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# From ocean to table: examining the potential of Blockchain for responsible sourcing and sustainable seafood supply chains

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## ABSTRACT

This study integrates technology-organisation-environment (TOE) theory with situation-actor-process (SAP) and learning-action-performance (LAP) models to provide a comprehensive evaluation of complex seafood supply chain management (SCM) systems. We present a framework based on Blockchain technology that facilitates the transformation of the seafood supply chain ecosystem from its current state to a more streamlined one in the future. This framework offers the potential for driving transformation and delivering advantages that encompass improved data efficiency, sustainable practices, and streamlined integration across the seafood supply chain. Our research highlights the importance of accurate data management, stakeholder involvement, regulatory compliance, cybersecurity, cost-effectiveness, transparency, and sustainability for the successful integration of Blockchain in seafood SCM systems. This allows stakeholders to make informed decisions and optimise spending. Furthermore, we emphasise the significant value of transparency provided by Blockchain, which enables stakeholders to make well-informed decisions and optimise their spending.

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## KEYWORDS

Blockchain; supply chain management; seafood industry; TOE



## 1. Introduction

Global supply chains have been slow to adapt to changing business landscapes and technological advances, leading to various challenges (Kalaitzi and Tsolakis 2022; Rauniyar et al. 2023; Vu, Ghadge, and Bourlakis 2023). The seafood supply chain, particularly in emerging markets, faces quality and sustainability issues owing to unethical practices, inadequate infrastructure, weak regulations, illegal fishing, labour concerns, and traceability problems (Kamilaris, Fonts, and Prenafeta-Boldú 2019; Raut et al. 2019; Tate and Bals 2017). Developing countries often lack essential seafood-processing infrastructure, leading to quality loss (Kruijssen et al. 2020). Inadequate regulations may result in non-compliant seafood trading (Bailey et al. 2016), whereas illegal, unreported, and unregulated (IUU) fishing practices pose long-term threats (Song et al. 2020). Labour exploitation and poor traceability systems further compounded these challenges (Prompatanapak and Lopetcharat 2020; Viridin et al. 2022).

Developed countries have made strides to address some of these issues, but still face environmental and labour-related concerns (Ruiz-Salmón et al. 2020). The global nature of the seafood supply chain means that problems can flow across borders, thus making international initiatives crucial. Blockchain offers a potential solution by enhancing

transparency, traceability, and accountability across seafood supply chains (I. Ali and Govindan 2021). It provides a tamper-proof data management system that ensures transparency from harvest to consumption (Rauniyar et al. 2023; Sauer, Orzes, and Culot 2022). Blockchain can verify product sustainability, monitor labour standards, and improve overall accountability (see, e.g. Agrawal et al. 2021; Hackius and Petersen 2017; Howson 2020; Liu and Li 2020; Salah et al. 2019; Thompson and Rust 2023). Nevertheless, challenges remain in ensuring data quality and connectivity among supply chain participants (Saberi et al. 2019).

This study has three key objectives. First, we sought to elucidate the components and linkages within the existing seafood supply chain ecosystem to deepen our understanding of its current state. Second, to address the need for a theoretical foundation to support Blockchain adoption in SCM (Zhu, Bai, and Sarkis 2022), we employed technology-organisation-environment (TOE) theory (Tornatzky and Fleischer 1990) to construct a comprehensive conceptual model. TOE theory facilitates a thorough examination of the internal and external factors influencing technology adoption, promoting flexibility, certainty, and transparency in ecosystem interactions. We assert that the TOE theory offers valuable insights for addressing seafood supply chain issues (Bai, Quayson, and Sarkis 2022;

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Kalaitzi and Tsolakis 2022), emphasising the roles of technology, organisational innovation, leadership, and commitment in overcoming supply chain challenges. Third, departing from previous studies that primarily proposed Blockchain-enabled supply chain frameworks (Agrawal et al. 2021; M. H. Ali et al. 2021; Bai, Quayson, and Sarkis 2022; Liu and Li 2020; Vu, Ghadge, and Bourlakis 2023), our approach involved interviews with Blockchain and supply chain experts to glean insights into the optimal implementation of Blockchain.

We aimed to contribute to the development of an efficient Blockchain-enabled SCM system, advancing the seafood industry towards sustainable resource sourcing to meet global demand. Against this background, this study seeks to answer the following question: *What are the critical factors influencing the effective utilisation of Blockchain technology in the seafood supply chain, considering organisational barriers and enablers, regulatory considerations, and alignment with environmental sustainability and traceability requirements?* To explore the potential of Blockchain in seafood SCM and address the gaps in understanding its adoption, we conducted a qualitative study. We collected data from 11 individuals in two phases. In the first phase, we interviewed five experts and professionals from India and the USA who had experience in seafood, aquaculture, Blockchain, and information technology (IT). In the second phase, we interviewed six stakeholders from Denmark, including fishermen, auction house managers, Blockchain application developers, seafood distributors, supermarket managers, and seafood consumers, all of whom play vital roles in the seafood supply chain.

This study contributes to the understanding of the multifaceted dynamics within the seafood supply chain and how Blockchain can be effectively harnessed to streamline SCM. Unlike previous research that leverages TOE theory to understand Blockchain adoption (Bai, Quayson, and Sarkis 2022; Kalaitzi and Tsolakis 2022; Oguntegbe, Di Paola, and Vona 2022), our approach uniquely integrates TOE theory with the SAP-LAP inquiry model (Sushil 2019; Tornatzky and Fleischer 1990). This innovative combination allows us to comprehensively explore existing challenges. Our findings show that Blockchain can transform the seafood supply chain by improving data efficiency, promoting sustainability, and facilitating seamless integration. The results advocate precise data management, stakeholder collaboration, regulatory compliance, cybersecurity, cost-effectiveness, consumer education, and sustainability principles for successful Blockchain adoption. The findings also stress the value of transparency in the Blockchain, which enables stakeholders to make informed decisions and allocate resources more efficiently. Our goal is

to pave the way for a Blockchain-enabled SCM model that streamlines data and processes, reducing time, effort, and costs while promoting sustainability.

The remainder of this paper is organised as follows. Section 2 describes the development of the Blockchain-enabled SCM systems. In Section 3, we describe our method and data. Section 4 presents the interpretation of our case. Section 5 explains how our proposed model contributes to the practical and academic landscape, and highlights its limitations. Finally, Section 6 concludes the paper with the rules and future research directions.

## 2. Theoretical background and literature review

This section presents a thorough analysis of the successful implementation of Blockchain technology in seafood supply chains. It not only evaluates the technical aspects but also considers the organisational and environmental factors that come into play. This review offers stakeholders invaluable insights and resources to effectively navigate challenges and leverage the advantages of Blockchain in this crucial sector. The analysis is divided into five sections, each covering a fundamental component of Blockchain and its potential impact. Section 2.1 provides an overview of the seafood supply chains. Section 2.2 highlights the potential of Blockchain technology in managing seafood supply chains. Section 2.3 introduces the TOE framework. Section 2.4 establishes a direct link between the TOE framework and its applicability to the seafood supply chain, thereby providing valuable recommendations for stakeholders. Finally, Section 2.5 presents the SAP-LAP inquiry model, showcasing a pragmatic approach to leveraging Blockchain to enhance the operational efficiency in the seafood sector.

### 2.1. Seafood supply chain

The seafood industry is globally significant, with market value increasing from USD 250 billion in 2022 to USD 269 billion the following year.<sup>1</sup> The seafood industry's market value is anticipated to exceed USD 350 billion by 2027.<sup>2</sup> It employs millions of people, and is an essential source of protein and food for communities worldwide.<sup>3</sup> In both developing and developed countries, the seafood industry is critical for the growth and livelihoods of coastal populations. The industry's supply chain structure is complex (Bailey et al. 2016). Furthermore, it includes numerous stakeholders in a

**Table 1.** Examples of stakeholders in the seafood industry.

Stakeholder	Description
Coastguards	The group responsible for maritime security, vigilance, and patrol over a country's territorial waters.
Regulatory bodies	Law enforcement agencies, food safety organisations, and port authorities.
Middlemen	Exporters, packing, and freight forwarders transport agents.
Infrastructure providers	Boat rentals, chartered logistics providers, and vessel service and maintenance providers.
Seafood Experts	Aquaculture professionals, practitioners, researchers, and scientists.
Insurance service providers	Trawling bulk carriers, smaller vessels, and fishing boats.
Coastal communities	Fisherman, socio-cultural governance structures and practices, and environmental groups, and residents whose livelihoods and cultural practices are closely tied to the marine.
Consumers	For people worldwide where seafood serves as their primary source of protein.

complex network of relationships. This structure involves networks of multiple parties and actors, as shown in [Table 1](#).

Similar to any other, an end-to-end seafood supply chain begins with a community of fishermen (producers) and ends with the market (buyers and consumers). Supply chain performance is primarily the responsibility of stakeholders. Seafood supply chains are facing environmental safety, tangibility, and socioeconomic issues. Overfishing, habitat destruction, and illegal fishing threaten marine ecosystems and fish stocks ([Viridin et al. 2022](#)). The lack of proper traceability measures can lead to mislabelling and fraudulent activities.<sup>4</sup> Small-scale fishers face difficulties because they are not adequately compensated and have limited market opportunities. Integrating sustainable practices and sound traceability systems is, therefore, critical for ensuring the long-term sustainability of businesses ([Cochrane 2021](#); [Lynch et al. 2020](#)).

Global seafood demand has exceeded sustainability limits ([Lam et al. 2020](#); [Naylor et al. 2021](#)). By the middle of the twenty-first century, human societies will need to feed more than nine billion people. Industrialisation and the sudden demand for seafood have led Third World countries to invest rapidly in trawling equipment and practices, resulting in overfishing, pollution, and other predatory behaviours ([Hu et al. 2021](#)). Some regulatory loopholes and high-handed actions have also contributed to overfishing epidemics ([Said, Tzanopoulos, and MacMillan 2016](#); [Yıldırım et al. 2022](#)). Furthermore, overfishing contributes to overall opacity in the supply chain, which can have several consequences: (1) waste due to poor storage conditions and bureaucratic hurdles; (2) lack of coordination among national and international regulators; (3) less support from external stakeholders, such as rental agencies, insurance companies, and lenders; and (4) unsustainable fishing practices.

Developing countries are adopting industrialised and unsustainable fishing practices to meet the demands of the international market, which severely compromises the efficiency of the supply chain ([Cramer and Kittinger 2021](#)). Developed countries continue to import seafood from developing countries and have agreements to access their markets. This agreement compensates for the decline in production and cannot meet the high demands of domestic consumers ([Avdelas et al. 2021](#)). This economic dependence, coupled with the lack of management and governance capacity in developing countries, has widened the gap in supply chain sustainability between developed and developing countries ([The Food and Agriculture Organization 2020a](#)). The Food and Agriculture Organisation emphasises the importance of solid technology in providing transparency when assessing vulnerability to seafood fraud ([Campbell et al. 2021](#); [Pincinato et al. 2022](#); [The Food and Agriculture Organization 2020a, 2020b](#)).

Relevant stakeholders must address the gap between developed and developing countries and progress towards realising the 2030 agenda for zero overfishing ([Cochrane 2021](#); [Lynch et al. 2020](#)). Efforts have been made to support sustainable projects in the developing countries.<sup>5</sup> Stakeholders should find appropriate initiatives to address

the complicated circumstances of SCM, including change management and technology, to facilitate the efficient flow of data and value in the SCM network ([Cochrane 2021](#); [Viridin et al. 2022](#)). These initiatives are critical to ensure transparency and fair trade in the seafood supply chain.

## 2.2. Blockchain and supply chain management systems

Blockchain, known for its cryptographic, digital, and immutable ledger systems, has evolved beyond its initial application in cryptocurrencies such as Bitcoin ([Perdana, Robb, et al. 2021](#)). It offers versatile solutions for data validation in business transactions, peer reference verification, and trust enhancement in various sectors ([Casino, Dasaklis, and Patsakis 2019](#)). Although its roots lie in cryptocurrency security ([Nakamoto 2008](#)), Blockchain has expanded to securely exchange digital information ([Perdana, Lee, et al. 2021](#); [Perdana, Robb, et al. 2021](#)), thus benefiting companies and institutions across diverse fields.

Blockchain's core technology facilitates secure decentralised data exchange among nodes, ensuring data integrity, and minimising errors ([Grewal-Carr and Marshall 2016](#)). Its applications include financial transactions, SCM, smart contracts, tokenisation, cost reduction, and risk mitigation ([Casino, Dasaklis, and Patsakis 2019](#); [Helo and Hao 2019](#); [Liu and Li 2020](#); [Rauniyar et al. 2023](#); [Salah et al. 2019](#)). Blockchain transparency and traceability enhance SCM efficiency and data integration, enabling real-time communication and securing transactions ([Agrawal et al. 2021](#); [Hackius and Petersen 2017](#); [Rauniyar et al. 2023](#)). Interoperability is crucial for ecosystem security, accountability, and efficiency, allowing supply chain members and customers to track goods throughout the network ([Bai, Quayson, and Sarkis 2022](#); [Wamba and Queiroz 2022](#)). Blockchain-enabled SCM bolsters reliability and transparency in material and information flows ([Rauniyar et al. 2023](#); [Sabeti et al. 2019](#); [Vu, Ghadge, and Bourlakis 2023](#)), thus reducing fraud and operational costs ([Sarker et al. 2021](#)). Its transformative potential extends beyond cryptocurrencies and provides innovative solutions to modern business challenges.

