and thereby benefiting HTS. The results suggest that 'low cost' and 'risk management' are the key drivers with driving power of 1 and 10 in Indian and the Netherlands, respectively. They are placed at I and VI hierarchy levels and fall under the cause effect group. 'Lack of Government Regulation/ Policy' and 'Market Uncertainty' are the critical barriers with driving power 9 and 10 in the Indian and Netherlands context, respectively. They are placed at V and III hierarchy levels and fall under the cause effect group.

1. Introduction

BCT is a virtual live database that creates a real-time, unique, and permanent record entry for every financial transaction (Wille, 2019). It is a groundbreaking disruptive technology that has revolutionized digital currencies and financial assets (Abeyratne and Monfared, 2016; Frizzo-Barker *et al.*, 2020). Blockchain technology (BCT) offers transparent, cryptographic, tamper-proof transaction and data storage mechanisms (Saberi *et al.*, 2019). The financial sector leads the way of investments in blockchain technology by spending about $552 million on blockchain-powered projects in 2018 (Mitic, 2020). BCT has the potential to reduce investment banks' infrastructure costs by 30% (Mitic, 2020). It is expected that the BCT market will grow to $23.3 billion in annual revenues by the end of the year 2023 (Statista, 2020a). Due to its transparency, security, and decentralization, blockchain is expanding to more and more industries such as finance, economy, healthcare, IoT, and security (Zheng *et al.*, 2017; Varelas *et al.*, 2019).

The application of BCT in the tourism and hospitality industry is inevitable due to three main reasons. First, the industry's inequitable environment is prone to risky capital expenditures, imbalances in travel and consumer spending patterns, seasonality, and operational sensitivity. Due to these factors, the industry demands a disruptive technology that optimizes operational efficiencies (Shermin, 2017). Second, the hospitality and tourism industry is currently facing a global fierce digitalization competition. Due to this, the industry is ready to build, acquire and adopt disruptive innovations like BCT (Kizildag *et al.*, 2019). Third, BCT applications are multi-faceted and can benefit the hospitality sector in numerous ways, such as providing better information sharing, and verifiability thereby removing inefficient transactions, pilferage, and fraud. BCT is still in the infancy stage, especially for online travel agencies (OTA) such as Expedia, Skyscanner, the market leaders with approximately 12 billion USD revenue (2019). Diffusion of any technology depends on identifying enablers and resolving critical barriers (Birch and Burnett, 2009); hence there is a need for an investigation that can identify barriers and enablers, which could provide a holistic landscape for potential adopters. The existing studies on BCT are either conceptual or exploratory in nature; there is a dearth of empirical evidence that can provide a clear understanding to the industry practitioners and decision-makers. Yli-Huumo *et al.* (2016) showed that the focus in over 80% of the papers (around 41 papers studied) is on the

* Corresponding author
E-mail addresses: mahaksharma89@gmail.com (M. Sharma), rajatsehrawat91@gmail.com (R. Sehrawat), tugrul.u.daim@pdx.edu (T. Daim), ashaygan@pdx.edu (A. Shaygan).
[1] Present Address: 1e Kekerstraat, 133, Amsterdam, 1104VA, Netherlands

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Bitcoin system, and less than 20% deals with other BCT applications such as smart contracts and licensing. Most of the works are conducted in developed countries. To best of the authors' knowledge, no work has tried to explore BCT adoption in both developed and developing economies.

Netherlands was among the first twenty signatory countries that launched EU Blockchain Observatory and Forum in February 2018 by investing over 200 million Euro[2]. However, India is in its nascent stage of development and adoption of BCT[3] owing to the ban on crypto currency in India. Recently several companies worldwide have expressed their interest in the Indian crypto sector after the supreme court quashed the banking ban imposed by the central bank, the Reserve Bank of India (RBI)[4].

While the application of cryptocurrency in industries such as finance and banking has been successful and getting attention, the academic side has been lagging in terms of BCT-related investigations (Onder and Treiblmaier, 2018). It is also evident that barriers to adopting new technology are present (Sharma et al., 2020a). Therefore, there is a call for an in-depth investigation of blockchain adoption in the tourism and hospitality sector. To this end, this research aims to identify enablers and barriers influencing the adoption of BCT in different economies. The paper extends the scope of scholarly research by contributing to both industry and business fronts. The present work explores BCT adoption in both developed (Netherlands) and developing (India) economies. BCT can bring digital revolution; however, proper policy formulation is needed to implement these revolutionary innovations better. It has also been observed that for development, developed countries have generally devised national strategies while developing countries intents to adopt such innovation on a corporate level, primarily based upon individual company initiatives rather than coordinated national policies (Raj et al., 2020). Therefore, it is critical to investigate all the factors (drivers and barriers) that influence the adoption of BCT in developed as well as developing countries to understand the phenomenon in question holistically. Research investigating this difference is indispensable since it assists multinational corporates working across the globe with different economic conditions. These studies will aid them while making a decision towards the adoption of such disruptive innovations.

This is the first study that uses mixed methodology and employs an integrated framework of Analytic hierarchy process - Interpretive Structural Modeling- Decision making trial and evaluation laboratory (AHP-ISM-DEMATEL) to rank critical enablers and barriers; find hierarchy among them and find cause-effect relationships. The open-ended semi-structured questionnaire was developed, enabling the researcher to conduct an in-depth investigation of the BCT adoption in the hospitality domain. The discussion guide was pilot tested with industry experts (N=5), and questions were added on their recommendation. Purposive and judgmental sampling was used as it allows the selection of experts who were in the best position to provide hands-on experience and were interviewed either in person or via phone (Raj et al., 2020). The research approach was designed to obtain all required information from the interviewees (N=35) and gave the researcher more room to ask for clarification (if needed) by adding questions to gain additional insights. Interviews spanned multiple sessions to suit the convenience of the interviewees and lasted for 3 to 4 hours. The interviews were transcribed immediately after the sessions with the permission of participants and then analyzed. The initial interviews were analyzed immediately, and unique questions were added for the following interviews. If the later interviews revealed some momentous findings, those questions were asked with the initial companies in form of follow-up questions.

In that line the next section provides an outline of the literature review (Section 2) followed by data collection (Section 3) and research methodology (Section 3.1). The results and analysis are presented in section 4. Section 5 provides discussions that also talk about the significant drivers and challenges related to BCT in HTS. Section 6 concludes the paper and presents theoretical and practical implications as well. Section 7 provides limitations and scope of future research. The research interconnects BCT with the existing theoretical lenses and evolving practical themes so that academicians can utilize its full capability. The current examination will help industry practitioners to diminish the misconceptions about BCT, i.e., impeding its adoption; as a result, delaying its potential impact in the HTS.

2. Literature review

2.1. Blockchain

A blockchain is a public ledger of all transactions or a distributed database of records or digital events that are executed and shared among participating parties (Crosby *et al.*, 2016). Each transaction in the public ledger is verified by the consensus of most of the participants in the system. Due to its characteristics of transparency, security and decentralization, Blockchain is expanding to more and more fields of the industry such as finance, economy, healthcare, IoT, and security (Varelas *et al.*, 2019). Stafford and Treiblmaier (2020) analyzes electronic medical records (EMR) users in the United States to develop a perspective from industry and literature on the suitability of Blockchain technologies for EMRs, security, and storage. As another example of BCT-related research in healthcare, Biswas *et al.*(2020) studied the interoperability and synchronization management of BCT-based decentralized e-health systems. On the security side, Angieri *et al.* (2019) proposes a disturbed autonomous organization for internet address management and argues while Shahriar Rahman *et al.* (2020) uses BCT to create a cross-border data sharing platform among multiple countries. Moreover, Wang *et al.* (2019) propose a BCT-based anonymous reporting and rewarding scheme. On the Internet of Things side, Olivares-Rojas *et al.* (2019) use a multitier blockchain architecture to protect data in smart metering systems resulting in improved cybersecurity and data protection in an effective way, while Lockl *et al.* (2020) explore design principles for BCT based IoT applications. Meng, Li and Zhu (2019) address the BCTs application in security, healthcare, and IoT by investigating blockchain-based trust management's performance while focusing on the internet of medical things. Schweizer *et al.* (2020) discuss the blockchain-based technology's promise for economically autonomous machines from security, privacy, regulation, business models, trustful transaction processing, and interoperability. Alzahrani and Daim (2019) studied the factor affecting the adoption of cryptocurrency and BCT from economic, technical, social, and personal perspectives. They found out that investment opportunity, subjective norms, businesses acceptance, privacy, and global attention as the main factors around the decision to adopt cryptocurrency technology. Financial sector (46%) is leading BCT adoption worldwide, followed by industrial products and manufacturing (12%), energy and utility (12%), healthcare (11%), government (8%), retail and consumer (4%) and lastly entertainment and media (1%). It is also expected that USA and China are the future BCT leader territories by the year 2023 (PwC, 2018; Statista, 2020b). BCT eliminates the requirement for a trustworthy 'third party' to regulate the monetary flows (Filimonau and Naumova, 2020). Due to this, BCT significantly decreases the system's complexity and substantially curtails the operational costs (Filimonau and Naumova, 2020). Furthermore, the availability of 'smart contracts' and autonomous action execution facilitate quicker and safer transactions between a travel booking site and hotels or airlines (Shermin, 2017). BCT helps in forming a legal-binding authentic contract and serves as a platform that diminishes chances of fraud and errors (Dogru et al., 2018; Willie,

[2] https://ec.europa.eu/digital-single-market/en/news/european-countries-join-blockchain-partnership

[3] https://niti.gov.in/sites/default/files/2020-01/Blockchain_The_India_Strategy_Part_I.pdf

[4] https://news.bitcoin.com/crypto-investments-india/

2019). Due to these affordances, scholars argue that giant corporations and the governments can test and potentially integrate the policies and agreements using BCT, which will provide sustainable management due to reduced costs associated with paperwork (Saberi et al., 2019).

2.2. Blockchain in tourism and hospitality industry

BCT's economic and technical paradigm shift is disrupting the traditional realm of the tourism and hospitality sector since its underlying principle facilitates the shift from a centralized server-based internet system to a transparent cryptographic network (Saberi *et al.*, 2019; Flecha-Barrio *et al.*, 2020). Due to inefficiency in the finance and banking industry, Online Travel Agencies (OTA) wireless transmissions face problems related to transaction fees that can be easily solved with BCT by removing intermediaries. Blockchain can reinvent the tourism and hospitality sector by facilitating digital identification of guests (travelers), increase provenance and effective identity, inventory, and credential management (Erceg, Damoska Sekuloska and Kelić, 2020). The tourism and hospitality industry's total contribution to the world economy was 10.4% of the global Gross Domestic Product (GDP), i.e., 8.8 trillion USD (2018)[5]. PricewaterhouseCoopers (PwC) (2017) reported that the tourism and hospitality industry are expected to receive the highest share of blockchain investments. BCT has been gaining more significance in a myriad of areas such as the travel and tourism industry with the help of new tools such as smart contracts, decentralized applications, and cryptocurrencies (Ozdemir, Ar, and Erol, 2019). Nuryyev *et al.* (2020) studied the factors influencing the adoption of cryptocurrency payments in small to medium tourism and hospitality-related enterprises using the technology acceptance model (TAM). They found that strategic orientation, owner/manager's personal characteristics (self-efficacy and innovativeness), and social influence impact cryptocurrency adoption (Nuryyev *et al.*, 2020). There are other studies in the literature studying the adoption and applications of BCT in the tourism and hospitality industries (Polukhina et al., 2019; Antoniadis et al., 2020; Flecha-Barrio *et al.*, 2020; Valeri, 2020).