Although Blockchain can improve SCM systems, challenges may arise from users, governments, regulatory agencies, and technology ([Hackius and Petersen 2017](#)). Users, industries, and organisations lack technological maturity and acceptance. In addition, implementation requires regulatory certainty that the government and regulators must support. As an information system technology, Blockchain also has drawbacks, such as data security concerns and garbage-in-garbage-out issues ([Alles and Gray 2020](#)). In addition, a blockchain solution is both data- and computing power-intensive. For a viable solution, these issues must be addressed sustainably. Stakeholders must be offered a system that incentivizes their data collection. Some form of collective computing power must be provided at the edge (a viable solution could be the emerging concept of fog computing) ([Barenji et al. 2021](#)).

Blockchain is increasingly being used in the food supply chain to address sustainability challenges ([Friedman and](#)

Ormiston 2022; J. Zhang, Zhang, et al. 2022; Y. Zhang, Zhang, et al. 2022). Previous research suggests that Blockchain can improve food traceability, increase fairness in the supply chain, and ensure environmental sustainability (Agrawal et al. 2021; Biswas et al. 2022). A Blockchain's core feature of decentralisation is beneficial to a sustainable supply chain. For example, it can empower participants in SCM, encourage collaboration rather than competition, and support strategic partnerships among SCM actors (Friedman and Ormiston 2022; Oguntegebe, Di Paola, and Vona 2022; Queiroz and Wamba 2019).

Prior research has proposed relevant frameworks for Blockchain-enabled SCM from technical, theoretical, and professional perspectives. For example, Liu and Li (2020) proposed a framework that manages and stores data in a multi-chain structure. This framework enables a cross-border e-commerce SCM. For certain products, such as textiles and apparel, customers may want information about the origin of raw materials and the processing and value addition of products within the SCM. This information requires traceability in the SCM. Blockchain-enabled SCM facilitates traceability. Agrawal et al. (2021) developed a Blockchain-enabled SCM traceability framework to track inputs and outputs in the textile and apparel industry by leveraging smart contracts and transaction rules via Blockchain.

Unlike Liu and Li (2020) and Agrawal et al. (2021), who technically approach the Blockchain-enabled SCM framework, Vu, Ghadge, and Bournakis (2023) developed a Blockchain-enabled framework from managerial and organisational perspectives. These perspectives are critical and complement the technical framework of Blockchain-enabled SCM. Vu, Ghadge, and Bournakis (2023) explained that Blockchain-enabled SCM implementation comprises three phases: *Initiation*, *Decision to Adopt*, and *Implementation*. These phases must be supported by innovation, organisation, the environment, and managerial characteristics. Another framework proposed by M. H. Ali et al. (2021) addresses comprehensive supply chain integration and regulation as the key enablers of Blockchain-enabled SCM for the halal food industry. As a complement to existing research on the Blockchain-enabled SCM framework, our study presents another perspective of Blockchain-enabled SCM for the seafood industry by examining the role of Blockchain for each actor involved in SCM. Understanding the behaviour of the actors and how data flow between them in the SCM system is crucial for ensuring the optimal use and successful implementation of Blockchain. This study proposes a matrix of existing and planned business processes from the theoretical lens of TOE to properly implement Blockchain in the seafood industry.

In the following paragraphs, we expound on the TOE theory in subsection 2.3, offer a rationale for its application in the context of Blockchain implementation within the seafood supply chain in subsection 2.4, and introduce the SAP-LAP framework in subsection 2.5.

### 2.3. The technology-organisation-environment theory

The TOE framework offers a comprehensive analytical perspective for comprehending and rationalising new

technologies within organisations. TOE theory was originally developed to study the adoption of organisational-level innovation (Tornatzky and Fleischer 1990). At the organisational level, the TOE framework identifies three essential elements (technology, organisation, and environment) when organisations engage in information systems and technology (IST) innovation (Lin 2014; Tornatzky and Fleischer 1990). TOE theory provides valuable insights into the interaction of these three elements by broadening the focus from individual organisations to the entire supply chain, including multiple organisations (Bai, Quayson, and Sarkis 2022; Mukherjee, Chittipaka, and Baral 2022). We argue that applying TOE in the context of multiple organisations is still relevant because the seafood supply chain includes multiple organisations involved in the chain, such as fishers, processors, distributors, retailers, and regulators. Therefore, we should consider the interdependencies and interactions between these organisations. These factors may also influence the adoption and implementation of Blockchains in the fishery supply chain. In addition, network effects can eventually arise as Blockchain implementation progresses, such as the role of influential organisations and the potential for collective action or resistance within the network (Tornatzky and Fleischer 1990).

At the technology level, TOE theory helps analyse the unique characteristics of Blockchain and its suitability for solving traceability and transparency issues in the seafood supply chain (Bai, Quayson, and Sarkis 2022). To better understand the potential applications and limitations of Blockchain, researchers can explore the technical requirements, benefits, and difficulties of implementing blockchain in different organisations. Technology represents the technological capabilities currently used in industry or available in the market, and these capabilities can help organisations improve their business processes and be competitive. Technological infrastructure, support availability, and functional affordance are among the three most important factors relevant to the technological context of SCM adoption (Wong et al. 2020). For example, Wong et al. pointed out that although Blockchain is perceived as complex and costly, it is a viable technology for improving SCM.

The second element in TOE is the organisation. This refers to firm size and characteristics, structure and hierarchy, culture and communication, and resources. These components contribute to a firm's ability to acquire, adopt, and adapt to new technologies (Lin 2014). Orji et al. (2020) state that the availability of training facilities, top management support, firm size, and employee skills are among the three critical organisational components to consider for Blockchain adoption in the freight logistics industry. Owing to the complexity of Blockchain, training facilities are vital in overcoming the knowledge barrier in the organisation. Top management support is the next priority for organisations. Top management should be actively involved in adopting Blockchain. Company size is third in this context, and significantly affects the adoption of Blockchain in the freight logistics industry. Resource constraints are the next consideration; companies with sufficient resources can be more flexible in deciding,

developing, and adapting Blockchain-enabled technology solutions. Large companies, therefore, have a more significant advantage than small companies when considering these constraints. In addition, companies must have a sufficiently skilled workforce and supportive organisational culture to ensure the sustainability of Blockchain-enabled technology solutions (Orji et al. 2020). TOE can also help us examine how organisations, including fishers, processors, wholesalers, and retailers, interact and collaborate to adopt Blockchain within the seafood supply chain. We can comprehend the extent to which these companies are willing and able to adopt Blockchain technology by examining organisational barriers and facilitators such as cultural fit, access to resources, and collaborative relationships.

The last element in TOE is the environmental context. This element refers to industry structure, standards, regulatory bodies, competitors, suppliers, and technology providers (Lin 2014; Tornatzky and Fleischer 1990). All these factors influence technology implementation in an organisation. Government regulations and industry standards are critical for implementing blockchain-enabled technologies (Orji et al. 2020). Due to the novelty of this technology, regulatory enforcement is lacking. The adoption of Blockchain technology is an ongoing process; therefore, industry standards evolve with technology implementation experimentation, success, and failure.

#### 2.4. TOE theory in technology-driven supply chain

The seafood supply chain is a complex web of interconnected businesses ranging from fishermen and processors to wholesalers and retailers (Bailey et al. 2016). As traceability, transparency, and sustainability become increasingly important, stakeholders can turn to innovative solutions such as Blockchain technology. However, a comprehensive analytical framework is needed to fully understand the dynamics and difficulties associated with Blockchain adoption and implementation across organisations. The TOE is applicable to this situation. Previous research has used this theoretical lens to understand how Blockchain should be implemented in the supply chain in different contexts, such as in the agricultural

and cocoa industries (Bai, Quayson, and Sarkis 2022; Oguntegbe, Di Paola, and Vona 2022). Technology or innovation adoption requires organisations to interact with their external environments. TOE theory has also been used in previous studies to explain the relationship between internal and external factors influencing the adoption and implementation of technology (see, e.g. Bai, Quayson, and Sarkis 2022; Kalaitzi and Tsolakis 2022; Oguntegbe, Di Paola, and Vona 2022; Orji et al. 2020; Wong et al. 2020). Understanding the interplay between these factors is crucial for the successful implementation of new technologies in an organisation.

Existing studies on Blockchain-enabled SCM use TOE as a theoretical foundation (see, e.g. Clohessy and Acton 2019; Ghaleb et al. 2021; Orji et al. 2020). However, previous studies have used TOE elements to identify the relationships between them using a nomological net (i.e. relationships between constructs and variables within a box-and-arrow model). Our study uses TOE as a sensitising device to view Blockchain-enabled SCM from the perspective of those involved in the system. By extracting this view from TOE, we can gain additional insight into how TOE elements should be appropriately managed to accelerate the implementation of Blockchain-enabled SCM. Our study develops a matrix that comprehensively explains the complex dynamics between TOE theory and the SAP-LAP model concerning existing and anticipated business operations. Through comprehensive matrix analysis, we can identify the individual contributions and impacts of each element. Table 2 summarises the relevance of the TOE lens for understanding the implementation of technology-based SCM adoption.

Numerous studies have explored potential applications of Blockchain technology in SCM across different domains (Kouhizadeh, Zhu, and Sarkis 2020; Naef, Wagner, and Saur 2022; Sauer, Orzes, and Culot 2022; Xu and He 2022). From a technological standpoint, researchers have suggested investigating technical issues such as data capture, network maintenance, enterprise architecture models, and interoperability between cold chains and Blockchain.<sup>6</sup> Another valuable area of research is exploring the infrastructure and security requirements for implementing Blockchain in the food supply chain sector (Kayikci et al. 2022; Mukherjee, Chittipaka,

**Table 2.** Leveraging the TOE framework in tech-driven SCM.

Aspect	Summary
Technology	<ul style="list-style-type: none"> <li>Blockchain technology is an innovative solution for improving traceability, transparency, and sustainability in the seafood supply chain.</li> <li>Previous research has applied the TOE framework to understand the nuances of implementing blockchain in various supply chain contexts such as agriculture and cocoa (Bai, Quayson, and Sarkis 2022; Oguntegbe, Di Paola, and Vona 2022).</li> <li>Existing studies have foundational roots in the TOE theory for Blockchain-enabled SCM (Clohessy and Acton 2019; Ghaleb et al. 2021; Orji et al. 2020).</li> </ul>
Organisation	<ul style="list-style-type: none"> <li>The intricate dynamics and challenges of Blockchain adoption and implementation in organisations necessitate a comprehensive analytical framework.</li> <li>The TOE framework has been frequently employed to delineate the internal and external factors that play pivotal roles in the adoption and effective integration of new technologies (Bai, Quayson, and Sarkis 2022; Kalaitzi and Tsolakis 2022; Orji et al. 2020; Wong et al. 2020).</li> <li>Emphasis is on the understanding of the synergy between TOE elements for the successful rollout of novel technological solutions.</li> </ul>
Environment	<ul style="list-style-type: none"> <li>The seafood supply chain is characterised by a multifaceted network of stakeholders, including but not limited to fishermen, processors, wholesalers, and retailers (Bailey et al. 2016)</li> <li>For the adoption of innovative technologies, there is an indispensable requirement for organisations to be in sync with their external environment.</li> </ul>

and Baral 2022). Regarding organisational aspects, research could investigate the development of regulations to meet customer demand, create a recognised consortium, and prepare competent manpower for the adoption of Blockchain technology. Studies exploring the key operational governing principles and industry-specific challenges facing Blockchain and SCM practices are essential (Biswas et al. 2022; Friedman and Ormiston 2022; Liu and Li 2020). From an environmental perspective, previous studies examined the impact of combining Blockchain technology with innovative capabilities on companies' environmental performance (Hackius and Petersen 2017; Liu and Li 2020). In addition, exploring how the adoption of Blockchain and the development of innovative capabilities can define the strategic orientation of SCM and its impact on manufacturing and assembly activities is an area of interest.

### 2.5. The situation actor process (SAP) and learning action performance approach (LAP)

This study complements the interpretive approach by using the SAP-LAP inquiry model (Sushil 2019), which helps in the reengineering processes (Sushil 2000, 2019). In any business context, the three main entities are situation, actors, and processes. A situation is created through processes that involve one or multiple actors. This model allows for a high degree of flexibility in representing the business environment. Hence, we aimed to create an *as-is* landscape and a *to-be* (possible or intended) model that can be used to learn and act, which would achieve improved performance. Unlike the typical management paradigm of planning, organising, and controlling, the LAP component in the SAP-LAP paradigm was used in a flexible system scenario. Learning is based on an understanding of the SAP matrix and its linkages. Learning is then used to determine desirable actions and monitor performance.