The application of BCT in the tourism and hospitality industry is inevitable due to three main reasons. First, the industry's inequitable environment is prone to risky capital expenditures, imbalances in travel and consumer spending patterns, seasonality, and operational sensitivity. Due to these factors, the industry demands a disruptive technology that optimizes operational efficiencies (Shermin, 2017). Second, the hospitality and tourism industry is currently facing fierce global digitalization competition. Due to this, the industry is ready to build, acquire and adopt disruptive innovations like BCT (Kizildag *et al.*, 2019). Third, BCT applications are multi-faceted and can benefit the hospitality sector in numerous ways, such as providing better information sharing, and verifiability thereby removing inefficient transactions, pilferage, and fraud.

As mentioned before, the application of BCT in the tourism and hospitality industry is inevitable due to; the industry's inequitable environment being prone to risky capital expenditures, imbalances in travel and consumer spending patterns, seasonality, and operational sensitivity leading to be open to disruptive technologies that optimize operational efficiencies (Shermin, 2017). Hospitality and tourism industry being faced by a global fierce digitalization competition forcing them to be open to build, acquire and adopt disruptive innovations like BCT (Kizildag *et al.*, 2019), and, finally this industry benefiting in general from things such as providing better information sharing, and verifiability thereby removing inefficient transactions, pilferage, and fraud. Integration of the BCT in the hospitality and tourism sector will improve profitability, service quality, customer satisfaction, stakeholder management, and hassle-free remittances for cross-border transactions (Dogru et al., 2018). BCT can help the hotel and airline industry develop loyalty programs on a blockchain platform, thereby issuing and updating loyalty tokens, which could be easily bought, sold, or exchanged among customers to increase the overall service quality. Pilkington et al. (2017) suggest that the integration of BCT in tourism domain removes corruption issues thereby reducing poverty in Moldova. Rejeb et al. (2019) indicated that BCT could facilitate affordable and accessible quality treatment to patients by allowing disintermediation in medical tourism. These countless benefits and the positive impacts of BCT can accelerate its faster diffusion among industry practitioners (Valeri, 2020). BCT offers an untapped potential to use smart personalization and seamlessly integrated tourist services without intruding on guests' privacy (Kwok and Koh, 2019). In the future, properties can serve guests better based on their transactions (expenditure information, bookings made) and records from past experiences (profile, length of visit, preferences, and tastes) (Willie, 2019). BCT can aid blockchain-based travel insurance, property locks, and rental agreements that can apprise its numerous benefits to its potential target population[6]. BCT can help the aviation industry in preventing lost luggage since it can update its exact real-time location[7]. In addition, online transactions using BCT do not need any client support from a credit card service provider, thus making cheaper customer payment processing (Wille, 2019).

There are many advantages of BCT including seamless and holistic experiences to users (Rashideh, 2020), still few intriguing issues like security threats due to peer to peer network usage, the discrepancy in maintaining system based updates, issues related to scalability, inefficiency due to delay in validating multiple ledger versions, lack of awareness about the technology & infrastructure and environmental challenges need immediate attention (Gausdal et al., 2018). Another major challenge is block mismanagement in BCT which can put an individual's sensitive data at high risk (Matzutt *et al.*, 2018). The performance of the e-commerce transaction depends heavily on its efficiency and speed (Baršauskas et al., 2008). BCT-related delays in the authorization process will plummet the cost advantage (Filimonau and Naumova, 2020), raising concerns about its immediate appropriateness to serve the requirements of travel and tourism businesses unless an appropriate solution is identified and reinforced in the foreseeable future.

It is also worth noting that most of the existing studies on BCT applicability in the tourism and hospitality sectors are either conceptual or exploratory, and there is a dearth of empirical studies. Also, the existing handful of empirical studies only provides the perspective of single geography. No study to date has investigated and provided empirical evidence and a hierarchical model for driver and dependence factors influencing BCT adoption in the tourism and hospitality domain. The potential of BCT in the hospitality sectors goes beyond mere usage of digital currencies, superior trade models, shortening of travelers' waiting time, and optimized product distribution (Valeri, 2020). However, this perspective is primarily untapped, especially in the context of tourism businesses, due to the thematic novelty of the BCT concept. This calls for an impending requirement of managing and recognizing contemporary information and investigate technological, scientific, and societal encounters before applying BCT in the hospitality domain (Calvaresi *et al.*, 2019).

The advent of BCT and its prominent successful application to cryptocurrency has garnered much attention from industry such as finance and banking, but in comparison, the academic community has been slow in picking up the BCT-related investigations (Onder and Treiblmaier, 2018). For example, only a handful of studies have

[5] World Travel and Tourism Council. Global Economic Impact and Trends. Available online: https://www.wttc.org/economic-impact/country-analysis/ (accessed on 5 June 2020).

[6] https://www.aegonlife.com/insurance-investment-knowledge/blockchain-and-smart-contracts-revolutionising-the-insurance-industry/

[7] https://www.eos-intelligence.com/perspectives/transportation/blockchain-likely-to-make-a-safe-landing-in-aviation-sector/

examined the applicability of BCT in the hospitality sector (Nam *et al.*, 2019; Filimonau and Naumova, 2020). BCT is the underlying principle of digital currencies and bitcoins. Bitcoins[8] is an alternative monetary and financial scheme that can that primarily focuses on rooting out intermediation in financial transactions (Rejeb and Karim, 2020). Its usage for travel purchases is still in its early stages, where consumers, in general, lack sufficient knowledge about their applicability (Leung and Dickinger, 2017).

3. Research methodology

The data was collected from September 2019 to March 2020 in three periods. 35 Employees from online travel agencies (OTA) from two geographies, namely India (N=17) and Netherlands (N=18), who were in the process of implementation, were invited to participate in the study. These economies have been selected for the present research because these economies are deemed to accurately represent the context of developing and developed nations. Further, Netherlands is placed at rank 12 while India bagged 109 rank in terms of tourist destination competitiveness (Gómez-Vega and J Picazo-Tadeo, 2019). The Networked Readiness Index (NRI) assesses economies' readiness level to exploit the advantages of disruptive innovations and take advantage on the benefits offered by digital disruption (Raj et al., 2020). India and Netherlands differ in their readiness to exploit the benefits and opportunities presented by disruptive technologies such as BCT, as clearly indicated in their respective 88th and 4th places in the Networked Readiness Index (NRI, 2020). This calls for an investigation to explore which factors (barriers and drivers) can help a firm to improve their overall ranking by implementing technology solutions. The number of experts (N) is directly dependent on the methodology or technique used, such as for ethnography or case study research (N=3-10), grounded theory (N= 50-60), phenomenology (N= 3-5), narrative (N= 1-2) (Sharma and Sehrawat, 2020b). Vaidya & Kumar (2006) have apotheosized that results using multi-criteria-decision-making techniques can be generalized with sample organizations in the range of three to ten from one sector. Further, to ensure validation for MCDM and ISM, the number of experts is in line with previous studies that stated that five to twenty expert opinions are required (Kapse et al., 2018; Sharma et al., 2020a). At the starting of the interview session, the researcher explained the aim of the study to the interviewee. In line with the interviewee's request, the researcher assured that identity and information would be treated confidentially, and thus the company's name was not mentioned in the manuscript. The summary and findings were sent for approval from the interviewees.

An exploratory-descriptive research design with mixed methodology was used (Fig. 1). Content analysis was applied to analyze the transcripts (Miles et al., 1994; Lichtman, 2012; Sharma and Sehrawat, 2020a; 2020b). We analyzed the interview transcripts to verify the relevance of existing factors (drivers and barriers) reported in the literature and identify new factors specific to the Indian context.

Studies exploring the adoption of disruptive techniques need industry/expert viewpoint owing to two reasons, 1. They have hands-on experience and in-depth understanding of technology with respect to the sector under investigation; 2. Cross-sectional studies are not possible since the technology is in its initial stage of adoption. Hence, the present study uses an integrated approach based on the AHP, ISM, and DEMATEL approaches. Various authors have used integrated methods such as AHP-ISM (Sharma and Sehrawat, 2020a, c); ISM -DEMATEL (Kamble et al., 2020); AHP-DEMATEL (Sharma et al., 2021); to align the objective. The first objective of the present research is to identify and rank critical drivers as well as barriers that has been answered with AHP. Further, the next objective is to find hierarchical relationships between the identified factors (drivers and barriers) which has been examined with ISM. Finally, to identify the cause-and-effect groups DEMATEL has been utilized.

For pairwise comparisons (AHP), expert opinion is taken, and the consistency index is calculated & checked to ensure the data consistency (Saaty, 2008). The consistency ratio is below 0.1 is accepted for the present work (Saaty, 2008). Hierarchical models such as AHP, FAHP, and HDM have been used to study technology adoption (Sharma et al., 2020a, 2020b, 2020c; Sharma and Sehrawat, 2020b) and gain insights into the multicriteria decision making nature in a wide variety of topics and industries such as big data projects, university collaborative research centers, robotics, pharmaceutical, healthcare organizations, energy, and technology standards. Iskin and Daim (2016) use hierarchical decision model (HDM) to assess energy efficiency program planning in electric utilities in the Pacific Northwest, while Neshati and Daim (2017) created a model to aid decision-makers in assessing the factors that inform the call to participate in the development of technology standards. From the healthcare side, Hogaboam and Daim (2018) uses hierarchical decision model to assess the potential of technology adoption for mobility medical devices in neurosurgery and orthopedics patients, and Shaygan and Testik (2019) and Testik *et al.* (2017) use Fuzzy Analytical Hierarchy Process (FAHP) and AHP to prioritize quality improvement projects in healthcare organization while Shaygan and Daim (2019) uses HDM to identify and assess the factors affecting technology management maturity in healthcare organizations. In addition, Pereira *et al.* (2019) use hierarchical decision models to develop an emerging score to select/rank promising therapeutic monoclonal antibody patents; Chan and Daim, (2018) evaluate prospective technology areas, development strategies, and various innovation resources in China's pharmaceutical sector. Hierarchical decision models have also been used in the assessment of other topics such as wearable computing fitness (Aldhaban *et al.*, 2020), big data projects (Barham and Daim, 2020), university collaborative research centers (Gibson et al., 2019), technology transfer capabilities (Lavoie and Daim, 2020), and roadmapping robotics technology (Daim *et al.*, 2018) among others. Hence, based on the extant literature AHP has been found suitable to rank the identified barriers and drivers with respect to the present context in both economies. Further, ISM (Warfield, 1974) is applied to the critical barriers and drivers. The final diagraphs are developed using a detailed process explained in Fig. 1. The final and last step of the methodology is to find cause-effect relationship among drivers and barriers, respectively. DEMATEL (Gabus and Fontela, 1972, 1973) using a scale based on '0–4' where '0' represents no influence and '4' stands for very high influence has been applied to obtain pairwise direct relations matrix. Further, average matrix, followed by total relational matrix has been computed. The results obtained from the method are validated with the experts as well as with the threshold and accepted values indicated in the academic literature (Kamble et al., 2020; Raj et al., 2020).

4. Results and analysis

This study presents an effort for the adoption of BCT in HTS. In this connection, the relevant drivers, and barriers (Refer Table 1) for both developing (India) as well as developed (Netherlands) economies are identified, evaluated, and ranked. Further, their hierarchy has been assessed using ISM. The final step of the work is to find which drivers and barriers fall under cause or effect groups for both the economy. The outcomes of this examination were conferred to industry experts to aid them in making useful decision strategies and policies for the effective adoption of BCT in HTS.