The SAP-LAP model recognises complexities in *as-is* (or existing) and *to-be* (or intended) seafood supply chain environments. This model allows us to gain clarity for mapping, engaging, and managing various participants and their

processes in the digital supply chain. The SAP-LAP model can provide insight into how existing situations inform intended situations (See, Figure 1). The current situation, composed of situations, actors, and processes, describes the existing problems. These three components are interconnected, and interact with each other (1, 2, 3, 4, 5, and 6) and informal learning.

Consequently, learning leads to actions (7) and performance (8) in the intended situation. This performance provides feedback for learning (9). What was performed in the intended situation can provide feedback that helps further improve the process. Figure 1 shows a complete picture of the SAP-LAP model.

Prior research has used the SAP-LAP model to analyse organisational and managerial issues such as supply chains, strategic performance management, IT, and technology management. For example, SAP-LAP helps researchers understand the link between Industry 4.0, and the circular economy. Chauhan, Sharma, and Singh (2021) argue that management commitment is essential in managing and integrating various elements in Industry 4.0 to achieve sustainability. Technologies such as the Internet of Things (IoT) and cyber-physical systems can help organisations realise circular economy initiatives. Sushil (2019) implemented SAP-LAP using an interpretive approach to understand what, who, how, why, when, and where disaster management challenges and problems should be solved. John and Ramesh (2012) and Kabra and Ramesh (2015) used an SAP-LAP model to analyse various IT implementation problems in humanitarian SCM (HSCM) in the Indian context. They found that the government's role is critical in improving IST's effective utilisation by enabling effective and transparent workflow policies.

In the automotive industry, Kanda, Deshmukh, and Arshinder (2007) suggested that supplier-buyer relationships, supply chain coordination among members, information sharing, and IT utilisation must be agile and nimble to achieve better SCM. Garg and Deshmukh (2010) also identified critical SCM issues, particularly in maintaining flexibility in automotive maintenance facilities. These problems include the organisational philosophy, business processes, performance measurements, inventory, and IT usage. SAP-LAP has

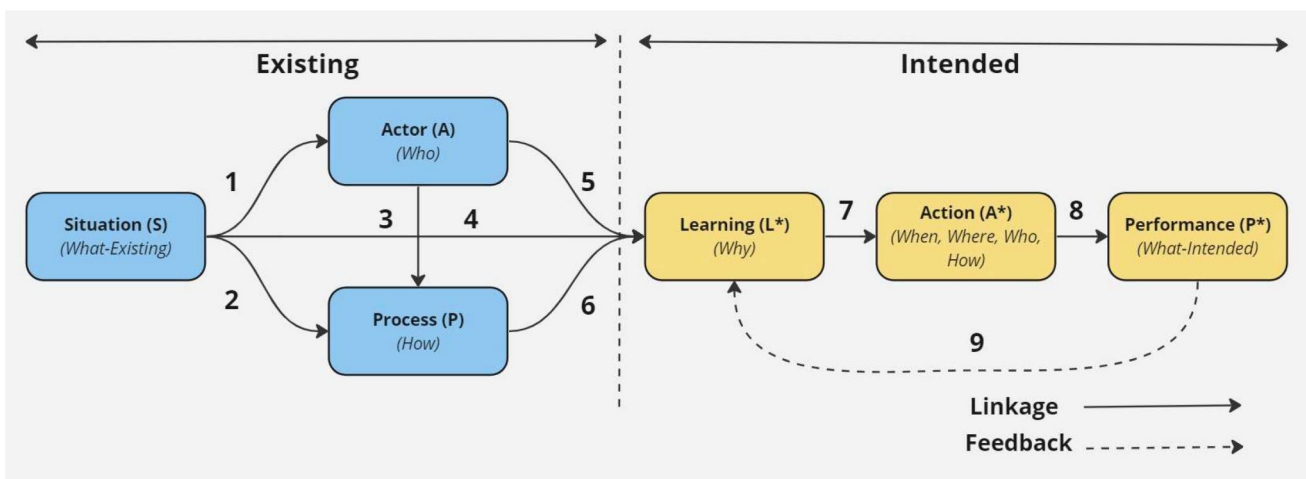


Figure 1. SAP-LAP framework (adopted from Sushil 2019).



**Table 3.** Selected works on SAP-LAP as an inquiry model.

Studies	Domain	Description
Chauhan, Sharma, and Singh (2021)	Industry 4.0 and circular economy	The integration of industry 4.0 and circular economy to achieve sustainability in SCM and business processes.
Sushil (2019)	Disaster management	Provide an understanding of issues and challenges in disaster management and relevant solutions to overcome the problems.
Kabra and Ramesh (2015)	HSCM	HSCM requires strategic and proactive planning and support from the Government.
John and Ramesh (2012)	HSCM	Multiple elements are essential in enhancing HSCM, such as central authority, SCM professionals, and resources management.
Kanda, Deshmukh, and Arshinder (2007)	SCM in an automotive company	Organisations must be able to organise the dependency among SCM elements. Agility and flexibility are essential capabilities in managing the SCM elements
Garg and Deshmukh (2010)	SCM in an automotive maintenance facility	Direct attention to the organisational resources and management philosophy should be made to facilitate better SCM
(Thakkar, Kanda, and Deshmukh 2008b)	SCM in SMEs	Various factors in SCM are critical, such as inadequate owner support, opportunistic suppliers, increasingly tough competition, and government policies. In addition, the interaction between actors in SCM must be carefully managed.
(Thakkar, Kanda, and Deshmukh 2008a)	IT Adoption in SMEs	IT adoption in SMEs could be triggered by internal and external drivers. Internal drivers include a positive attitude towards IT implementation and use, whereas external drivers include inter-firm competition and IT penetration in the industry.

also been used to understand SCM issues and IT adoption in small and mid-size enterprises (SMEs). Various problems have been identified, and solutions have been proposed to help SMEs better manage their SCM and IT. Table 3 summarises the considerable research on SCM that incorporates the SAP-LAP model into its interpretive approach.

### 3. Method and data

We employed an interpretive field approach to propose how Blockchain should be implemented across SCM (Klein and Myers 1999). This process can help researchers understand human thought and action in social and organisational contexts, and it allows researchers to gain deep insights into information systems (IS) phenomena, including IS management and development. We followed the seven principles of the interpretive field approach proposed by Klein and Myers (1999). Our research conducted interviews with participants and thoroughly analysed relevant SCM documentation in the seafood industry. Our proposed solutions aim to address the identified problems through thematic analysis of the sources. To provide context for this study, we examine the phenomenon of global demand exceeding sustainable supply capacity, which leads to non-compliance with regulations and quality standards in the Global South (i.e., India). Simultaneously, we also investigate how SCM problems arise in the Global North (i.e., Denmark and US). We propose the use of a Blockchain-based approach to SCM to effectively address these obstacles.

The interaction process between the researcher and interviewee involved examining the interview data and extracting key themes using the transcript coding method. We use the SAP-LAP model to describe the seafood supply chain and link it to TOE theory to improve our understanding. The SAP-LAP model facilitates a comprehensive and collaborative

approach to business process analyses. TOE is an effective tool for synthesising and interpreting research materials. We used three elements of TOE to examine the patterns in the transcripts. A systematic evaluation of the existing process identifies the relevant problems to improve the desired process. As this study assumes an interpretive approach, we acknowledge the possibility of divergent conceptual perspectives among our research colleagues. We have considered potential biases in the limitations section and made the assessment more transparent.

We collected empirical data in two phases through the interviews. The duration of each interview ranged from 60 to 150 minutes. Prior to approaching the participants, we collected relevant information from various sources, such as (i) LinkedIn profiles, (ii) websites of associations, and (iii) the authors' contacts. In the first phase, we interviewed five experts to gain insight into the most pressing issues in the applicability of Blockchain-enabled SCM in the seafood industry derived from their experience. In this phase, our interviewees were from India and the USA. In the second phase, we aimed to examine the actual situation by interviewing six people from Denmark. Hence, we specifically focused on the seafood supply chain in northern Denmark and interviewed different stakeholders within the supply chain, including fishermen, auction houses, Blockchain application developers, distributors, supermarkets, and end-consumers. Generally, our sample size considerations are based on 'data saturation', as a small sample is sufficient to obtain reliable results (Suddaby 2006). This strategy allows researchers to determine when they have reached the required number of respondents, as including a new respondent no longer contributes further insights into the study. With this strategy, the number of participants/cases has varied from five to more than 16 in previous studies

(Goddard and Schmidt 2021; Laguir, Laguir, and Tchameni 2019; Parker, Jacobs, and Schmitz 2018).

The interviewees were selected for their expertise and involvement in interdisciplinary supply chain and Blockchain research and were directly involved in supply chain implementation projects. For example, one of the experts, a 'professor', had experience with Blockchain consulting in a perishable food supply chain between Africa and North America. Another expert, the 'Senior Researcher', worked as a core team member on a project focused on sustainability and minimising the impacts on the marine environment. This project aims to protect fragile marine ecosystems in coastal regions. The expert was consulted to analyse the shelf life of exotic catches and plan appropriate logistics and transportation facilities.

To identify interview outcomes, we used SAP-LAP and TOE as axial coding schemes (Yin 2018). SAP-LAP elements are situation (e.g. what exists?), actor (who performed existing processes?), and process (How is the existing process performed?); and learning (why should the existing process be improved?), action (when, where, who, and how should the existing process be improved?), and performance (what is the intended process?). TOE is a coding scheme for technology, organisation, and environment. Technology refers to the potential uses of technology and how a person views its complexity and value of technology (Bai, Quayson, and Sarkis 2022). The organisation reflects the institutional capacity to implement the technology, including management support, organisational culture, and availability of resources (Tornatzky and Fleischer 1990). The environment describes potential enablers and barriers to technology adoption and implementation, such as market pressure, government support, and

technology infrastructure (Kalaitzi and Tsolakis 2022; Mukherjee, Chittipaka, and Baral 2022). Table 4 introduces our interviewees and Table 5 presents our coding scheme.

#### 4. Results and case interpretation

The following subsection explains the interview findings and links them to the TOE and SAP-LAP models. The first and second authors coded sentence blocks containing TOE elements and matched them with the SAP-LAP model. The coding was performed independently. Cohen's inter-rater reliability kappa showed high agreement for axial coding ( $\kappa = 0.9$ ) (McHugh 2012). Based on these themes, our findings were elaborated following the principles of the interpretive approach listed previously. Our results and analyses comprise two subsections: existing (as-is) and intended (to-be) business processes. Subsections 4.1 and 4.2 elaborate the seafood supply chain's existing (as-is) and planned (to-be) scenarios, respectively.

##### 4.1. Existing business process

Outlining the existing business process in the seafood supply chain provides a better understanding of SAP elements regarding TOE components. This section presents pertinent expressions that reflect the current state of the seafood supply chain. It examines the shortcomings of the processes, barriers that affect performance efficiency, and business maturity of various stakeholders. This section addresses the need for a technology-enabled solution that can improve the efficiency of the seafood supply chain process and effectiveness of the outcomes. Table 6 summarises our interpretation.

Table 4. Description of interviewees.

Code	Interviewee role	Affiliation	Expertise	Experience in years	Country	Interview period
Phase 1						
IC1	Senior Researcher	Non-Governmental Organisations working in the development of seafood and coastal business development areas	Seafood, Aquaculture and Ocean Studies	10	India	Aug-20
IC2	Chief Operating Officer	Blockchain Firm specialising in enterprise Blockchain applications	Technology operations for Blockchain and strategic initiatives	15	India	Sep-20
IC3	Professor	IT Program, University	Blockchain, cryptocurrencies, Business intelligence, and big data analytics	20	USA	Aug-20
IC4	Chief Technology Officer	Blockchain Firm specialising in enterprise Blockchain applications	Blockchain and peer-to-peer technologies and contributions to Hyperledger Fabric, Ethereum, and Interplanetary File System	10	India	Aug-20
IC5	Director	Blockchain R&D Lab	Blockchain adoption in agriculture, dairy farming supply chain	18	Australia	Sep-20
Phase 2						
IC6	Fishermen	Self-business fishing companies	Fishing	30	Denmark	October 2020 – June 2021
IC7	Manager	Auction house	Fish auction	20	Denmark	Feb-21
IC8	Manager	Development company of Blockchain applications	Blockchain application development	13	Denmark	Mar-21
IC9	Manager	Distributor	Seafood distribution	9	Denmark	Feb-21
IC10	Manager	Supermarket	Seafood sales	11	Denmark	May-21
IC11	Consumer	N.A.	Seafood consumers		Denmark	May-21

**Table 5.** Axial coding scheme.

Code	SAP-LAP code	TOE code	Status
SI-T	Situation	Technology	As-Is
SI-O	Situation	Organisation	
SI-E	Situation	Environment	
AR-T	Actors	Technology	To-Be
AR-O	Actors	Organisation	
AR-E	Actors	Environment	
PR-T	Process	Technology	
PR-O	Process	Organisation	
PR-E	Process	Environment	
LN-T	Learning	Technology	
LN-O	Learning	Organisation	
LN-E	Learning	Environment	
AN-T	Action	Technology	
AN-O	Action	Organisation	
AN-E	Action	Environment	
PF-T	Performance	Technology	
PF-O	Performance	Organisation	
PF-E	Performance	Environment	

Fishing practices are primitive, with some technologies such as mobile phones, fish finders, and global positioning systems (GPS). The technical knowledge of fishermen is deficient and the entire fishing process and practices are instinctive. Fishermen have no mechanism to capture, store, or disseminate knowledge to their communities. Tacit knowledge is transferred from generation to generation, and is primarily based on a culture built on trust and respect. The lack of traceability is apparent throughout the supply chain regarding the critical parameters. These parameters include the catch's legality, quality, origin verifiability, and overall sustainability.