4.1. Analysis of drivers India

The analysis of the present investigation reveals that in accordance with **AHP priority rank,** '*reduction in cost (Low cost)*' possesses the **first rank** in the Indian context and the highest priority with a weight of

[8] peer-to-peer electronic cash system

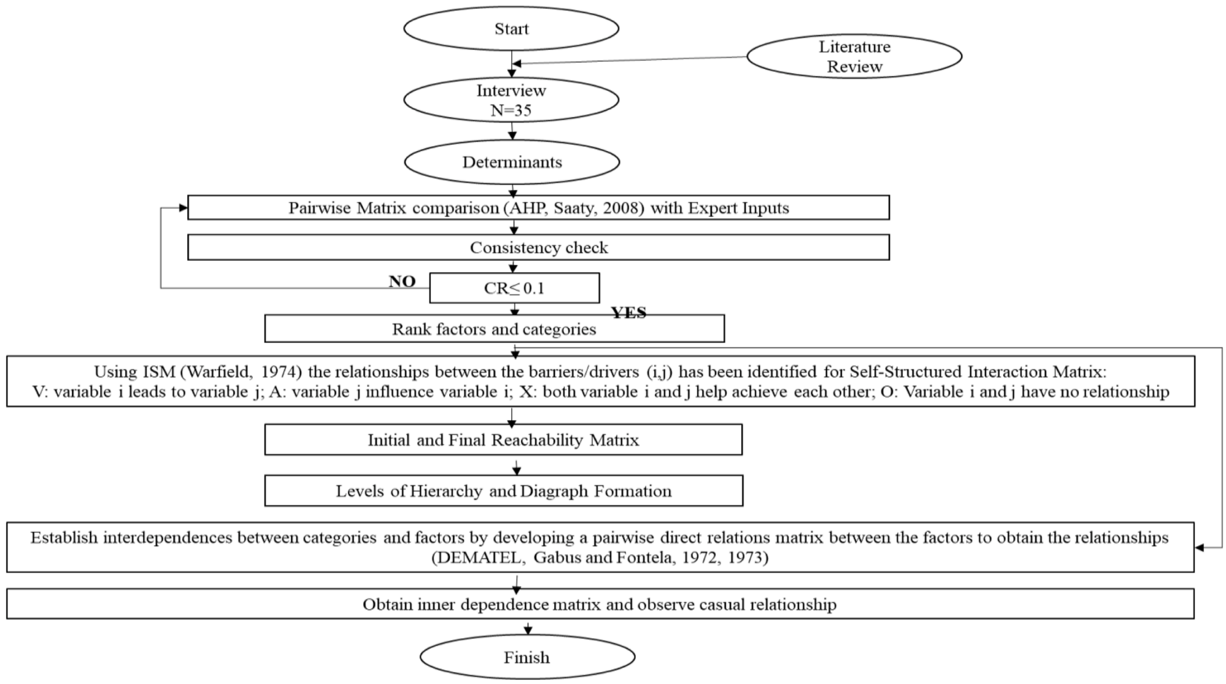


Fig. 1. Flow of Research Methodology

Table 1
Drivers and Barriers divulged from the analysis of the qualitative study with literature references.

Drivers	References for Definition
Reduction in cost	Flecha-Barrio et al. (2020); Sharma et al. (2020a)
Traceability	Kamble et al. (2020)
Disintermediation	Parekh et al. (2020)
Transparency	Wang et al. (2020)
Automation	Mistry et al. (2020); Flecha-Barrio et al. (2020)
Security and Privacy	Flecha-Barrio et al. (2020); Sharma et al. (2020c)
Trust	Anjum, Sporny, & Sill (2017); Hawlitschek, Notheisen, & Teubner (2018)
Immutability	Politou et al. (2019); Flecha-Barrio et al. (2020)
Secured Database	Ajao et al. (2019)
Decentralized Database	Prokofieva, & Miah (2019)
Risk Management	Fu, & Zhu (2019)
Distributed Network preventing Single Point of Failure (SPOF)	Mwitende et al. (2020)
Cryptographic and Tamper Proof	Yang et al. (2020)
Improved Resiliency of System	Ceccarelli et al. (2020)
Reducing System Wide Complexity	Wong et al. (2020)
Barriers	
Market Uncertainty	Le Tran & Leirvik (2020)
Legal and Contractual Uncertainty	Lohmer & Lasch (2020)
Security, Privacy and Surveillance Issue	Lee & Park (2020)
Lack of Government Regulation/ Policy	Zhang et al. (2020)
Size and Bandwidth	Xie et al. (2019), Bouachir et al. (2020); Farooque et al. (2020);
Problems in collaboration, communication, and coordination	Farooque et al. (2020)
Lack of management commitment and support	Sharma et al (2020a, c); Farooque et al. (2020)
Resistance to Change	Sharma et al (2020a, c)
Lack of Knowledge and expertise	Helliar et al. (2020)
Unclear Benefits of Technology	Hackius & Petersen (2017)

0.225 (see Table 2). It has both driving and dependence power equal to 1 (see Table 3). **In hierarchical digraph** (ISM) it is placed at the level I (Refer Fig. 2a). It lies in the first quadrant (lower left- see Fig. 3a) and is labelled as autonomous drivers in **MICMAC analysis.** It has weak driver potential as well as driving potential. Further using **DEMATEL analysis**, it is placed in the **effect** group factor (see Table 4 and Fig. 4a), with -0.005 (negative) as the (r − d) score and placed at rank '7'. The effect group factors represent the meaning of influenced factors, i.e., they are affected by cause-group factors.

The driver placed at **second position** in **AHP priority ranking** is *'traceability'* with priority weight 0.130 (see Table 2). It has driving power equal to 8 and dependence power equal to 1 (See Table 3). In the **hierarchical digraph,** it is placed at level VII. It is a driving enabler, i.e.,

Table 2
Drivers Rank (India and Netherlands)

Drivers	Weights (India)	Rank (India)	Weights (Netherlands)	Rank (Netherlands)
Reduction in cost (Low Cost)	0.225	1	0.012	15
Traceability	0.130	2	0.116	3
Disintermediation	0.114	3	0.106	4
Transparency	0.092	4	0.126	2
Automation	0.057	8	0.059	7
Security and Privacy	0.067	6	0.105	5
Trust	0.067	7	0.035	11
Immutability	0.073	5	0.065	6
Secured Database	0.038	9	0.05	8
Decentralized Database	0.031	10	0.027	12
Risk Management	0.023	11	0.175	1
Distributed Network preventing SPOF	0.022	12	0.045	9
Cryptographic and Tamper Proof	0.021	13	0.04	10
Improved Resiliency of System	0.020	14	0.021	13
Reducing System Wide Complexity	0.020	15	0.017	14

Table 3
Drivers -ISM (India)

Drivers (India)	DRP	DP	Reachability	Antecedent	Intersection	Level
Decentralised Database	9	1	1	1,2,3,4,5,67,8,9	1	II
Automation	6	6	1,2,3,6,7,8	2,4,6,7,8,9	2,6,7,8	V
Secured Database	8	2	1,3	2,3,4,5,6,7,8,9	3	III
Disintermediation	2	7	1,2,3,4,6,7,8	4,9	4	VI
Transparency	1	3	1,3,5	5	5	IV
Security & Privacy	6	6	1,2,3,6,7,8	2,4,6,7,8,9	2,6,7,8	V
Trust	6	6	1,2,3,6,7,8	2,4,6,7,8,9	2,6,7,8	V
Immutability	6	6	1,2,3,6,7,8	2,4,6,7,8,9	2,6,7,8	V
Traceability	1	8	1,2,3,4,6,7,8,9	9	9	VII
Reduction in cost (Low cost)	1	1	10	10	10	I

Note: DP: Dependence Power; DRP: Driver Power

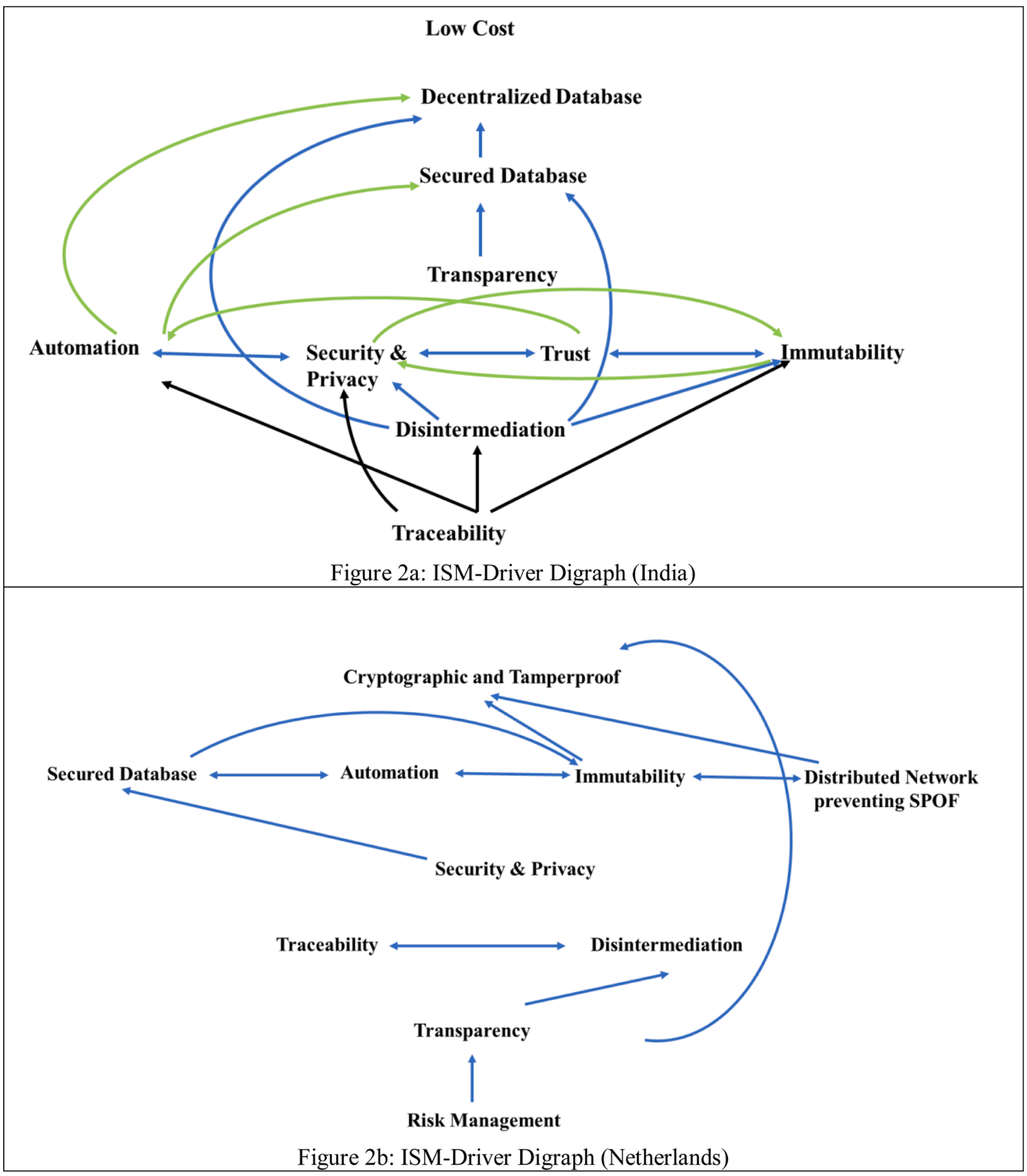


Fig. 2. ISM-Driver Diagraph (India and Netherlands)

the drivers that lie on the bottom of the ISM model (digraph- Refer Fig. 2a) fall in the fourth quadrant (upper left) of the **MICMAC analysis** (Fig. 3a). The drivers have high driving power, and their dependence power is very low, which actuates the entire system. Further, it belongs to the **cause group** factor (see Table 4 and Fig. 4a), with 0.262 (positive) as the (r − d) score and placed at rank 4. The cause group factors point to the meaning of influencing factors, which means these factors influence other factors.

The drivers placed at **third, fourth,** and **fifth** positions in **AHP priority ranking** are '*Disintermediation*,' '*Transparency*,' and

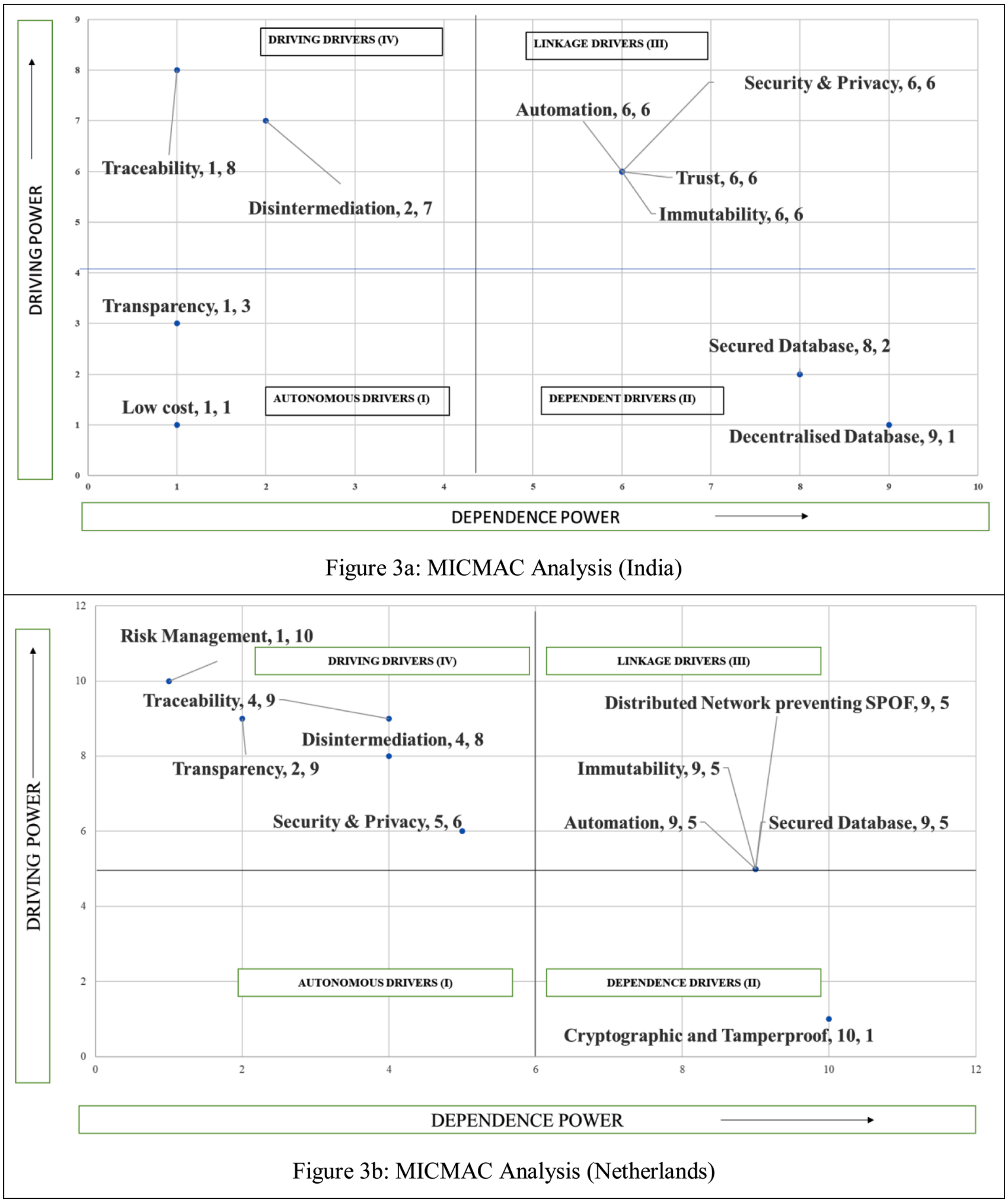


Figure 3a: MICMAC Analysis (India)

Figure 3b: MICMAC Analysis (Netherlands)

Fig. 3. MICMAC Analysis (India and Netherlands)

Table 4
Drivers ranking and clustering using DEMATEL (India)

DI	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D	D+R	R-D	Rk	C-E
A1	0.132	0.193	0.193	0.169	0.287	0.256	0.234	0.231	0.194	0.154	2.043	4.614	0.529	2	C
A2	0.252	0.199	0.238	0.245	0.351	0.348	0.290	0.289	0.240	0.225	2.675	5.613	0.262	4	C
A3	0.314	0.266	0.228	0.236	0.395	0.342	0.371	0.362	0.316	0.249	3.078	6.052	-0.104	8	E
A4	0.171	0.229	0.192	0.130	0.249	0.214	0.269	0.225	0.198	0.155	2.033	4.585	0.520	3	C
A5	0.324	0.361	0.368	0.285	0.396	0.444	0.514	0.471	0.376	0.291	3.830	7.918	0.259	5	C
A6	0.269	0.330	0.290	0.215	0.407	0.262	0.309	0.414	0.215	0.169	2.883	6.311	0.546	1	C
A7	0.285	0.353	0.400	0.328	0.534	0.363	0.371	0.461	0.447	0.258	3.800	7.596	-0.005	7	E
A8	0.279	0.353	0.356	0.274	0.495	0.469	0.464	0.345	0.360	0.282	3.678	7.339	-0.016	9	E
A9	0.233	0.264	0.309	0.354	0.388	0.256	0.448	0.353	0.243	0.213	3.063	6.133	0.007	6	C
A10	0.311	0.390	0.399	0.316	0.586	0.475	0.526	0.509	0.480	0.235	4.228	6.459	-1.997	10	E
R	2.571	2.937	2.974	2.552	4.088	3.428	3.796	3.661	3.070	2.231					

A1: Transparency; A2: Traceability; A3: Immutability; A4: Trust Reduction in cost; A5: Security and Privacy; A6: Disintermediation; A7: Reduction in cost; A8: Secured Database; A9: Automation; A10: Decentralized Database; C-E: Cause-Effect; DI: Drivers-India; Rk: Rank; D: Sum of Columns; R: Sum of Rows

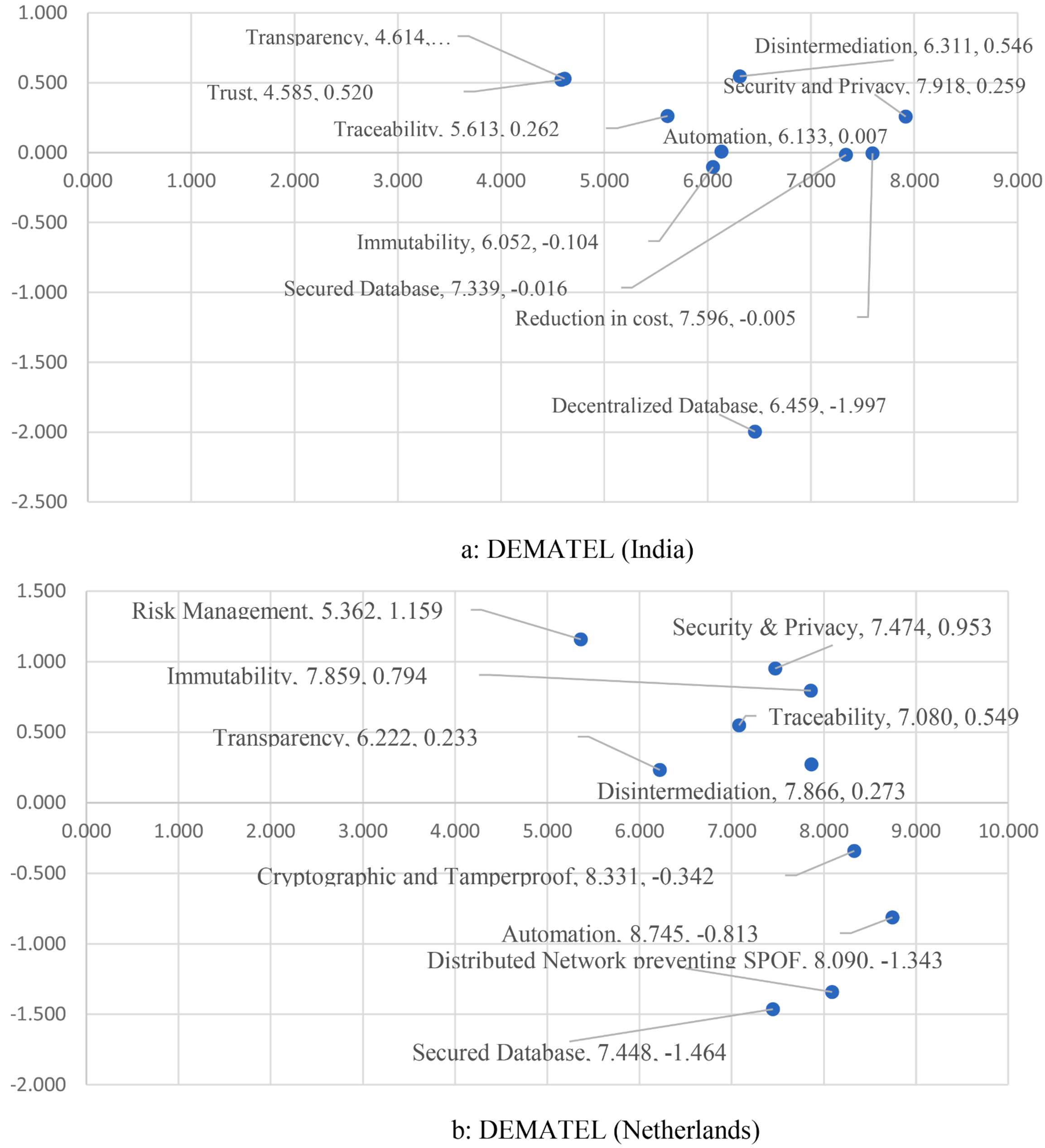


Fig. 4. Driver- DEMATEL (India and Netherlands)

'*Immutability*' with priority weight 0.114, 0.092, and 0.067, respectively (see Table 2). *Disintermediation* has driving power equal to '7' and dependence power equal to '2' while '*Transparency*', and '*Immutability*' have driving and dependence power of '1,3' and '6,6' respectively (Refer Table 3). In a **hierarchical digraph,** they are placed at levels VI, IV, and V, respectively (Refer Fig. 2a). Further, they belong to the **cause group** factors (see Table 4), with 0.546, 0.529, and 0.259 as the (r − d) scores and placed at rank 1, 2, and 5, respectively. '*Disintermediation*' lies in the fourth quadrant (See Fig. 3a), which also acts as a system actuator. 'Transparency' and '*Immutability*' are placed in the third quadrant (upper-right) and in the middle of the hierarchy and termed as **linkage drivers** since they help in binding the driving and dependent drivers.

The drivers **positioned** from sixth to fifteen positions are 'Security and Privacy' > 'Trust' > 'Automation' > 'Secured Database' > 'Decentralized Database' > 'Risk Management' > 'Distributed Network preventing SPOF' > 'Cryptographic and Tamper Proof' > 'Improved Resiliency of System' > 'Reducing System-Wide Complexity' (Refer Table 2) . The **driving** and **dependence powers** of drivers in the Indian context are '*Security and Privacy*'- (6,6); '*Trust*'- (6,6); '*Automation*'- (6,6,); '*Secured Database*'- (8,2); and '*Decentralized Database*'- (9,1) (Refer Table 3). The former three drivers are placed at Level V while the latter two at level III and II, respectively (Refer Fig. 2a). These drivers are among the top of the digraph since these are dependent enablers with low driving and high dependent power. *'Security and Privacy,' 'Trust,'* and *'Automation'* are clustered as **linkage drivers** while the latter two as **dependence drivers** (See Fig. 3a). The **DEMATEL** analysis reveals that *'Security and Privacy'* and *'trust'* belong to the cause group, and the rest all belong to the effect group (Refer Table 4). There is a crucial necessity to emphasize the cause group factors, which can clearly influence the other factors.