The marketing process is dominated by intermediaries or agents who buy large quantities of fish daily from fishermen. In addition, boats used for fishing are poorly or moderately automated and many are rented to fishermen by

**Table 6.** Existing business process elements.

SAP-LAP-TOE matrix	Questions	Elements of seafood industry supply chains	Matrix code	Local (L)/ Global (G)		
Situation-TOE	What-Existing?	<ul style="list-style-type: none"> <li>Increasing number of supply chain susceptibilities and blind spots worldwide.</li> </ul>	SI-E	G		
		<ul style="list-style-type: none"> <li>Inadequate infrastructure for seafood SCM in third world economies.</li> </ul>	SI-E	L		
		<ul style="list-style-type: none"> <li>Poorly regulated intermediaries and unequal distribution of power.</li> </ul>	SI-O	L		
		<ul style="list-style-type: none"> <li>Global growth in demand for seafood exceeds the supply, leading to overexploitation of fishing grounds.</li> </ul>	SI-E	G		
		<ul style="list-style-type: none"> <li>Absence of, or poor use of, technology (sub-standard, fragmented, and siloed).</li> </ul>	SI-T	L		
		<ul style="list-style-type: none"> <li>Poor coordination between international regulators.</li> </ul>	SI-E	G		
		<ul style="list-style-type: none"> <li>Inefficient, lack of trusted and transparent support systems such as insurance, leasing, and financing.</li> </ul>	SI-E	L		
		<ul style="list-style-type: none"> <li>Unethical fishing practices</li> </ul>	SI-E	L		
		<ul style="list-style-type: none"> <li>Environmental severe costs are often overlooked due to the overwhelming demand in the seafood market.</li> </ul>	SI-E	G		
		<ul style="list-style-type: none"> <li>Inadequate sustenance for aquaculture and lack of a feasible and rewarding alternative to overfishing in the developing economies</li> </ul>	SI-O	L		
		Actor-TOE	Who – is involved?	<ul style="list-style-type: none"> <li>Coastguards.</li> </ul>	AR-O	L
				<ul style="list-style-type: none"> <li>Universal law is enforcing bodies, food safety administrations, and port authorities.</li> </ul>	AR-O	G
				<ul style="list-style-type: none"> <li>Intermediaries (exporters, packers, shippers/transport management).</li> </ul>	AR-O	L
<ul style="list-style-type: none"> <li>Fishermen and supporting infrastructures such as vendors, boat rentals, and service maintenance providers.</li> </ul>	AR-E			L		
<ul style="list-style-type: none"> <li>Insurance companies and agents for bulk, smaller vessels and boats.</li> </ul>	AR-O			L		
<ul style="list-style-type: none"> <li>Culinary and Hospitality industries.</li> </ul>	AR-O			L		
<ul style="list-style-type: none"> <li>Fishing societies.</li> </ul>	AR-E			L		
<ul style="list-style-type: none"> <li>Consumers worldwide for whom fish is a primary basis of protein.</li> </ul>	AR-E			G		
Process-TOE	How – happening?	<ul style="list-style-type: none"> <li>Predictive process (from historical and real-time data of fishing).</li> </ul>	PR-E	G		
		<ul style="list-style-type: none"> <li>Protective process (quality controls at major ports check various quality metrics and import clearances for seafood consignments).</li> </ul>	PR-E	L		
		<ul style="list-style-type: none"> <li>Inadequate prevention procedures (appropriate post-capture preservation, sterilised packaging areas, controlled transportation environment, accurate labelling).</li> </ul>	PR-O	G		
		<ul style="list-style-type: none"> <li>Delayed response and recovery process (In case of any quality violation, the entire product batch requires integrity and authenticity verification. Delays result in decay for many seafood supplies lots).</li> </ul>	PR-O	L		

intermediaries. Data used to manage supply chains are in heterogeneous formats (from manuals to various levels of automation). They are owned by a few actors who control their interests unilaterally.

Most fishing communities are still in the dark about the **supply chain process**, as they do not participate beyond catching fish and bringing it to the shore. (IC1, IC6, IC7)–[SI-E], [AR-E], and [PR-O]

The smart intermediaries exploit fishermen's knowledge (sea, weather, location, breeding seasons, exotic and commercially rich seafood resources). (IC1, IC6, IC7) [AR-E], and [SI-E]

Various technical requirements and implementation levels exist across the seafood supply chain. Unlike their counterparts in developed countries such as Denmark, grassroots seafood in developing countries such as India, the Philippines, and some other regions of Southeast Asia are technically primitive. Individual fishers go fishing in these countries without adequate information and communication technology infrastructures. Access and connectivity remain as significant challenges. GPS and satellite links provide continuous connectivity between land and water over hundreds of nautical miles. The level of integration among the different actors in the seafood supply chain is currently far from satisfactory.

Fishermen, agents, and auction houses are isolated, and there is no reliable mechanism for tracking and monitoring catch quality. A high degree of data inconsistency is apparent among supply chain partners in the seafood industry, owing to different levels of technology enablement. Lack of understanding of international compliance guidelines has led to illegal ventures and fishing in troubled waters. Exploring the possibility of an environment where all stakeholders in the seafood supply chain have better communication and access to the correct data at the right time and from the right source is, therefore, essential. Currently, manual tasks are heavily involved in reporting fishery details and fishers have no options other than self-certifying their catch. On several occasions, the breeding areas of turtles and endangered marine species are threatened by official entry of fishing boats. The main reason for this was a lack of awareness and technical infrastructure to warn and reroute fishing routes.

**Data inconsistency** due to lack of a **common communication platform** between the seafood channel partners adversely affects the **fishing farmers' credibility**. (IC2, IC7, IC8, and IC9) [SI-T], [AR-E]

The **current inequalities in technology** use pull down the **efficiency of the seafood supply process** and call for an **affordable, orchestrating technology platform** to connect all the partners. (IC3, IC8) [PR-T], and [AR-T]

Like a black box in an airplane, **GPS devices** are used in developed fishing environments that are tamper-proof and provide **critical data transmission in real-time**. (IC3) [SI-E], [SI-T]

Despite many discussions on Blockchain projects, sustainability, traceability, security, and transparency, feedback recognises a digital divide between practices in developed and developing countries. For example, better compliance and more rigorous monitoring mechanisms in the US provide a much better grower-to-consumer experience than in developing countries, where the supply chain remains opaque,

resulting in fishing communities mainly dominated by intermediaries. Transporters and fishing brokers form an unauthorised cartel that dictates and monopolises daily market prices. These practices lack transparency throughout the supply chain, especially at the origin (fishermen) and the destination (seafood consumers).

Infrastructure remains a significant barrier in developing countries, as the growth and maturity of renewable energy sources are low compared to those of electricity from finite sources. As a result, Blockchain applications may be prohibitively expensive in countries where electricity generation, storage, and transmission are capital intensive. Fisheries registration practices in coastal communities of emerging economies are more cultural than procedural or formal. In other words, the less formal mechanism combines registration and certification processes for stakeholders in the seafood supply chain ecosystem. The current global SCM scenario is characterised by a lack of transparency, lobbying, and unapproved certification processes, which can negatively impact consumer confidence.

Many processes exist in the global supply chain and function in silos. These silos are a digitisation challenge and an Achilles heel for many industries, such as insurance, finance, and seafood. These industries operate independently and have little or no integration with surrounding systems/networks. Stakeholders often face many primary hurdles in resource management, which are also barriers to the entry of new players into the industry. Red tape facilitates intermediaries who are unique and often incompatible, which ultimately negatively affects supply chain performance. They rely on sophisticated functions to translate input from foreign environments. Today, technologies are increasingly tracing the movement of goods, and while their widespread adoption is still developing, they hold immense potential to benefit various stakeholders, particularly fishermen. This technology aims to create a networked seafood ecosystem to weigh unethical practices and expose hidden intermediaries in the system.

There is a **need for a solution** that addresses the anomalies of price fixation and goods movement and **ensures visibility of market conditions** to all the seafood supply chain players. (IC4, IC8, IC9, and IC10) [AR-O], [PR-E]

No single platform is available for identifying and bringing **legitimate partners together**, so the seafood ecosystem is free of illegal players and intermediaries. (IC4, IC6, IC7, IC8, IC9, IC10) [SI-O] and [AR-E]

The global supply chain faces challenges in its flexibility to adapt to these disruptions while effectively keeping pace with the changing regulations that impact its lower elements. Blockchain has created excitement in various business sectors such as supply chains, agriculture, government services, real estate, and financial services, particularly in India and China. However, in the perishable supply chain (seafood and agriculture), implementation and operationalisation are still in the testing or proof-of-concept phases, even in developed countries, such as Denmark. There is no proven traceability solution for seafood and agriculture. Exploring Blockchain solutions in these two sectors offers immense learning opportunities within and between subsystems such

as fishermen, auction agents, suppliers, buyers, consumers, software companies, and government agencies.

During the evolving stage of **Blockchain implementation** in the seafood supply chain, the role of the **Government** is critical in restructuring and mediating agents. (IC5, IC7, IC8) [SI-T], [AR-E], and [PR-T]

Based on our interviews, we identified contextual elements in the supply chain. The discussions during all interviews brought to light global and local (regional) perspectives on the conditions prevailing in the seafood supply chain. Table 6 shows how the supply chain elements are mapped in the matrix and differentiated from the local and global perspectives.

We uncovered two critical insights into business processes. First, environmental and organisational factors have a significant influence on the entire seafood supply chain. Technology plays a relatively minor role in facilitating changes in the environment, actors, and processes. Second, the prevailing circumstances, actors, and functions are predominantly shaped by local factors. It is imperative to

cautiously identify these concerns at the local or regional level before implementing any technology because technical solutions must be tailored for effective issue resolution. In Section 4.2, we discuss the proposed business process and contrast the elements of LAP with the components of TOE theory to highlight the significant differences between them.

#### 4.2. Intended business process

Based on what we learned from the current situation in the fisheries supply chain ecosystem (see Section 4.1), we discuss the elements of the LAP with the TOE components in the following section. We discuss how an integrated technology platform, such as a Blockchain, can adequately address the shortcomings identified in the current seafood supply chain (see Table 7).