4.2. *Analysis of drivers Netherlands*

Netherlands

The analysis of the present investigation reveals that in accordance with **AHP priority rank** '*Risk Management*' possesses the first rank in the Netherlands context and the highest priority with a weight **0.175** (see Table 2). It has both driving and dependence power equal to **10 and 1,** respectively (Refer Table 5). In a **hierarchical digraph,** it is placed at level VI, i.e., the bottom of the digraph, which actuates the entire system (Refer Fig. 2b). It is a driving enabler and falls in the fourth quadrant (upper left) of the **MICMAC** analysis with high driving power and low dependence power (Refer Fig. 3b). Further, **DEMATEL** analysis placed it under the **cause group factor** (see Table 6), with 1.159 (positive) as the (r − d) score and placed at rank 1 (Refer Fig. 4b).

The driver placed at second position in **AHP priority ranking** is '*transparency*' with priority weight 0.126 (see Table 2). In a **hierarchical digraph,** it is placed at level V (Refer Fig. 2b) with a driving power equal to 9 and dependence power equal to 2 (Refer Table 5). It is also a driving enabler (Refer Fig. 3b) and falls in the fourth quadrant of **MICMAC** analysis. Further, it belongs to the **cause group factor** (see Table 6), with 0.233 (positive) as the (r − d) score and placed at rank **6** (Refer Table 6 and Fig. 4b).

The drivers placed at **third, fourth,** and **fifth** positions in **AHP priority ranking** are *'traceability,' 'Disintermediation,'* and *'Security and Privacy'* with priority weight 0.116, 0.106, and 0.105, respectively (see Table 2). *Traceability* has driving power equal to '9' and dependence power equal to '4' while *'Disintermediation'* and '*Security and Privacy*' have driving and dependence power of '9', '4' and '6,5' respectively (Refer Table 5). They are placed at level IV, IV, and III in a hierarchical digraph (Refer Fig. 2b). In **MICMAC** analysis, all three drivers fall in the fourth quadrant and act as driving drivers (Refer Fig. 3b). Further, they belong to the **cause group factors** (see Table 6), with 0.549, 0.273, and 0.794 as the (r − d) scores and placed at rank **4, 5,** and **3**, respectively (Refer Fig. 4b).

The drivers **positioned** from **sixth** to **fifteen** positions are 'Immutability' > 'Automation' > 'Secured Database' > 'Distributed Network preventing SPOF' > 'Cryptographic and Tamper Proof' > 'Trust' > 'Decentralised Database'> 'Improved Resiliency of System' > 'Reducing System Wide Complexity'> 'Reduction in cost' (Refer Table 2).

The **driving** and **dependence** powers of drivers in the context of Netherlands are '*Immutability*' - (5,9); '*Automation*'- (5,9); '*Secured Database*'-(5,9); '*Distributed Network preventing SPOF*'- (5,9) (Refer Table 5). All the four drivers are placed at Level II, act as linkage drivers, and fall in the **third quadrant** (see Fig. 2b and 3b). '*Cryptographic and Tamper Proof*' has driving and dependence power as (1,10). It is placed at level I and falls in **quadrant II** (Refer Fig. 2b and 3b) and acts as dependence driver with high dependence power and low driving power. The **DEMATEL** analysis reveals that '*Immutability*' belongs to cause group and '*Automation*', '*Secured Database*', '*Distributed Network preventing SPOF*' and '*Cryptographic and Tamper Proof*' belong to the **effect group** (Refer Table 6).

4.3. Analysis of Barriers (India)

The analysis of the present investigation reveals that in accordance with **AHP priority rank,** '*Lack of Government Regulation/ Policy*' possesses the first rank in the Indian context and the highest priority with weight 0.172 (See Table 7). It has both driving and dependence power equal to 9 and 1, respectively (Refer Table 8). In the **hierarchical digraph,** it is placed at level V and quadrant IV of **MICMAMC analysis** which suggests its role in actuating the system (See Figs. 5a and 6a). Further, it belongs to the **cause group factor** (see Table 9), with 0.930 (positive) as the (r − d) score and placed at rank **1** in **DEMATEL** calculations (see Fig. 7a).

The barrier placed at second position in **AHP priority ranking** is '*Problems in collaboration, communication and coordination*' with a priority weight 0.162 (see Table 7). It has driving power equal to 6 and dependence power equal to 2 (see Table 8). In **hierarchical digraph,** it is placed at level IV and quadrant IV of MICMAMC analysis, indicating its significance and influence on BCT adoption (See Figs. 5a and 6a). Further, it belongs to the **cause group** factor (see Table 9), with 0.52 (positive) as the (r − d) score and placed at rank 2 (see Fig. 7a).

The barriers placed at **third, fourth,** and **fifth** positions in **AHP priority ranking** are '*Security, Privacy and Surveillance Issue*', '*Network (Size and Bandwidth),*' and '*Resistance to Change*' with priority weight 0.110, 0.080 and 0.077, respectively (see Table 7). 'Security, Privacy and Surveillance Issue' has driving power equal to '6' and dependence power equal to '1' while 'Network (Size and Bandwidth)', and 'Resistance to Change' have driving and dependence power of '5,4' each (see Table 8). In **hierarchical digraph,** they are placed at level III (see Fig. 5a). '*Security, Privacy and Surveillance Issue*' is placed in quadrant IV while the rest two as linkage barriers in quadrant III (see Fig. 6a). Further, '*Security, Privacy and Surveillance Issue*' is placed in the **cause group** while the rest two belong to the **effect group** factors (see Table 9), with 0.292, -0.131, and -0.473 as the (r − d) scores and placed at rank 3, 5 and 10 respectively (see Fig. 7a).

The barriers positioned from **sixth** to **fifteen** positions are 'Market Uncertainty' > 'Lack of Knowledge and expertise' > 'Lack of management commitment and support' > 'Legal and Contractual Uncertainty'> 'Unclear Benefits of Technology' > 'Lack of Awareness' > 'Lack of Access to Technology' > 'Lack of Incentives for Adopters' > 'Network Effect' > 'Longer Latency time' (see Table 7).

The **driving** and **dependence powers** of drivers in the Indian context are '*Market Uncertainty*'- (2,6); '*Lack of Knowledge and expertise*' - (3,4); '*Legal and Contractual Uncertainty*'-(1,7); '*Lack of management commitment and support*'- (2,6); and '*Unclear Benefits of Technology*' - (1,8) (see Table 8). The former three barriers are placed at Level II while the latter two at level I, respectively (see Fig. 5a). All the five barriers are placed in **quadrant II** and are clustered as dependence barriers (see Fig. 6a). The **DEMATEL** analysis reveals that all belong to the effect group (Table 9).

Table 5
Drivers -ISM (Netherlands)

Drivers (Netherlands)	DRP	DP	Reachability	Antecedent	Intersection	Level
Traceability	9	4	1,3,4,6,7,8,9,10	1,2,3,5	1,3	IV
Risk Management	10	1	1,2,3,4,5,6,7,8,9,10	2	2	VI
Disintermediation	8	4	1,3,4,6,7,8,9,10	1,2,3,5	1,3	IV
Secured Database	5	9	4,6,7,8,9	1,2,3,4,5,6,8,9,10	4,6,8,9	II
Transparency	9	2	1,3,4,5,6,7,8,9,10	2,5	5	V
Automation	5	9	4,6,7,8,9	1,2,3,4,5,6,8,9,10	4,6,8,9	II
Cryptographic and Tamperproof	1	10	7	1,2,3,4,5,6,7,8,9,10	7	I
Immutability	5	9	4,6,7,8,9	1,2,3,4,5,6,8,9,10	4,6,8,9	II
Distributed Network preventing SPOF	5	9	4,6,7,8,9	1,2,3,4,5,6,8,9,10	4,6,8,9	II
Security & Privacy	6	5	4,6,7,8,9, 10	1,2,3,5,10	10	III

Note: DP: Dependence Power; DRP: Driver Power

Table 6
Drivers ranking and clustering using DEMATEL (Netherlands)

DN	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D	D+R	R-D	Rk	C-E
A1	0.148	0.219	0.230	0.192	0.242	0.237	0.226	0.199	0.227	0.181	2.102	5.362	1.159	1	C
A2	0.319	0.272	0.330	0.310	0.389	0.425	0.320	0.280	0.323	0.297	3.266	7.080	0.549	4	C
A3	0.395	0.358	0.332	0.310	0.443	0.431	0.413	0.365	0.417	0.332	3.796	7.866	0.273	5	C
A4	0.262	0.331	0.392	0.208	0.328	0.318	0.342	0.266	0.306	0.241	2.994	6.222	0.233	6	C
A5	0.340	0.378	0.394	0.292	0.329	0.449	0.346	0.302	0.388	0.315	3.533	7.859	0.794	3	C
A6	0.324	0.395	0.367	0.270	0.429	0.301	0.315	0.277	0.321	0.260	3.261	7.474	0.953	2	C
A7	0.385	0.478	0.555	0.428	0.617	0.485	0.417	0.476	0.580	0.359	4.779	8.745	-0.813	8	E
A8	0.383	0.522	0.501	0.375	0.577	0.601	0.525	0.343	0.495	0.394	4.716	8.090	-1.343	9	E
A9	0.351	0.403	0.521	0.474	0.498	0.433	0.543	0.408	0.380	0.326	4.336	8.331	-0.342	7	E
A10	0.355	0.458	0.446	0.368	0.475	0.532	0.519	0.458	0.557	0.286	4.456	7.448	-1.464	10	E
R	3.261	3.815	4.069	3.227	4.327	4.213	3.966	3.374	3.995	2.992					

Note: A1: Risk Management; A2: Traceability; A3: Disintermediation; A4: Transparency; A5: Immutability; A6: Security & Privacy; A7: Automation; A8: Distributed Network preventing SPOF; A9: Cryptographic and Tamper-proof; A10: Secured Database; Rk: Rank; C-E: Cause-Effect; D: Sum of Columns; R: Sum of Rows; DN: Drivers- Netherlands

Table 7
Barriers Rank (India and Netherlands)

BARRIERS	Weights (India)	Rank (India)	Weights (Netherlands)	Rank (Netherlands)
B1	0.172	1	0.148	2
B2	0 .162	2	0.096	4
B3	0.080	4	0.076	6
B4	0.074	6	0.171	1
B5	0.077	5	0.080	5
B6	0.060	7	0.061	7
B7	0.050	8	0.053	8
B8	0.049	9	0.050	9
B9	0.035	11	0.036	11
B10	0.037	10	0.036	10
B11	0.033	12	0.033	12
B12	0.023	13	0.024	13
B13	0.110	3	0.098	3
B14	0.016	15	0.015	15
B15	0.022	14	0.021	14

Note: B1: Lack of government Regulation/ Policy; B2: Problems in collaboration, communication, and coordination; B3: Size and Bandwidth; B4: Market Uncertainty; B5: Resistance to Change; B6: Lack of Knowledge and expertise; B7: Lack of management commitment and support; B8: Legal and Contractual Uncertainty; B9: Lack of Awareness; B10: Immaturity of Technology/ Unclear Benefits of Technology; B11: Lack of Access to Technology; B12: Lack of Incentives for Adopters; B13: Security, Privacy and Surveillance Issue; B14: Longer Latency time; B15: Network Effect

4.4. Analysis of Barriers (Netherlands)

'*Market uncertainty*' is positioned at the **first rank (AHP priority rank)** with respect to Netherland's context, in accordance with and the highest priority with weight 0.171 (see Table 7). It has driving and dependence power equal to 10 and 4, respectively (Refer Table 10). In **hierarchical digraph** it is placed at level III (See Fig. 5b). In **MICMAC analysis,** it is placed in driving barriers in quadrant IV on the upper left side (See Fig. 6b). Further, it belongs to the cause group factor (see Table 11), with 1.164 (positive) as the (r − d) score and placed at rank **1** in **DEMATEL** calculations (See Fig. 7b).