Therefore, stakeholders should consider the seafood supply chain from an end-to-end perspective. Disruptive technologies, such as Blockchain, can be integrated with the cloud, analytics, and the IoT. These technologies lead to a

**Table 7.** Intended business process elements.

SAP-LAP – TOE matrix	Questions	Supply chain components	Matrix code	Local (L)/ Global (G)
Learning-TOE	Why?	<ul style="list-style-type: none"> <li>• Cognizance of all the parties involved throughout the supply chain</li> </ul>	LN-E	G
		<ul style="list-style-type: none"> <li>• Enhanced visibility and transparency between exporters of first-world economies and sub-contractors in the third-world countries</li> </ul>	LN-E	G
		<ul style="list-style-type: none"> <li>• Technology-enabled vigilance needed to prevent regulation escapism and bureaucratic corruption</li> </ul>	LN-T	L
		<ul style="list-style-type: none"> <li>• Knowledge about the implications of investment costs (capital expenditures/CAPEX and operational expenditures/OPEX) associated with technology-platform migration and digitisation in the seafood supply chain</li> </ul>	LN-T	G
		<ul style="list-style-type: none"> <li>• Striking a balance between the business and science of the seafood industry. The balance will foster amicable collaboration with research institutions and fishing companies in understanding the restrictions.</li> </ul>	LN-O	G
Actions-TOE	How?	<ul style="list-style-type: none"> <li>• Collate data from several unorganised players, including exporters in third-world economies. The collation can facilitate a radical shift to being an organised supply chain and leverage governmental regulations.</li> </ul>	AN-T	G
		<ul style="list-style-type: none"> <li>• Blockchain platform for validating and monitoring the transactions executed between supply chain partners.</li> </ul>	AN-E	G
		<ul style="list-style-type: none"> <li>• Ensure that the platform can create value and bring about sustainability in operations for all its stakeholders.</li> </ul>	AN-T	G
		<ul style="list-style-type: none"> <li>• Bring all stakeholders together on a global platform and provide access and visibility to all required information.</li> </ul>	AN-O	G
		<ul style="list-style-type: none"> <li>• Design appropriate algorithms to validate confirmation that the data collected is free of any bias</li> </ul>	AN-T	G
		<ul style="list-style-type: none"> <li>• Create appropriate infrastructure to support the operationalise this platform</li> </ul>	AN-T	G
		<ul style="list-style-type: none"> <li>• Map the fishing environment to facilitate digital replication.</li> </ul>	AN-E	L
Performance	What-Intended?	<ul style="list-style-type: none"> <li>• Incentivize stakeholders to enable data sharing and knowledge dissemination throughout the seafood supply chain.</li> </ul>	AN-O	L
		<ul style="list-style-type: none"> <li>• Process reliability and robustness measurement through audit trail of seafood supply chain transactions.</li> </ul>	PF-O	L
		<ul style="list-style-type: none"> <li>• All-in-one information dashboard with analytics by means of creating a digital thread for supporting informed decision-making.</li> </ul>	PF-T	G
		<ul style="list-style-type: none"> <li>• Degree of seafood supply chain optimisation using smart contracts and digitised processes.</li> </ul>	PF-T	G
		<ul style="list-style-type: none"> <li>• The extent of tamper-proof data verification through an immutable ledger throughout the seafood supply chain process owners</li> </ul>	PF-T	G
<ul style="list-style-type: none"> <li>• Information symmetry and single shared source of truth by automated reconciliation of seafood supply chain data.</li> </ul>	PF-E	L		

system that provides scalability, robustness, and transparency to increase value for all supply chain stakeholders. Agencies should conduct training on how IT can improve the efficiency of fishing processes and the effectiveness of catches. In addition, research on sustainable practices is needed to provide transparency in the supply chain to reduce overfishing, habitat destruction, bycatch avoidance, and fishing during the breeding season. The use of technology should ensure last-mile connectivity within the fishing community and among different actors in the supply chain.

Technology can be a boon to the community if it brings **process transparency** and **market visibility** to explore better business prospects. (IC1, IC6, IC7), [PF-O], and [AN-O]

**Access to the right information** relating to short-term financing, pricing, regulations, and governance can **boost the seafood sustainability** of the fishing communities. (IC1, IC7, IC8) [LN-E] and [PF-E]

Challenges can arise when new technologies and practices are introduced into the business environment for Blockchain-enabled SCM operations. Garbage-in-and-out is the most critical consideration for any information system and technology implementation, including Blockchain. Blockchain helps in data dissemination, but its authenticity depends heavily on the quality of participants' behaviour. This indirectly calls for simplifying the data entry and moving to automation. *Good behaviour* in terms of data quality must be rewarded. This problem usually arises from knowledge gaps between stakeholders. Complicated data entry rules may be acceptable to some stakeholders, but are a barrier to others. Data entry should be simplified as much as possible to avoid errors. Comprehensive assessments of the capabilities of different stakeholders are critical for deciding how to incorporate data into the Blockchain at multiple levels. Innovative solutions that incorporate IOTs, radio frequency identification (RFID), and related technologies to capture data remotely with minimal human oversight could mitigate this problem.

Data collection poses a challenge in developing countries because of the ongoing maturation of underlying technologies, particularly in terms of networks and infrastructure. Therefore, it is critical to develop data collection systems applicable to underdeveloped areas. These areas may lack reliable internet connections and power. This may mean using existing mobile networks, satellite technology, or offline data-collection methods. Data from fishermen and stakeholders can be collected via mobile apps, short message services (SMS), or unstructured supplementary service data (USSD)-based systems. Consider using satellite Internet, offline data synchronisation, or low-bandwidth connectivity technologies to ensure data collection in remote locations.

The four practices to improve the accuracy of data collection before the data are stored in the Blockchain are (i) user access to a single relevant source of truth, (ii) automated data entry with fish detection scanners, (iii) fish movement scanners and other appropriate data collection mechanisms, and (iv) scalability, digitisation, and integration of the system across the supply chain. Different stakeholders use the system to accommodate different levels of knowledge. It should

be comprehensive and involve members with different levels of expertise, including *fishing communities, aqua culturists, research institutes and organisations, vendors and market intermediaries, fishery boards operating at national and international levels, coast guards, and infrastructure providers, port authorities, financial intermediaries, and investors*. The system facilitates consensus among stakeholders while disseminating specific data to minimise redundancy.

Automated identification systems are critical for improving data quality. It uses sophisticated sensors to oversee and regulate maritime operations, ensure compliance with regional seafood industry protocols, and strengthen naval defence mechanisms. They provide vessel registration services and protect against illegal activities such as piracy and poaching. These systems use digital technology to create a synchronised representation of fishing locations and participants, providing a comprehensive range of benefits to various stakeholders in the seafood industry. They improved the overall monitoring framework within the supply chain by enhancing the capabilities for detecting and preventing unauthorised and illegal fishing vessel movements. The implemented systems also effectively regulate fishing activities by identifying dangerous zones and factors such as inadequate releases, increased emissions, and the use of illegal means. Diligent detection of illicit activity improves the overall monitoring framework within the supply chain.

Furthermore, data collected from vessel catches can be used by marine researchers to assess the sustainability status of fish populations and increase their capacity for predictive analysis, thereby mitigating fluctuations in the market. Real-time data collection, analysis, and efficient information sharing also increase transparency at the point of origin, thereby providing stakeholders with accurate and timely information to make informed decisions. A Blockchain platform, such as Hyperledger Fabric, is highly recommended as a supporting infrastructure. Seafood supply chain partners must use this infrastructure to extend the consensus at the core of the Hyperledger fabric to confirm various transactions on the Blockchain. Such confirmation will solve the problems of traceability and transparency, which are of the utmost importance to the seafood industry. Therefore, it is crucial to take proactive steps to implement these systems and ensure their proper functioning.

Blockchain deployments to cover an entire coastline of a country such as India may be far **too expensive and complex**. The intervention of the Government as a mediator is critical to bringing about an **amicable solution** that can **address the expectation** of the seafood supply chain stakeholders. (IC2, IC8) [LN-T]; [AN-O]; [AR-T]

**Empowering** the fishermen through technology enablement can have far-reaching benefits in **striking a balance** between the demand and supply of seafood. (IC3), [AN-T], and [LN-E]

When planning a Blockchain platform for the seafood supply chain, it is crucial to consider all associated costs, clarify financial responsibility, and incentivise adoption. The aim of implementing blockchain is to benefit all stakeholders, and it is essential to evaluate the different deployment models to achieve the desired results. A Blockchain is a powerful

enabler that can integrate information, communication, and network technologies to enhance transparency and promote sustainable food safety practices. It provides end-to-end transparency across processes, partners, interactions, transactions, and management, making it an ideal solution to enhance oversight in the seafood supply chain. Therefore, it is crucial to embrace Blockchain technology to achieve desired results and ensure fair play across the supply chain.

**Blockchain enablement** in the seafood supply chain calls for a **confluence of subject matter experts** from **multiple dimensions** such as information technology, operations, fishermen community, and finance. (IC4, IC8) [AR-T]; [AN-T]

Examining the maturity of technologies already in place among the partners in the fishery supply chain is critical. Enterprise resource planning (ERP) is widely used by partner companies to expand their functionality by integrating analytics, the IoT, and cloud delivery models. The following questions must be considered when implementing a Blockchain platform. Can Blockchain be integrated with existing technologies? Given the heterogeneous technological landscape of fishery supply chain partners, how complex is the integration? How can scalability be addressed? How interoperable are the existing technology platforms that meet Blockchain requirements? How do the investment and operating costs decrease?

In a perishable supply chain such as seafood, customer satisfaction can be sustained if you can address the **traceability and visibility issues** of the product to the entirety of its supply chain. (IC5) [PE-T], [PE-E]

Table 7 shows the planned business process elements obtained from a review of the transcribed interview documents. After mapping the supply chain elements in the matrix, we identified the regional/local specifics and global perspectives of the planned seafood supply chain.

We make four critical observations regarding the development of the business process. First, the focus shifted to technological factors in the targeted seafood supply chain business-process scenario. Second, our analysis substantiates the expectation that technology will enable learning, action, and performance measurements. Third, the targeted plan requires harmonisation between global and local views. Fourth, paying more attention to the business models behind Blockchain platforms is critical. We suggest that Blockchain-enabled SCM must consider regional specificities while adopting and leveraging globally recognised best practices.

## 5. Discussion and implications

Recall that our study aims to address the following RQ: *What are the critical factors influencing the effective utilisation of Blockchain technology in the seafood supply chain, considering organisational barriers and enablers, regulatory considerations, and alignment with environmental sustainability and traceability requirements?* The seafood industry is on the cusp of transformative change driven by the potential of Blockchain technology. Our findings reveal that integrating Blockchain

into the seafood supply chain can herald profound transformations in standard business processes.

The core of this transformative potential lies in Blockchain's ability to offer a robust and feasible solution for the industry. This enhances data efficiency, bolsters sustainability efforts, and facilitates seamless integration across value chains. One of its standout features is ensuring the secure and transparent documentation of transactions. Consequently, businesses can comprehensively track and monitor seafood rights from the perspective of identifying the final consumer. Such rigorous traceability not only ensures that seafood products adhere to environmental and social sustainability practices but also prevents the market's infiltration by fraudulent or mislabelled goods. This comprehensive documentation fosters an unparalleled level of trust between investors and consumers, thereby guaranteeing the reliability of seafood products.

However, effective integration of Blockchain technology in this sector depends on several factors. Precise and reliable data management, active stakeholder cooperation, and strict adherence to regulatory standards are of paramount importance. Furthermore, it is imperative to develop systems that are interoperable, prioritise cybersecurity, cost-effective, focus on consumer education, and underscore sustainability. Factors such as standardisation, trustworthiness, transparency, and quality control cannot be overlooked in the pursuit of successful technological adoption.

Enhanced transparency is another significant boon of Blockchain, streamlining the flow of real-time data-driven insights that are accessible to all stakeholders. This transparency augments stakeholder visibility, allowing them to make evidence-based decisions and optimise expenses. Such precise and current information offers maritime enterprises a golden ticket for refining their operations and boosting their efficiency and overall performance. However, the seafood industry faces challenges. Issues, such as deceptive practices and illicit replication, are rare. However, Blockchain has emerged as a beacon of hope, guaranteeing secure transactions and promising solid defense against these challenges. By leveraging this technology, businesses can fortify product integrity and shield customers from deceptive practices, thus reinforcing industrial integrity. Table 8 presents the primary advantages, approaches, and hurdles in adopting and implementing Blockchain in SCM.

Emphasising the importance of transparency in the seafood industry, Blockchain offers customers tools to trace their seafood origin effortlessly, fostering informed purchasing decisions. This heightened transparency cultivates trust between consumers and business. However, for this technological revolution to take root, securing endorsements and support from all industry players, from fishermen and processors to wholesalers, retailers, and consumers is crucial. A unanimous agreement on Blockchain adoption is vital for its smooth integration into the existing workflows. Establishing standardised data capture and sharing procedures will ensure unwavering precision and consistency across supply chains.

**Table 8.** Key benefits, strategies, and challenges of Blockchain based SCM adoption and implementation.

Aspect	Description/Value
Potential Impact and Benefits	Profound transformations in business processes; enhanced data efficiency; sustainability; integration across the value chain
Critical Factors	<ul style="list-style-type: none"> <li>• Precise data management</li> <li>• Stakeholder cooperation</li> <li>• Regulatory adherence</li> <li>• Standardisation</li> <li>• Trustworthiness</li> <li>• Effective quality control</li> <li>• Interoperability</li> <li>• Cost-effectiveness</li> <li>• Cybersecurity</li> <li>• Consumer education</li> <li>• Sustainability</li> <li>• Uniform data capture and sharing</li> </ul>
Implementation Considerations and Strategy	
Blockchain Applications and Benefits	Secure transaction documentation; seafood tracking from capture to consumption; rigorous traceability; preventing fraud; environmental and social responsibility
Challenges, Solutions, and Key to Adoption	<ul style="list-style-type: none"> <li>• Challenges: Deceptive practices, counterfeit products</li> <li>• Solutions: Secure transactions, improved transparency, stakeholder buy-in</li> </ul>

**Table 9.** Matrix of findings.

SAP-LAP model	Technology	Organisation	Environment
Existing (As-Is) business processes			
Situation	Primitive, Incongruent	Disorganised, Disparity, Escapism, Corruption, Non-regulated	Vulnerable, Unfavourable infrastructure, Ambiguous
Actor	Unaware, Sceptical, Reluctant	Conservative, Fragmented	Susceptible, Exploitative
Process	Incoherent, Immature	Unstandardized, Disorganised, Reactive, Unresponsive	Inefficient, Unproductive
Intended (To-Be) business processes			
Learning	Curiosity, Necessity, Digitisation, Integration.	Inclination, Harmony, Collaboration	Cognizance, Visibility, Transparency, Vigilance
Action	IoT, RFID, Consensus Mechanisms, Analytics Dashboard, Collation, Value-creation, Infrastructure	Incentives, Universal Access.	Digital Mapping, Verified and Optimised
Performance	Smart Contract, Permissioned Blockchain, Vulnerability Scanner, GS1 standards.	Reliability, Robustness, Trustworthiness.	Information symmetry, Single source of truth, Compliance.