The barrier placed at **second position** in **AHP priority ranking** is '*Lack of Government Regulation/ Policy*' with priority weight 0.148 (see Table 7). It has driving power equal to 10 and dependence power equal to 4 (see Table 10). In **hierarchical diagraph,** it is placed at level III (See Fig. 5b). In **MICMAC analysis** it is also placed in driving barriers in quadrant IV on upper left side (See Fig. 6b). Further, it belongs to the **cause group factor** (see Table 11), with 0.909 (positive) as the (r − d) score and placed at rank 2 ((See Fig. 7b).

The barriers placed at **third, fourth,** and **fifth positions** in **AHP priority ranking** are '*Security, Privacy and Surveillance Issue*', '*Problems in collaboration, communication and coordination*', and '*Resistance to Change*' with priority weight 0.098, 0.096, and 0.080 respectively (see Table 7). '*Security, Privacy and Surveillance Issue*' and '*Problems in collaboration, communication and coordination*' have driving power equal to '10' and dependence power equal to '4' each while '*Resistance to Change*' have driving and dependence power of '1,6' (see Table 10). In **hierarchical digraph,** the former two are placed at level III while the latter one is placed at level I, respectively (See Fig. 5b). In **MICMAC Analysis** first two are clustered as driving barriers (Quadrant IV) while '*Resistance to Change*' falls under the cluster of dependence barriers (Quadrant II) (See Fig. 6b). Further, all the barriers belong to **cause group factors** (see Table 11), with 0.795, 0.526, 0.366 as the (r − d) scores and placed at rank 3, 4, and 5, respectively (See Fig. 7b).

The barriers positioned from **sixth** to **fifteen** positions are 'Size and Bandwidth' > 'Lack of Knowledge and expertise' > 'Lack of management commitment and support' > 'Legal and Contractual Uncertainty'> 'Immaturity of Technology/ Unclear Benefits of Technology' > 'Lack of Awareness' > 'Lack of Access to Technology' > 'Lack of Incentives for Adopters' > 'Network Effect' > 'Longer Latency time' (see Table 7).

The **driving** and **dependence powers** of other barriers in the context of Netherlands are '*Size and Bandwidth*' - (4,9); '*Lack of*

Table 8
Barriers -ISM (India)

Barriers (India)	DRP	DP	Reachability	Antecedent	Intersection	Level
Legal and Contractual Uncertainty	3	4	1,3	1,3,5,10	1,3	**I**
Unclear Benefits of Technology	1	8	2	1,3,4,5,8,9,10	2	**I**
Lack of Knowledge and expertise	3	4	1,3	1,3,5,10	1,3	**II**
Problems in collaboration, communication, and coordination	6	2	4	4,10	4	**IV**
Security, Privacy and Surveillance Issue	6	1	5	5	5	**III**
Lack of management commitment and support	1	7	6	4,5,7,8,9,10	6	**I**
Market Uncertainty	2	6	7	4,5,7,8,9,10	7	**II**
Resistance to Change	5	4	8,9	4,8,9,10	8,9	**III**
Network (Size and Bandwidth)	5	4	8,9	4,8,9,10	8,9	**III**
Lack of Government Policy	9	1	4,10	10	10	**V**

Note: DP: Dependence Power; DRP: Driver Power

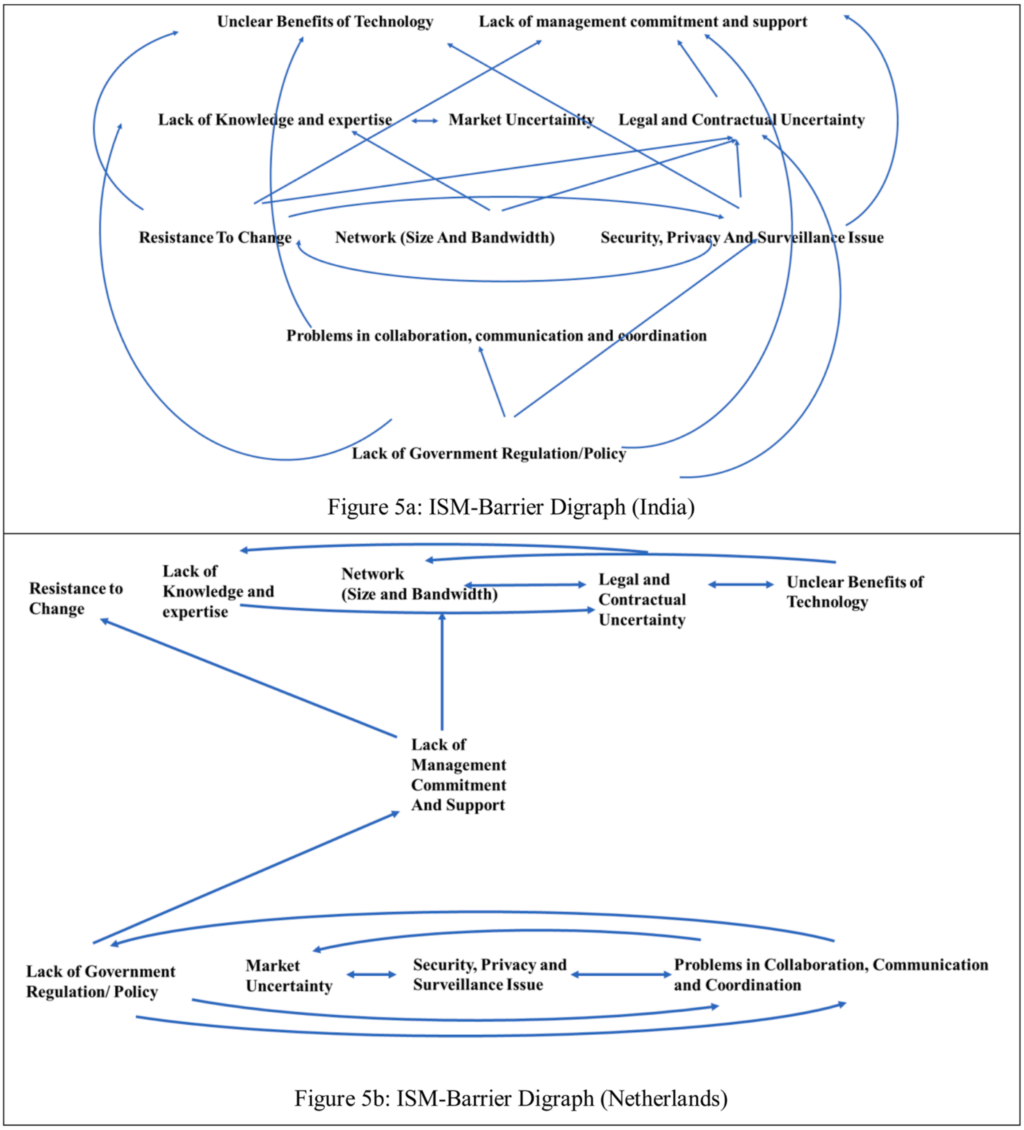


Figure 5a: ISM-Barrier Digraph (India)

Figure 5b: ISM-Barrier Digraph (Netherlands)

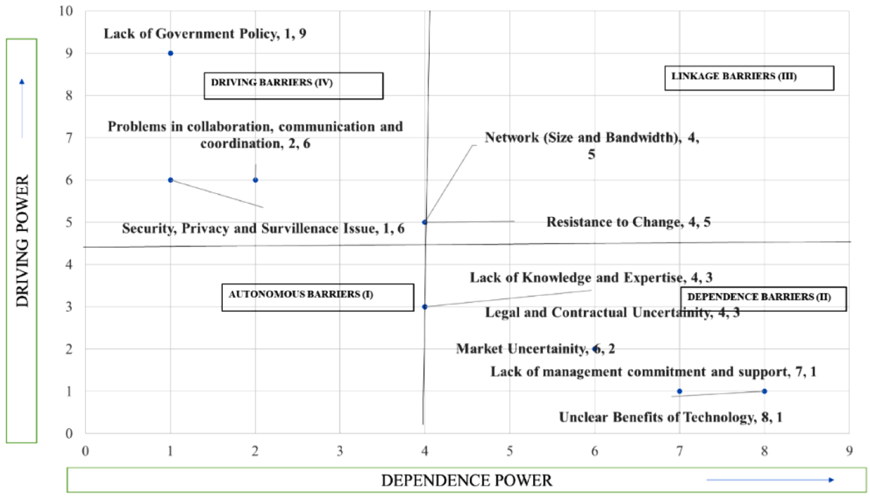
Fig. 5. ISM-Barrier Diagraph (India and Netherlands)

Knowledge and expertise' - (4,9); '*Lack of management commitment and support*'- (6,5); '*Legal and Contractual Uncertainty*'-(4,9); and '*Immaturity of Technology/ Unclear Benefits of Technology*'- (4,9) (see Table 10). '*Lack of management commitment and support*' is placed at Level II and falls in the cluster of linkage barrier (**Quadrant III**) (See Figs. 5b and 6b). All the others are placed at Level I and clustered as dependence barriers (**Quadrant II**) (See Figs. 5b and 6b). The **DEMATEL** analysis reveals that has 'r-d' values as '*Size and Bandwidth* (-0.924)', '*Lack of Knowledge and expertise* (-0.022)' '*Lack of management commitment and support* (-0.229)', '*Legal and Contractual Uncertainty*- (-1.825)' and '*Immaturity of Technology/ Unclear Benefits of Technology* (-0.759)' and all belong to effect group ((see Table 11 and Fig. 7b).

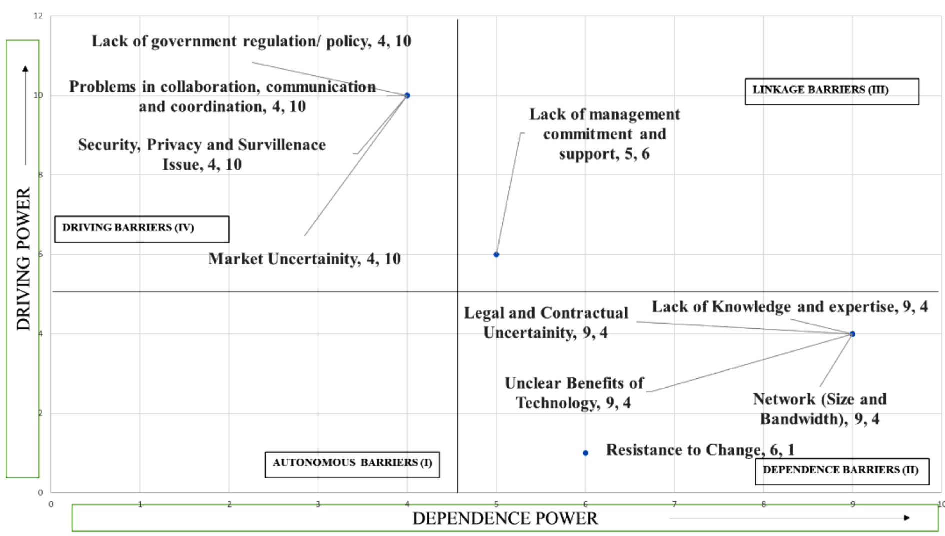
5. Discussions

'**Reduction in cost/ Low cost'** is a very critical influencer while making a decision for adoption in emerging economies compared to developed ones. This finding is in line with the literature of Ma & Lee (2019); Sharma et al. (2020a). Also, BCT reduces the commission fees from the host destination perspective, thereby lowering overall operating costs (Kwok and Koh, 2018). Firms supporting BCT can provide subscriptions that can be mutually beneficial to both customers and host destination operators, such as hassle-free cross-border remittances, lower transaction fees, and security money (Flecha-Barrio et al., 2020). This strategy helps to attract more customers (Kwok and Koh, 2018; Sharma et al., 2020a, c) and increase the market share of the OTA. It is clearly highlighted in our results that reduction in cost is not a critical driver in the Netherlands. It is primarily because firms in HTS in the Netherlands emphasize more on risk management and security and consider them far more critical than the cost. The BCT helps in risk Management since all the transactions are recorded and are irreversible (Flecha-Barrio et al., 2020). BCT also helps to handle various risks, including counterparty fraud, illicit association user error, service failure, and third-party-related issues (Filimonau and Naumova, 2019).

'Traceability' is believed to be essential since it scrutinizes the production, processing, logistics, and sales systems effectiveness that not only increases customer confidence but as well as trust in the services. It limits the possibility of fraud and forgery by providing the origin, processing, and final destination information. It is a reliable and transparent way to ensure originality which is immutable. BCT certifies that the information can only be modified as per the agreed terms between the participating parties. This is in line with the literature (Filimonau and Naumova, 2020; Baralla et al., 2020). Traceability factor is placed under top three critical factors in both economies. However, immutability is



a: MICMAC Analysis (Barrier- India)



b: MICMAC Analysis (Barrier- Netherlands)

Fig. 6. MICMAC Analysis (Barrier- India and Netherlands)

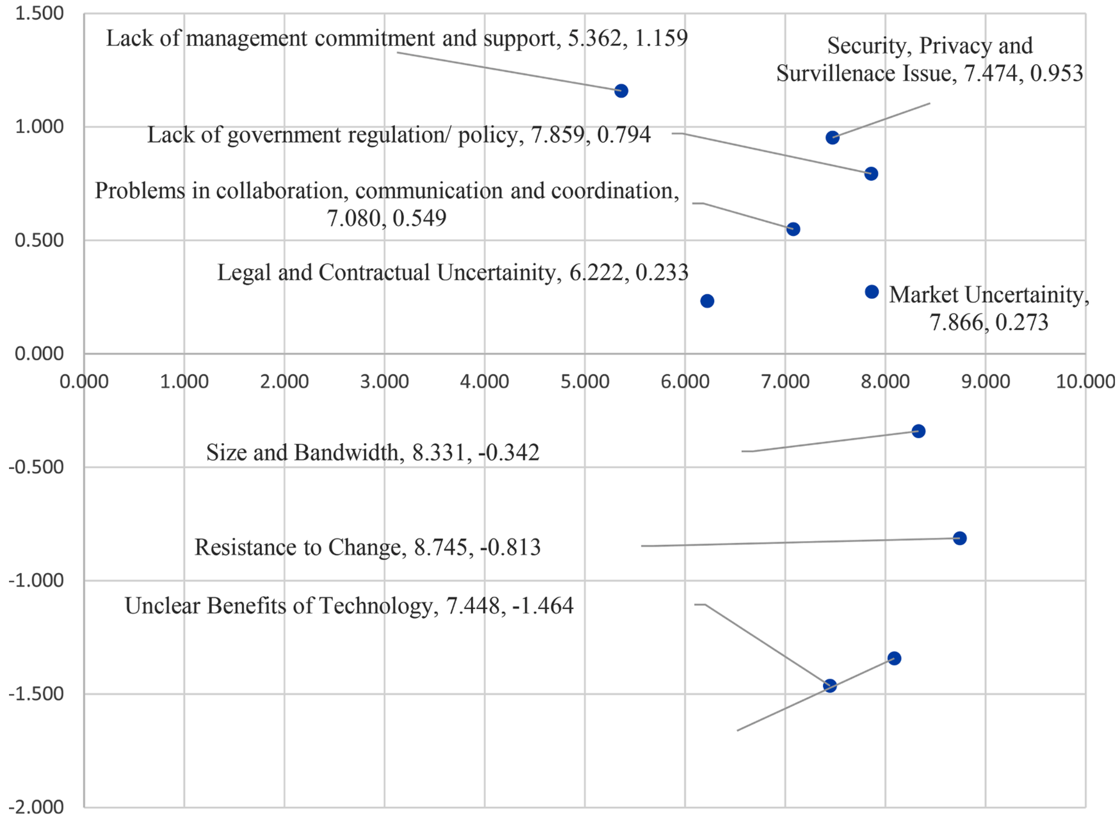
Table 9
Barriers ranking and clustering using DEMATEL (India)

BI	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	D	D+R	R-D	Rk	C-E
B1	0.223	0.380	0.306	0.242	0.320	0.299	0.294	0.295	0.354	0.280	2.994	5.781	-0.207	6	E
B2	0.266	0.230	0.229	0.225	0.319	0.246	0.299	0.244	0.352	0.256	2.668	5.857	0.521	2	C
B3	0.322	0.294	0.219	0.214	0.376	0.239	0.328	0.267	0.414	0.311	2.983	5.663	-0.302	8	E
B4	0.230	0.224	0.257	0.134	0.221	0.187	0.208	0.215	0.310	0.229	2.215	4.427	-0.003	4	E
B5	0.263	0.285	0.228	0.169	0.188	0.183	0.239	0.155	0.308	0.196	2.215	5.360	0.930	1	C
B6	0.202	0.318	0.223	0.167	0.285	0.151	0.210	0.181	0.282	0.226	2.244	4.780	0.292	3	C
B7	0.376	0.323	0.337	0.265	0.404	0.265	0.257	0.348	0.445	0.306	3.325	6.178	-0.473	10	E
B8	0.275	0.344	0.240	0.235	0.335	0.320	0.282	0.188	0.368	0.269	2.856	5.364	-0.348	9	E
B9	0.346	0.437	0.392	0.345	0.382	0.345	0.411	0.320	0.366	0.394	3.740	7.350	-0.131	5	E
B10	0.285	0.353	0.248	0.215	0.316	0.301	0.324	0.295	0.409	0.215	2.961	5.643	-0.278	7	E
R	2.787	3.189	2.680	2.212	3.145	2.536	2.852	2.508	3.609	2.682					

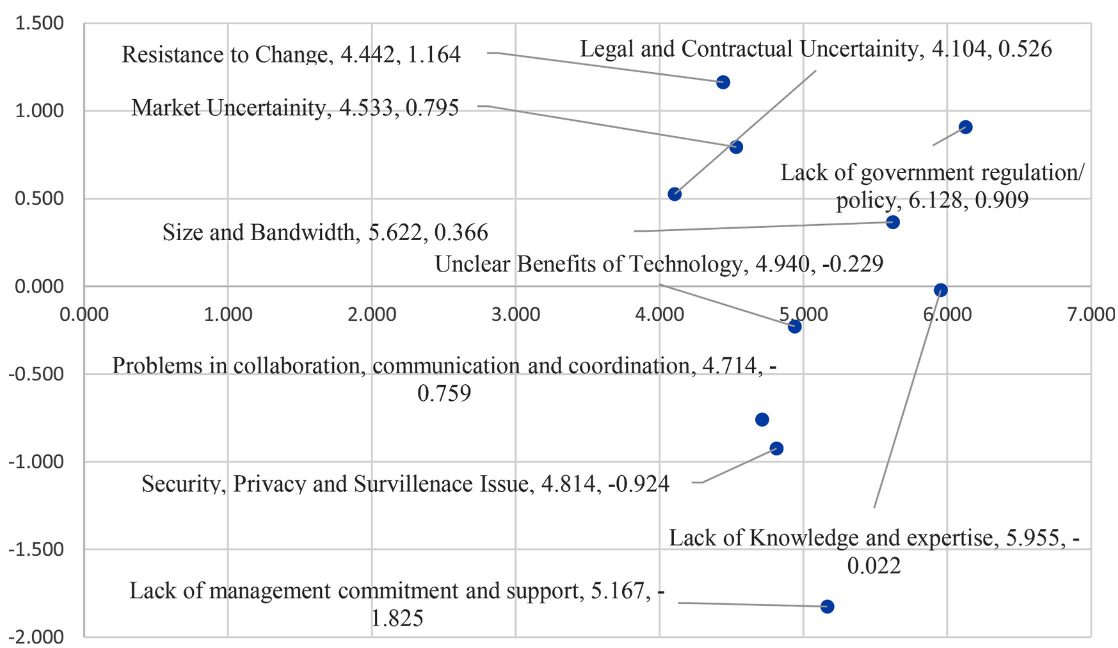
Note: B1: Lack of management commitment and support; B2: Problems in collaboration, communication, and coordination; B3: Market Uncertainty; B4: Legal and Contractual Uncertainty; B5: Lack of Government Regulation/ Policy; B6: Security, Privacy and Surveillance Issue; B7: Resistance to Change; B8: Lack of Knowledge and expertise; B9 Size and Bandwidth; B10: Unclear Benefits of Technology; Rk: Rank; C-E: Cause-Effect; D: Sum of Columns; R: Sum of Rows; BI: Barriers- India

placed at the fifth and sixth position, respectively.

'Disintermediation' is one of the primary potentials of BCT's application in the supply chain arguably lies tracking assets (Filimonau and Naumova, 2020). Generally, multiple intermediaries in the supply chain adds costs to producers as well as consumers (Rejeb et al., 2019;). Similarly, BCT reduces intermediaries between producers and consumers by allowing direct investment rather than through a bank (Parekh et al., 2020). Intermediaries in businesses reduce the supply chain



a: Barrier- DEMATEL (India)



b: Barrier- DEMATEL (Netherlands)

Fig. 7. Driver- DEMATEL (India and Netherlands)

velocity and inhibit transparency (Korpela et al., 2017). BCT helps in removing these barriers and has been ranked as a critical driver in both economies. Transparency is found to be very critical in both economies but placed at second position in context of Netherlands. Customers are a lot more knowledgeable and sophisticated about the information they want to share and the products they purchase. Hence, credible transparency emerges as an inevitable requirement since BCT provides a highly secured decentralized, trustworthy platform, i.e., accessible to all connected users, which can attract more customers.

Also, the barriers inhibiting BCT adoption need deeper scrutiny to overcome the challenges in a righteous manner. **'Lack of Government Regulation/ Policy'** is critical for both economies but scored a higher

Table 10
Barriers -ISM (Netherlands)

Barriers (Netherlands)	DRP	DP	Reachability	Antecedent	Intersection	Level
Lack of government regulation/ policy	10	4	1,3,4,5,10	1,3,4,10	1,3,4,10	III
Resistance to Change	1	6	2	1,2,3,4,5,10	2	I
Market Uncertainty	10	4	1,3,4,5,10	1,3,4,10	1,3,4,10	III
Security, Privacy and Surveillance Issue	10	4	1,3,4,5,10	1,3,4,10	1,3,4,10	III
Lack of management commitment and support	6	5	5	1,3,4,5,10	5	II
Lack of Knowledge and expertise	4	9	6,7,8,9	1,3,4,5,6,7,8,9,10	6,7,8,9	I
Network (Size and Bandwidth)	4	9	6,7,8,9	1,3,4,5,6,7,8,9,10	6,7,8,9	I
Legal and Contractual Uncertainty	4	9	6,7,8,9	1,3,4,5,6,7,8,9,10	6,7,8,9	I
Unclear Benefits of Technology	4	9	6,7,8,9	1,3,4,5,6,7,8,9,10	6,7,8,9	I
Problems in collaboration, communication, and coordination	10	4	1,3,4,5,10	1,3,4,10	1,3,4,10	III

Note: DP: Dependence Power; DRP: Driver Power.