### 5.1. Theoretical contributions

Our deliberations extended Klein and Myers (1999) interpretive field approach by facilitating information systems for researchers to understand the seafood supply chain's social, organisational, and technological facets. The method enabled us to further explore human thought and action in social and organisational contexts. This facilitated the understanding of information systems management and development in the seafood supply chain context by carefully intervening through a blend of TOE theory and the SAP-LAP inquiry model, which remains sparse in qualitative research. The combined approach enabled us to identify the existing situation in the seafood supply chain and understand the underlying issues and challenges of the processes. This method also allowed us to explore Blockchain as a potential technology platform to realise expectations from an intended (to-be) standpoint. The findings are summarised in the matrix shown in Table 9.

Based on this information, the SAP-LAP model is an overarching framework within a matrix. This enables a systematic assessment of the current situation (existing business processes), and forms the basis for understanding the desired state (future business processes). The model facilitates the analysis of the relationships between technology, organisation, and the environment, and enables a comprehensive

understanding of the opportunities and challenges of Blockchain in the seafood supply chain.

The use of technology in the seafood supply chain is critical to achieving traceability and transparency. The integration of advanced solutions, such as IoT, RFID, consensus mechanisms, and analytics dashboards, along with smart contracts, permissioned Blockchains, vulnerability scanners, and GS1 standards, ensures reliable and credible digital transactions that prevent fraudulent activity. To promote the adoption of Blockchain technology among industry participants, companies must foster a culture of innovation, adaptability, organisational cohesion, teamwork, motivation, and accessibility. On the environmental front, Blockchain technology can increase transparency, awareness, and credibility with consumers, enabling informed decision-making and ethical sourcing practices.

The current processes in seafood supply chains are seem to be inefficient, leading to high costs, fraud, and risks to millions of people. Blockchain can provide transparency, traceability, and efficient communication between actors worldwide. This can make the supply chain ecosystem transparent, trustworthy, and sustainable. Industries can collaborate to create a global quality standard that addresses unique challenges. Blockchain lowers cost and risk, enables the secure movement of products, and increases trust in the system.



An integrated platform framework that includes all stakeholders in a standardised manner is crucial for facilitating the transformation from exploitative to cooperative collaboration in the seafood industry. It is essential to collect and collate data for a well-organised supply chain to help identify unorganised players and bring them to the mainstream. The system involves sensors, consoles, and peer systems to collect data at various transaction points, which must be managed and sorted to ensure standardisation, traceability, and scalability. A common language for data is necessary for efficient system operation. For example, the industry currently adopts the GS1 standard, which uses extensible Mark-up Language (XML) code and RFID tags to store and capture data. Various application programming interfaces (APIs) enable stakeholders to access data on the basis of their rights. Blockchain applications act as a single source of truth, and are shared and maintained across the supply chain and logistics events.

This study contributes to the understanding of the relevant dimensions of TOE applicable to Blockchain-enabled SCM. Sarker et al. (2021) note that Blockchain-enabled SCM requires appropriate conditions to offer desirable affordances. Implementing Blockchain, while not a panacea, holds the potential to enable companies to reap their benefits through careful implementation and strategic use. This means that Blockchain potential comes from the appropriate assemblage of supporting resources other than technology: the organisation and the environment. For example, Blockchain technology has properties (e.g. as transparency, security, traceability,

efficiency, and speed) that can solve problems in existing business processes. These properties, however, require the organisation to spend effort (e.g. leadership, management commitment, collaboration, and coordination), corporate resources (e.g. financial and non-financial), and to consider the environmental dimension (e.g. regulation, culture, global SCM best practices, and other stakeholders) to offer the desirable Blockchain affordance and realise its successful adoption and implementation (Liang et al. 2021; Sarker et al. 2021).

The appropriate mobilisation and structuring of these efforts and resources help the relevant SCM actors to guide their purposeful behaviours and ultimately realise concrete actions with Blockchain. Our findings could help organisations focus on suitable dimensions when implementing Blockchain in the SCM environment. We speculate that when the intended (to-be) business process dimensions in Table 8 are appropriately addressed and managed, the blockchain-enabled system results in the optimal use of Blockchain technology, as depicted in Figure 2.

### 5.2. Practical implications

Blockchain and related technologies offer accessibility and efficiency improvements for the supply chain, benefiting workers and the seafood industry. This study demonstrates the potential of Blockchain-enabled seafood SCM. First, it addresses inefficiencies and corruption stemming from regulatory compliance issues and fosters transparency, traceability, and scalability.

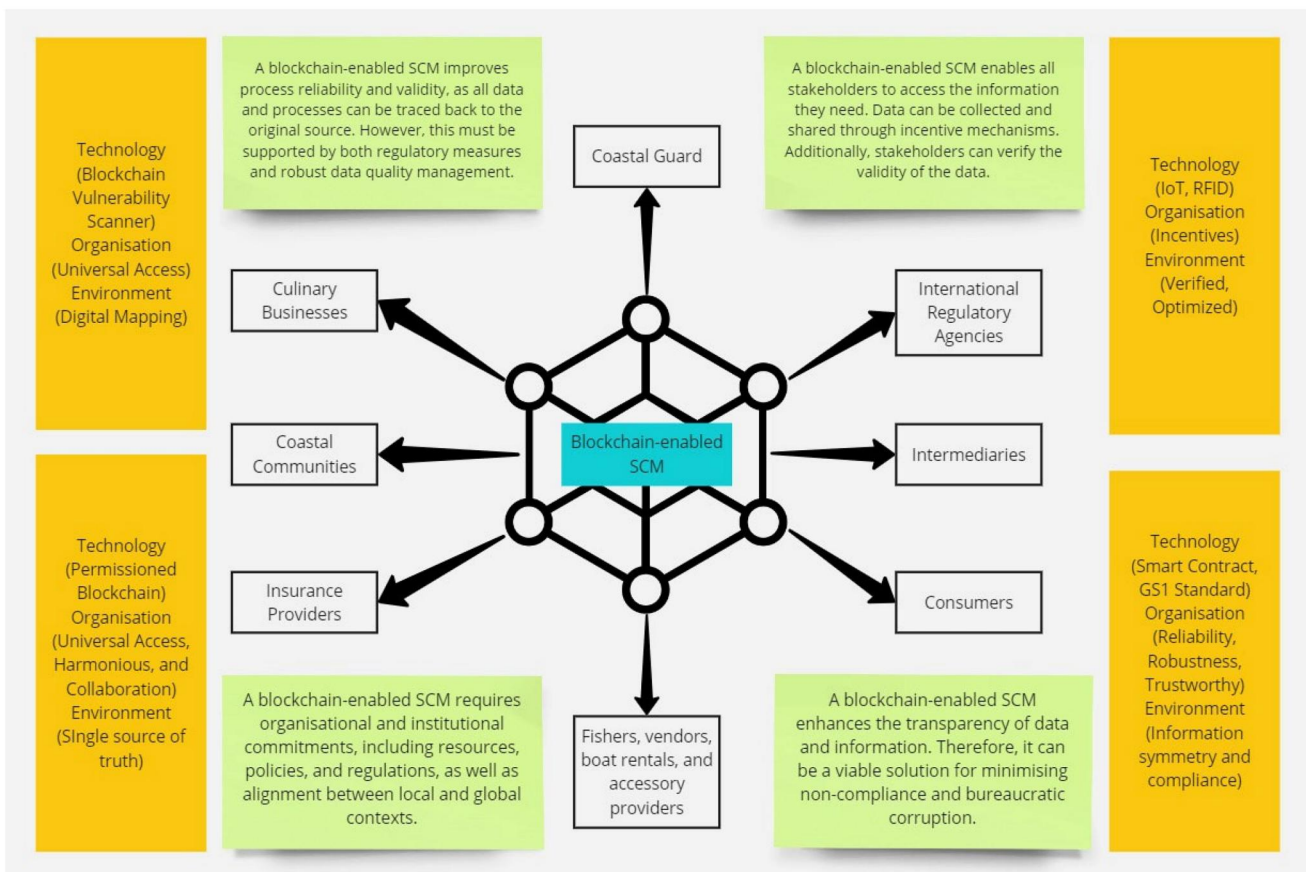


Figure 2. Framework for Blockchain-enabled seafood SCM platform.

**Table 10.** Tangible and non-tangible impacts of Blockchain-enabled SCM on firms, customers, and regulatory bodies.

Implication for practice	Impact on firms	Impact on customers	Impact on regulatory bodies
Digitalisation and Automation in Supply Chain	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Opportunity for technological upskilling.</li> <li>Enhanced efficiency in supply chain operations.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Cultural shift towards technology acceptance.</li> <li>Enhanced firm reputation.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Receive products/services with a reduced delay.</li> <li>Transparency in product origin.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Increased trust in the company.</li> <li>Sense of being part of a progressive ecosystem.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Easier oversight due to digitised operations.</li> <li>Improved compliance monitoring.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Strengthened public trust in regulatory systems.</li> <li>Enhanced global reputation for fostering innovation.</li> </ul>
Globalisation and Blockchain Efficiency	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Access to global markets and expanded business avenues.</li> <li>Reduction in corruption and inefficiencies.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Strengthened global partnerships.</li> <li>Elevated brand perception globally.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Greater product variety and assurance of authenticity.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Enhanced confidence in global products.</li> <li>Feeling of being part of a global community.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Clear rules and predefined requirements can be set.</li> <li>Efficiently address issues related to taxes, red tape, and other regulations.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Perception as forward-thinking and global-friendly.</li> <li>Stronger international collaborations.</li> </ul>
Transparency and Security in Supply Chain	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Improved trust among stakeholders.</li> <li>Enhanced security against traditional cybercrime.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Strengthened stakeholder relationships.</li> <li>Increased brand integrity and loyalty.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Increased confidence in product quality and source.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Peace of mind regarding product safety.</li> <li>Enhanced trust in suppliers.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Efficient enforcement of regulations, such as against overfishing and poaching.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Recognition for ensuring consumer safety.</li> <li>Improved stakeholder trust in regulatory enforcement.</li> </ul>
Flexibility and Crisis Management	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Agile response to supply chain disruptions.</li> <li>Cost savings due to reduced losses in crises.</li> <li>Smoother collaboration with other stakeholders.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Enhanced organisational resilience.</li> <li>Improved stakeholder trust in firm's agility.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Consistent product availability even in disruptions.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Sense of security and reliability associated with the firm.</li> <li>Appreciation for the firm's adaptability.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Rapid and transparent oversight during crises.</li> <li>Efficient deployment of resources where needed.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Enhanced public confidence in times of crises.</li> <li>Perception of proactive and agile governance.</li> </ul>
Integration of Blockchain in the Seafood Supply Chain	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Reduction in downtime and supply chain disruptions.</li> <li>Enhanced efficiency and data-driven operations.</li> <li>Skilled workforce due to training programs.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Improved internal cohesion and understanding of processes.</li> <li>Strengthened public image.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Seamless experience due to fewer disruptions.</li> <li>Assurance of product quality.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Increased brand loyalty.</li> <li>Enhanced trust in the supply chain.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Easier monitoring due to standardised processes.</li> <li>Proactive addressing of potential issues due to data insights.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Elevated status as a progressive regulatory body.</li> <li>Increased trust from industry stakeholders.</li> </ul>
Future proofing with Technology Advancements	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Stay ahead in the market with timely technology adoption.</li> <li>Efficient data analysis leading to predictive insights.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Organisational readiness for future challenges.</li> <li>Fostered culture of innovation.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Benefit from the latest technological features.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Anticipation of consistent technological improvements.</li> <li>Sense of being served by cutting-edge firms.</li> </ul>	<p><b>Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Stay updated with the latest tech advancements.</li> <li>Ensure that regulations are aligned with the latest technological standards.</li> </ul> <p><b>Non-Tangible Impact</b></p> <ul style="list-style-type: none"> <li>Enhanced reputation for staying ahead of the tech curve.</li> <li>Confidence in adapting to future challenges.</li> </ul>

Eliminating intermediaries and sharing resources enhance the business environment. Second, Blockchain technology ensures accountability, transparency, and cybercrime prevention, while enforcing regulations. This finding supports the sustainability of the seafood supply chain. Third, Blockchain-based SCM systems enhance flexibility and efficiency, digitally transform processes, and enable collaborations. This agility is crucial during disruptions such as the COVID-19 pandemic. Fourth, integration recommendations consider human factors and leverage the SAP-LAP model for structured governance. Upskilling and livelihood programs help adapt to changes. Fifth, AI-powered analytics and collaborative practices such as DevOps enable trend prediction and rapid feature integration. Scalability reflects one's readiness for change.