Table 11
Barriers ranking and clustering using DEMATEL (Netherlands)

BN	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	D	D+R	R-D	Rk	C-E
B1	0.175	0.304	0.375	0.278	0.362	0.283	0.499	0.438	0.448	0.334	3.496	5.167	-1.825	10	E
B2	0.125	0.121	0.210	0.143	0.186	0.160	0.256	0.224	0.227	0.137	1.789	4.104	0.526	4	C
B3	0.126	0.194	0.148	0.145	0.229	0.163	0.325	0.198	0.203	0.139	1.869	4.533	0.795	3	C
B4	0.174	0.223	0.315	0.164	0.267	0.230	0.390	0.372	0.377	0.223	2.737	4.714	-0.759	8	E
B5	0.116	0.153	0.198	0.129	0.136	0.218	0.206	0.178	0.175	0.130	1.639	4.442	1.164	1	C
B6	0.162	0.316	0.272	0.181	0.318	0.180	0.362	0.322	0.258	0.213	2.585	4.940	-0.229	7	E
B7	0.166	0.212	0.304	0.227	0.352	0.222	0.267	0.322	0.358	0.181	2.610	6.128	0.909	2	C
B8	0.215	0.345	0.303	0.207	0.351	0.343	0.406	0.256	0.325	0.238	2.989	5.955	-0.022	6	E
B9	0.198	0.213	0.247	0.294	0.290	0.250	0.406	0.305	0.237	0.188	2.628	5.622	0.366	5	C
B10	0.214	0.235	0.292	0.209	0.313	0.306	0.401	0.352	0.386	0.162	2.869	4.814	-0.924	9	E
R	1.671	2.315	2.664	1.977	2.803	2.356	3.519	2.967	2.994	1.945					

B1: Legal and Contractual Uncertainty; b2: Problems in collaboration, communication, and coordination; B3: Security, Privacy and Surveillance Issue; B4: Unclear Benefits OF Technology; B5: Market Uncertainty; B6: Lack of management commitment and support; B7: Lack of Government regulation/ policy; B8: Lack of Knowledge and expertise; B9: Resistance to Change; B10: Size and Bandwidth; Rk: Rank; C-E: Cause-Effect; D: Sum of Columns; R: Sum of Rows; BN: Barriers-Netherlands

place in developing economies. The lack of government regulation and a central regulatory body allows the sites using BCT are censorship resistant (Gainsbury and Blaszczynski, 2017). Government censorship can guarantee when the government can seize and block domain names, which can help in trust-building with the consumers (Zhang et al., 2020). There is a need for stringent regulations for BCT to avoid fraud and other illegal activities that can hurt the market and consumers' interests (Chang et al., 2020). Market uncertainty is placed at the top position in the Netherlands because of four reasons a) information asymmetry related to BCT; b) BCT applications and undefined policy regulations; c) whether traders in the BCT market are sensitive to volatility; c) difference in expectation and the actual value (worth) of BCT.

'Problems in collaboration, communication, and coordination' and **'Security, Privacy and Surveillance Issue'** are also critical barriers in both the context. This problem arises due to a lack of trust, fear of unrestricted access to data, technical restrictions, chances of easier access to important data (Farooque et al., 2020; Gainsbury and Blaszczynski, 2017). Also, the data is stored in databases that mostly reside in the cloud; hence chances of masquerading cannot be completely ruled out. Also, presently available security standards for platform configurations involving cloud and virtualized IoT platforms aiding multi-tenancy is immature. In that line, benefits such as data and transaction protection by private key method need to be endorsed. Consumers need to be made aware of the tamper-proof ledger options that make the data safe from malicious activities.

'Network (Size and Bandwidth)' is ranked at '4' position in India while at '6' place in the Netherlands. Traditional BCT has issues related to scalability (Xie et al., 2019) due to the prerequisite need for network bandwidth resources. Many transactions cannot be handled with BCT due to the existing problems related to the scaling up of data and transmission mode-related bandwidth requirements. It is important to understand that each transaction is transmitted two times to all nodes that use network resources and increases propagation delay. Few improved techniques such as sharding (nodes separation in different shards to reduce size of transaction), off-chain transactions (with the existing basic nodes off-chain micropayment channels between nodes are formed), decoupling management (multiple virtual and dynamic distributed ledgers are created), bigchainDB and InterPlanetary File System (IPFS) needs to be introduced and used (Xie et al., 2019).

The other critical barrier is **'Resistance to Change',** which is very common while a firm or group of users try to adopt new technologies (Sharma et al., 2020a). It is important to understand two points, i.e., why people resist and what can be done to overcome this resistance. There are many reasons for opposing emerging technologies, such as fear of lack of trust, unwillingness to learn new techniques. This can be overcome by having campaigns that can highlight the positive aspects and benefits of the technology. Also, consumers need assurance to the fact that all their electronic transactions are more secure, complete, and safe, which will motivate them to switch to or at least try BCT.

6. Conclusions

For HTS, BCT adoption is critical for both developing as well as developed economies. The present work has identified drivers, barriers and establishes cause-effect relationships to decrease the probability of failure for BCT implementation for developed and developing economies. The work elucidates that India and Netherlands have different priorities for drivers that promote and different barriers that inhibit the adoption. Furthermore, the hierarchies and relationships examined between the drivers and barriers respectively, using the perspectives and the perceptions industry and academic experts, help them to place at different levels and divide them into cause-and-effect groups.

Contributions of the study are multifold: 1. It is the first comprehensive study with empirical evidence on barriers and drivers for BCT adoption in the hospitality domain. 2. This is also the first inter-country comparison to give a holistic view to the potential adopters of both economies, increasing the generalizability of the study. 3. This study proposes a sequential methodology where data is explored and validated from both literature and expert opinions. 4. This is also the first study that integrates techniques and proposes a framework using AHP-ISM-DEMATEL to present an analytical means for decision-makers by ranking the factors depending upon their importance, and by determining their hierarchy and interactions in terms of how one factor is going to affect other and their overall effect on the system. 5.This study develops a structural hierarchy which is exceptionally beneficial for the practitioners to implement the adoption process effectively.

6.1. Practical Implications

The present study offers four important managerial implications for BCT service providers, tourism and hospitality firms and policy makers. First, HTS are often described as being risk-averse, conservative, and resistant to the embracement of disruptive innovations (Filimonau and Naumova, 2020). Due to this, HTS are reluctant to explore the potential of BCT to undertake well-informed and profitable decisions, even though BCT implementation has now become inevitable for any firm. Filimonau and Naumova (2020) also emphasized that the novelty of BCT imposes the biggest challenge towards its more ubiquitous commercial adoption. In this regard, the current study offers in-depth knowledge and understanding on the comprehensive list of different influential drivers and barriers of BCT adoption. Furthermore, the current study has shed insightful knowledge on the ranking of the influential drivers and barriers as well as the cause-effect relationships between them. This kind of knowledge and understanding will be of much value for firms and managers as it helps them to prioritize and specifically focus on influential ones that can increase their business potential. Moreover, the firms that will adopt BCT are likely to exploit the first-mover advantage in the market.

Second, the study findings have suggested that the BCT adoption is derived by the *reduction in cost* in India while *risk management* in Netherlands. Scholars have also observed that the speed of HTS firm's technology adoption for market disruptions determines business competitiveness (Law et al., 2014). Due to this, firms as well as the managers should take cognizance of the potential of these drivers since these can make or break their businesses.

The study findings have highlighted that lack of government regulations and policy and market uncertainty are two key influential barriers inhibiting adoption of BCT in India and the Netherlands, respectively. Overcoming these barriers are crucial for achieving the faster diffusion and early acceptance of emerging technologies such as BCT, especially when user data is at stake. Without trust in place, firms face pushback from both regulators as well as consumers. Also, scholars argue that BCT adoption is current at a nascent stage due to the absence of government support and policies (Farooque et al., 2020). Due to this, we suggest that (a) firms should also have a formal system for governance structures, dynamic processes, and teams with matching data skills; (b) government should formulate appropriate policies to governing the adoption of BCT. Furthermore, data governance measures, a governing council or body, and a strategy to follow and implement those measures should be introduced.

6.2. Theoretical implications

The current study has utilized a mixed-method research that comprises of the qualitative research design with MCDM and ISM techniques (quantitative) to provide a holistic overview of the determinants (i.e., drivers and barriers) of BCT adoption by the tourism and hospitality firms. The mixed method design was necessary for answering the different research questions of the study i.e., to identify, rank, and investigate causal relationships among the factors. Our research design is different from the prior limited studies as they have predominantly focused only on the cross-sectional (Wamba et al., 2017) and qualitative designs (Bisel et al., 2014). Scholars can utilize our research design and methodology to obtain an in-depth understanding of the different determinants of other emerging technologies in the tourism and hospitality sector, such as big data, fintech, and digital twins. The AHP-ISM-DEMATEL model is unique and has multifold contribution to the literature; A) This method can help to rank the drivers and barriers both on the base of priority matrix by AHP as well cause -effect group matrix by DEMATEL. This provides insight in terms of how factors behave individually as well as when one factor influences the other. B) The hierarchy at which the factor is placed is crucial to understand the mutual and contextual relationships among factors. The identified methodology will assist practitioners to recommend essential measures for improving 'Market Uncertainty', 'Lack of govt regulation' 'Security, Privacy and Surveillance Issue', 'Problems in collaboration, communication and coordination', and 'Resistance to Change'. The research outcomes will offer a roadmap to managers for achieving better BCT adoption in the context of HTS especially for corporates operating in different demographics.

The policymakers should propose guidelines, policies, and regulations to the firms in HTS for adopting BCT. Such policies will give a boost to the firms' trust towards BCT. The policymakers are also recommended to organize campaigns for BCT-related benefits that can create awareness to provide knowledge and educate the personnel, firms and their consumers who can help in accelerating the adoption of such practices. The final ranks of barriers and drivers acquired in this research can be applied by the firms that could aid with their primary focus on the influential ones.

7. Limitations and future scope of study

This research uses an integrated AHP-ISM–DEMATEL technique and identifies 15 drivers and 10 barriers to BCT adoption in the HTS. The proposed structural model is highly dependent on the judgments of the expert, which is one of the main limitations of the technique. Though researchers have taken great care while finalizing the drivers and barriers still incorrectness may exist due to human bias. A two-step process with multiple iterations, i.e., critical analysis of the literature, and responses from the experts' data has been used. In addition, the data collected, and findings of this study are primarily based on the adoption of BCT in HTS, which may limit the generalisability of findings in other sectors. However, this presents scope for further research on the identification of drivers and barriers in other sectors as well as other nations. Under this consideration, different sample sets could be examined to identify and evaluate the drivers and barriers for adoption of BCT, and the finding may be compared with the present study findings. The proposed integrated AHP-ISM–DEMATEL technique may be applied to other sectors of industry, that seek to analyze the BCT adoption performance in business.

CRediT authorship contribution statement

Mahak Sharma: Writing - original draft, Conceptualization, Data collection, Data curation, Formal analysis, Investigation, Methodology; **Rajat Sehrawat:** Conceptualization, Data Collection, Methodology, Project administration, Writing - review & editing; **Tugrul Daim:** Project administration, Supervision, Writing - review & editing, Validation; **Amir Shaygan:** Writing - review & editing. Both authors contributed equally

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Mahak Sharma received her PhD in Management of Technology and Information Technologies from National Institute of Industrial Engineering. Previously She was a Fellow at National Institute of Industrial Engineering.

Rajat Sehrawat has a Master of Technology in Computer Software Engineering. He is presently working as a Engineering Manager at Booking.com, Netherlands.

Tugrul U Daim is a Professor and PhD Program Director of Engineering and Technology Management, Portland State University. His research interests are in the areas of technology evaluation and acquisition, new product development, technology forecasting, manufacturing management.

Amir Shaygan is a doctoral student in Technology Management Doctoral Program at Portland State University