Overall, our study highlights the significant and diverse implications of Blockchain for supply chains. By leveraging the power of globalisation and Blockchain technology, companies have the opportunity to access global markets, elevate brand reputation, and establish transparent regulatory frameworks. Enhanced transparency and robust security measures bolster trust and fortify defences against cyber threats, thereby safeguarding consumer well-being and fostering supplier confidence. The importance of adaptability and effective responses to unexpected events highlights the necessity of agile reactions to disturbances, ultimately heightening organisational resilience and bolstering consumer trust. The incorporation of Blockchain into the Seafood Supply Chain enhances operational efficiency, thus promoting the cultivation of a highly competent workforce, ensuring unwavering quality, and nurturing enduring relationships. Additionally, the implementation of technological advancements for futureproofing equips organisations and governing bodies to effectively navigate the complexities of an ever-changing landscape, fostering an environment of forward-thinking creativity, and enabling consumers to fully leverage the advantages offered by cutting-edge technologies. [Table 10](#) categorises our research implications for practice segmented by their impact on firms, customers, and regulatory bodies.

## 6. Conclusion, limitations, and future directions

This study shows that seafood supply chain systems are complicated and require local practices and cultural considerations for implementation. Blockchain-enabled SCM can address specific requirements, such as disintermediation, smart contracts, and minimising asymmetries in information flow. However, implementing Blockchain requires significant organisational efforts and resources to unlock its full potential. This study suggests that future research should include other local contexts to map or cluster similar problems and challenges in the seafood SCM.

This study highlights that Blockchain adoption can transform the seafood industry's conservative practices and processes including traceability, transparency, and ethical seafood production. However, the study has limitations, including only considering the data saturation approach in selecting respondents and the inability to capture specific dimensions of Blockchain-enabled SCM implementation due to the complex nature of seafood SCM. This study encourages further research to explore the

factors hindering technology deployment in specific industry contexts and investigate effective Blockchain implementation involving institutional logic and critical business members.

## Notes

1. <https://www.thebusinessresearchcompany.com/report/seafood-global-market-report>.
2. <https://www.statista.com/statistics/821023/global-seafood-market-value/>.
3. <https://www.fao.org/3/cc0461en/online/sofia/2022/fisheries-aquaculture-employment.html>.
4. The act of mislabeling in the seafood industry refers to the deception of providing false information regarding product specifics, such as the species, origin, fishing techniques, quantity, expiration dates, and processing procedures. This deceptive behavior misleads consumers, influences market trends, poses potential health hazards, and perpetuates unethical fishing practices, emphasizing the urgent need for improved traceability and ethical conduct within the sector.
5. <https://www.consilium.europa.eu/media/23548/2017-g20-hamburg-upaden.pdf>.
6. Although both are essential in the modern supply chain, they differ in their areas of concentration, with cold chain addressing the physical management of goods and Blockchain focusing on the digital tracking of information.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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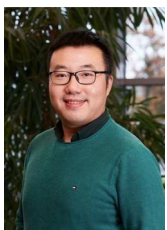
algorithmic systems, automated decision making, data analytics, and blockchain in a variety of sectors, from finance to education to health-care transformation. His research appears in several information systems journals such as *Information and Management*, *Behaviour and Information Technology*, *Journal of Information Systems*, *International Journal of Accounting Information Systems*, *Telematics and Informatics*, and *Technology in Society*. He has managed to secure significant funding for his work, including research grants from the Singapore institutions, Australian funding agencies, and the Indonesian government and corporations. Some notable research grants and projects include Monash Data Future Institute (MDFI), Whyte Fund, Research Grant Bank Indonesia, and Singapore Institute of Technology Ignition Grants.



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## References

- Agrawal, T. K., V. Kumar, R. Pal, L. Wang, and Y. Chen. 2021. "Blockchain-Based Framework for Supply Chain Traceability: A Case Example of Textile and Clothing Industry." *Computers & Industrial Engineering* 154: 107130. <https://doi.org/10.1016/j.cie.2021.107130>
- Ali, I., and K. Govindan. 2021. "Extenuating Operational Risks through Digital Transformation of Agri-Food Supply Chains." *Production Planning & Control* 34 (12): 1165–1177. <https://doi.org/10.1080/09537287.2021.1988177>
- Ali, M. H., L. Chung, A. Kumar, S. Zailani, and K. H. Tan. 2021. "A Sustainable Blockchain Framework for the Halal Food Supply Chain: Lessons from Malaysia." *Technological Forecasting and Social Change* 170: 120870. <https://doi.org/10.1016/j.techfore.2021.120870>
- Alles, M., and G. L. Gray. 2020. "The First Mile Problem": Deriving an Endogenous Demand for Auditing in Blockchain-Based Business Processes." *International Journal of Accounting Information Systems* 38: 100465. <https://doi.org/10.1016/j.accinf.2020.100465>
- Arun, Kanda, S.G., Deshmukh, Arshinder, (2007). Supply Chain Coordination Issues: An SAP-LAP Framework. *Asia Pacific Journal of Marketing and Logistics*, 19(3), 240–264. <https://doi.org/10.1108/13555850710772923>
- Avdelas, L., E. Avdic-Mravlje, A. C. Borges Marques, S. Cano, J. J. Capelle, N. Carvalho, M. Cozzolino, et al. 2021. "The Decline of Mussel Aquaculture in the European Union: Causes, Economic Impacts and Opportunities." *Reviews in Aquaculture* 13 (1): 91–118. <https://doi.org/10.1111/raq.12465>
- Bai, C., M. Quayson, and J. Sarkis. 2022. "Analysis of Blockchain's Enablers for Improving Sustainable Supply Chain Transparency in Africa Cocoa Industry." *Journal of Cleaner Production* 358: 131896. <https://doi.org/10.1016/j.jclepro.2022.131896>
- Bailey, M., S. R. Bush, A. Miller, and M. Kochen. 2016. "The Role of Traceability in Transforming Seafood Governance in the Global South." *Current Opinion in Environmental Sustainability* 18: 25–32. <https://doi.org/10.1016/j.cosust.2015.06.004>
- Barenji, A. V., H. Guo, Y. Wang, Z. Li, and Y. Rong. 2021. "Toward Blockchain and Fog Computing Collaborative Design and Manufacturing Platform: Support Customer View." *Robotics and Computer-Integrated Manufacturing* 67: 102043. <https://doi.org/10.1016/j.rcim.2020.102043>
- Biswas, D., H. Jalali, A. H. Ansariipoor, and P. De Giovanni. 2022. "Traceability vs. Sustainability in Supply Chains: The Implications of Blockchain." *European Journal of Operational Research* 305 (1): 128–147. <https://doi.org/10.1016/j.ejor.2022.05.034>

- Campbell, S. J., Jakub, R., Valdivia, A., Setiawan, H., Setiawan, A., Cox, C., Kiyo, A., Darman, Djafar, L. F., Rosa, E. de la, Suherfian, W., Yuliani, A., Kushardanto, H., Muawanah, U., Rukma, A., Alimi, T., and Box, S. (2021). Immediate Impact of COVID-19 across Tropical Small-Scale Fishing Communities. *Ocean & Coastal Management*, 200, 105485. <https://doi.org/10.1016/j.ocecoaman.2020.105485>
- Casino, F., T. K. Dasaklis, and C. Patsakis. 2019. "A Systematic Literature Review of Blockchain-Based Applications: Current Status, Classification and Open Issues." *Telematics and Informatics* 36: 55–81. <https://doi.org/10.1016/j.tele.2018.11.006>
- Chauhan, C., A. Sharma, and A. Singh. 2021. "A SAP-LAP Linkages Framework for Integrating Industry 4.0 and Circular Economy." *Benchmarking: An International Journal* 28 (5): 1638–1664. <https://doi.org/10.1108/BIJ-10-2018-0310>
- Clohesy, T., and T. Acton. 2019. "Investigating the Influence of Organizational Factors on Blockchain Adoption." *Industrial Management & Data Systems* 119 (7): 1457–1491. <https://doi.org/10.1108/IMDS-08-2018-0365>
- Cochrane, K. L. 2021. "Reconciling Sustainability, Economic Efficiency and Equity in Marine Fisheries: Has There Been Progress in the Last 20 Years?" *Fish and Fisheries* 22 (2): 298–323. <https://doi.org/10.1111/faf.12521>
- Cramer, K. L., and J. N. Kittinger. 2021. "Reef Conservation off the Hook: Can Market Interventions Make Coral Reef Fisheries More Sustainable?" *Frontiers in Marine Science* 8: 1–15. <https://doi.org/10.3389/fmars.2021.675274>
- Friedman, N., and J. Ormiston. 2022. "Blockchain as a Sustainability-Oriented Innovation?: Opportunities for and Resistance to Blockchain Technology as a Driver of Sustainability in Global Food Supply Chains." *Technological Forecasting and Social Change* 175: 121403. <https://doi.org/10.1016/j.techfore.2021.121403>
- Garg, A., and S. G. Deshmukh. 2010. "Engineering Support Issues for Flexibility in Maintenance." *Asia Pacific Journal of Marketing and Logistics* 22 (2): 247–270. <https://doi.org/10.1108/13555851011026980>
- Ghaleb, E. A. A., P. D. D. Dominic, S. M. Fati, A. Muneer, and R. F. Ali. 2021. "The Assessment of Big Data Adoption Readiness with a Technology–Organization–Environment Framework: A Perspective towards Healthcare Employees." *Sustainability* 13 (15): 8379. <https://doi.org/10.3390/su13158379>
- Goddard, F., and M. Schmidt. 2021. "Exploratory Insights into Audit Fee Increases: A Field Study into Board Member Perceptions of Auditor Pricing Practices." *International Journal of Auditing* 25 (3): 637–660. <https://doi.org/10.1111/ijau.12242>
- Grewal-Carr, V., and S. Marshall. 2016. *Blockchain: Enigma, Paradox, Opportunity*. London: Deloitte LLP.
- Hackius, N., and M. Petersen. 2017. "Blockchain in Logistics and Supply Chain: Trick or Treat? *Digitalization in Supply Chain Management and Logistics: Smart and Digital Solutions for an Industry 4.0 Environment*." Proceedings of the Hamburg International Conference of Logistics (HICL), Vol. 23, 3–18.
- Helo, P., and Y. Hao. 2019. "Blockchains in Operations and Supply Chains: A Model and Reference Implementation." *Computers & Industrial Engineering* 136: 242–251. <https://doi.org/10.1016/j.cie.2019.07.023>
- Howson, P. 2020. "Building Trust and Equity in Marine Conservation and Fisheries Supply Chain Management with Blockchain." *Marine Policy* 115: 103873. <https://doi.org/10.1016/j.marpol.2020.103873>
- Hu, F., H. Zhong, C. Wu, S. Wang, Z. Guo, M. Tao, C. Zhang, et al. 2021. "Development of Fisheries in China." *Reproduction and Breeding* 1 (1): 64–79. <https://doi.org/10.1016/j.repbre.2021.03.003>
- John, L., and A. Ramesh. 2012. "Humanitarian Supply Chain Management in India: A SAP-LAP Framework." *Journal of Advances in Management Research* 9 (2): 217–235. <https://doi.org/10.1108/09727981211271968>
- Kabra, G., and A. Ramesh. 2015. "Analyzing ICT Issues in Humanitarian Supply Chain Management: A SAP-LAP Linkages Framework." *Global Journal of Flexible Systems Management* 16 (2): 157–171. <https://doi.org/10.1007/s40171-014-0088-3>
- Kalaitzi, D., and N. Tsolakis. 2022. "Supply Chain Analytics Adoption: Determinants and Impacts on Organisational Performance and Competitive Advantage." *International Journal of Production Economics* 248: 108466. <https://doi.org/10.1016/j.ijpe.2022.108466>
- Kamilaris, A., A. Fonts, and F. X. Prenafeta-Boldú. 2019. "The Rise of Blockchain Technology in Agriculture and Food Supply Chains." *Trends in Food Science & Technology* 91: 640–652. <https://doi.org/10.1016/j.tifs.2019.07.034>
- Kayicki, Y., N. Subramanian, M. Dora, and M. S. Bhatia. 2022. "Food Supply Chain in the Era of Industry 4.0: Blockchain Technology Implementation Opportunities and Impediments from the Perspective of People, Process, Performance, and Technology." *Production Planning & Control* 33 (2–3): 301–321. <https://doi.org/10.1080/09537287.2020.1810757>
- Klein, H. K., and M. D. Myers. 1999. "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems." *MIS Quarterly* 23 (1): 67. <https://doi.org/10.2307/249410>
- Kouhizadeh, M., Q. Zhu, and J. Sarkis. 2020. "Blockchain and the Circular Economy: Potential Tensions and Critical Reflections from Practice." *Production Planning & Control* 31 (11–12): 950–966. <https://doi.org/10.1080/09537287.2019.1695925>
- Kruijssen, F., I. Tedesco, A. Ward, L. Pincus, D. Love, and A. L. Thorne-Lyman. 2020. "Loss and Waste in Fish Value Chains: A Review of the Evidence from Low and Middle-Income Countries." *Global Food Security* 26: 100434. <https://doi.org/10.1016/j.gfs.2020.100434>
- Laguir, L., I. Laguir, and E. Tchameni. 2019. "Implementing CSR Activities through Management Control Systems." *Accounting, Auditing & Accountability Journal* 32 (2): 531–555. <https://doi.org/10.1108/AAAJ-05-2016-2566>
- Lam, V. W. Y., E. H. Allison, J. D. Bell, J. Blythe, W. W. L. Cheung, T. L. Frölicher, M. A. Gasalla, and U. R. Sumaila. 2020. "Climate Change, Tropical Fisheries and Prospects for Sustainable Development." *Nature Reviews Earth & Environment* 1 (9): 440–454. <https://doi.org/10.1038/s43017-020-0071-9>
- Liang, T.-P., R. Kohli, H.-C. Huang, and Z.-L. Li. 2021. "What Drives the Adoption of the Blockchain Technology? A Fit-Viability Perspective." *Journal of Management Information Systems* 38 (2): 314–337. <https://doi.org/10.1080/07421222.2021.1912915>
- Lin, H.-F. 2014. "Understanding the Determinants of Electronic Supply Chain Management System Adoption: Using the Technology–Organization–Environment Framework." *Technological Forecasting and Social Change* 86: 80–92. <https://doi.org/10.1016/j.techfore.2013.09.001>
- Liu, Z., and Z. Li. 2020. "A Blockchain-Based Framework of Cross-Border e-Commerce Supply Chain." *International Journal of Information Management* 52: 102059. <https://doi.org/10.1016/j.ijinfomgt.2019.102059>
- Lynch, A. J., V. Elliott, S. C. Phang, J. E. Claussen, I. Harrison, K. J. Murchie, E. A. Steel, and G. L. Stokes. 2020. "Inland Fish and Fisheries Integral to Achieving the Sustainable Development Goals." *Nature Sustainability* 3 (8): 579–587. <https://doi.org/10.1038/s41893-020-0517-6>
- McHugh, M. L. 2012. "Interrater Reliability: The Kappa Statistic." *Biochemia Medica* 22 (3): 276–282. <https://doi.org/10.11613/BM.2012.031>
- Mukherjee, S., V. Chittipaka, and M. M. Baral. 2022. "Addressing and Modeling the Challenges Faced in the Implementation of Blockchain Technology in the Food and Agriculture Supply Chain." In *Blockchain Technologies and Applications for Digital Governance*, edited by P. Nijalingappa and M. M. Ghonge, 151–179. Hershey: IGI Global. <https://doi.org/10.4018/978-1-7998-8493-4.ch007>
- Naef, S., S. M. Wagner, and C. Saur. 2022. "Blockchain and Network Governance: Learning from Applications in the Supply Chain Sector." *Production Planning & Control* 1–15. Advance online publication. <https://doi.org/10.1080/09537287.2022.2044072>
- Nakamoto, S. 2008. "Bitcoin: A Peer-to-Peer Electronic Cash System." <https://bitcoin.org/bitcoin.pdf>
- Naylor, R. L., A. Kishore, U. R. Sumaila, I. Issifu, B. P. Hunter, B. Belton, S. R. Bush, et al. 2021. "Blue Food Demand across Geographic and Temporal Scales." *Nature Communications* 12 (1): 5413. <https://doi.org/10.1038/s41467-021-25516-4>
- Oguntegebe, K. F., N. Di Paola, and R. Vona. 2022. "Behavioural Antecedents to Blockchain Implementation in Agrifood Supply Chain Management: A Thematic Analysis." *Technology in Society* 68: 101927. <https://doi.org/10.1016/j.techsoc.2022.101927>

- Orji, I. J., S. Kusi-Sarpong, S. Huang, and D. Vazquez-Brust. 2020. "Evaluating the Factors That Influence Blockchain Adoption in the Freight Logistics Industry." *Transportation Research Part E: Logistics and Transportation Review* 141: 102025. <https://doi.org/10.1016/j.tre.2020.102025>
- Parker, L. D., K. Jacobs, and J. Schmitz. 2018. "New Public Management and the Rise of Public Sector Performance Audit." *Accounting, Auditing & Accountability Journal* 32 (1): 280–306. <https://doi.org/10.1108/AAAJ-06-2017-2964>
- Perdana, A., W. E. Lee, and A. Robb. 2021. "From Enfant Terrible to Problem-Solver? Tracing the Competing Discourse to Explain Blockchain-Related Technological Diffusion." *Telematics and Informatics* 63: 101662. <https://doi.org/10.1016/j.tele.2021.101662>
- Perdana, A., A. Robb, V. Balachandran, and F. Rohde. 2021. "Distributed Ledger Technology: Its Evolutionary Path and the Road Ahead." *Information & Management* 58 (3): 103316. <https://doi.org/10.1016/j.im.2020.103316>
- Pincinato, R. B. M., M. A. Gasalla, T. Garlock, and J. L. Anderson. 2022. "Market Incentives for Shark Fisheries." *Marine Policy* 139: 105031. <https://doi.org/10.1016/j.marpol.2022.105031>
- Promptanapak, A., and K. Lopetcharat. 2020. "Managing Changes and Risk in Seafood Supply Chain: A Case Study from Thailand." *Aquaculture* 525: 735318. <https://doi.org/10.1016/j.aquaculture.2020.735318>
- Queiroz, M. M., and S. F. Wamba. 2019. "Blockchain Adoption Challenges in Supply Chain: An Empirical Investigation of the Main Drivers in India and the USA." *International Journal of Information Management* 46: 70–82. <https://doi.org/10.1016/j.ijinfomgt.2018.11.021>
- Rauniyar, K., X. Wu, S. Gupta, S. Modgil, and A. Kumar. 2023. "Digitizing Global Supply Chains through Blockchain." *Production Planning & Control* 1–22. Advance online publication. <https://doi.org/10.1080/09537287.2023.2189614>
- Raut, R. D., B. B. Gardas, V. S. Narwane, and B. E. Narkhede. 2019. "Improvement in the Food Losses in Fruits and Vegetable Supply Chain—A Perspective of Cold Third-Party Logistics Approach." *Operations Research Perspectives* 6: 100117. <https://doi.org/10.1016/j.orp.2019.100117>
- Ruiz-Salmón, I., M. Margallo, J. Laso, P. Villanueva-Rey, D. Mariño, P. Quintero, A. C. Dias, et al. 2020. "Addressing Challenges and Opportunities of the European Seafood Sector under a Circular Economy Framework." *Current Opinion in Environmental Science & Health* 13: 101–106. <https://doi.org/10.1016/j.coesh.2020.01.004>
- Saberi, S., M. Kouhizadeh, J. Sarkis, and L. Shen. 2019. "Blockchain Technology and Its Relationships to Sustainable Supply Chain Management." *International Journal of Production Research* 57 (7): 2117–2135. <https://doi.org/10.1080/00207543.2018.1533261>
- Said, A., J. Tzanopoulos, and D. MacMillan. 2016. "Bluefin Tuna Fishery Policy in Malta: The Plight of Artisanal Fishermen Caught in the Capitalist Net." *Marine Policy* 73: 27–34. <https://doi.org/10.1016/j.marpol.2016.07.025>
- Salah, K., N. Nizamuddin, R. Jayaraman, and M. Omar. 2019. "Blockchain-Based Soybean Traceability in Agricultural Supply Chain." *IEEE Access* 7: 73295–73305. <https://doi.org/10.1109/ACCESS.2019.2918000>
- Sarker, S., S. Henningson, T. Jensen, and J. Hedman. 2021. "The Use of Blockchain as a Resource for Combating Corruption in Global Shipping: An Interpretive Case Study." *Journal of Management Information Systems* 38 (2): 338–373. <https://doi.org/10.1080/07421222.2021.1912919>
- Sauer, P. C., G. Orzes, and G. Culot. 2022. "Blockchain in Supply Chain Management: A Multiple Case Study Analysis on Setups, Contingent Factors, and Evolutionary Patterns." *Production Planning & Control* 1–16. Advance online publication. <https://doi.org/10.1080/09537287.2022.2153078>
- Song, A. M., J. Scholtens, K. Barclay, S. R. Bush, M. Fabinyi, D. S. Adhuri, and M. Houghton. 2020. "Collateral Damage? Small-Scale Fisheries in the Global Fight against IUU Fishing." *Fish and Fisheries* 21 (4): 831–843. <https://doi.org/10.1111/faf.12462>
- Suddaby, R. 2006. "From the Editors: What Grounded Theory is Not." *Academy of Management Journal* 49 (4): 633–642. <https://doi.org/10.5465/amj.2006.22083020>
- Sushil. (2000). "SAP-LAP Models of Inquiry." *Management Decision* 38 (5): 347–353. <https://doi.org/10.1108/00251740010340526>
- Sushil. (2019). "Theory Building Using SAP-LAP Linkages: An Application in the Context of Disaster Management." *Annals of Operations Research* 283 (1–2): 811–836. <https://doi.org/10.1007/s10479-017-2425-3>
- Tate, W. L., and L. Bals. 2017. "Outsourcing/Offshoring Insights: Going beyond Reshoring to Rightshoring." *International Journal of Physical Distribution & Logistics Management* 47 (2/3): 106–113. <https://doi.org/10.1108/IJPDLM-11-2016-0314>
- Thakkar, J., A. Kanda, and S. G. Deshmukh. 2008a. "A Conceptual Role Interaction Model for Supply Chain Management in SMEs." *Journal of Small Business and Enterprise Development* 15 (1): 74–95. <https://doi.org/10.1108/14626000810850856>
- Thakkar, J., A. Kanda, and S. G. Deshmukh. 2008b. "Interpretive Structural Modeling (ISM) of IT-Enablers for Indian Manufacturing SMEs." *Information Management & Computer Security* 16 (2): 113–136. <https://doi.org/10.1108/09685220810879609>
- The Food and Agriculture Organization. 2020a. "GLOBEFISH - Information and Analysis on World Fish Trade-2019 Gives Way to a More Uncertain Outlook for 2020." <http://www.fao.org/in-action/globefish/fishery-information/resource-detail/en/c/1263892/>
- The Food and Agriculture Organization. 2020b. "The State of World Fisheries and Aquaculture 2020." <https://www.fao.org/3/ca9229en/ca9229en.pdf>
- Thompson, B. S., and S. Rust. 2023. "Blocking Blockchain: Examining the Social, Cultural, and Institutional Factors Causing Innovation Resistance to Digital Technology in Seafood Supply Chains." *Technology in Society* 73: 102235. <https://doi.org/10.1016/j.techsoc.2023.102235>
- Tornatzky, L. G., and M. Fleischer. 1990. *The Process of Technology Innovation*. Lanham, MD: Lexington Books.
- Viridin, J., T. Vegh, B. Ratcliff, E. Havice, J. Daly, and J. Stuart. 2022. "Combatting Illegal Fishing through Transparency Initiatives: Lessons Learned from Comparative Analysis of Transparency Initiatives in Seafood, Apparel, Extractive, and Timber Supply Chains." *Marine Policy* 138: 104984. <https://doi.org/10.1016/j.marpol.2022.104984>
- Vu, N., A. Ghadge, and M. Bourlakis. 2023. "Blockchain Adoption in Food Supply Chains: A Review and Implementation Framework." *Production Planning & Control* 34 (6): 506–523. <https://doi.org/10.1080/09537287.2021.1939902>
- Wamba, S. F., and M. M. Queiroz. 2022. "Industry 4.0 and the Supply Chain Digitalisation: A Blockchain Diffusion Perspective." *Production Planning & Control* 33 (2–3): 193–210. <https://doi.org/10.1080/09537287.2020.1810756>
- Wong, L.-W., L.-Y. Leong, J.-J. Hew, G. W.-H. Tan, and K.-B. Ooi. 2020. "Time to Seize the Digital Evolution: Adoption of Blockchain in Operations and Supply Chain Management among Malaysian SMEs." *International Journal of Information Management* 52: 101997. <https://doi.org/10.1016/j.ijinfomgt.2019.08.005>
- Xu, X., and Y. He. 2022. "Blockchain Application in Modern Logistics Information Sharing: A Review and Case Study Analysis." *Production Planning & Control* 1–15. Advance online publication. <https://doi.org/10.1080/09537287.2022.2058997>
- Yin, R. K. 2018. *Case Study Research and Applications: Design and Methods*. Thousand Oaks, CA: Sage Publications.
- Yıldırım, D. Ç., S. Yıldırım, S. H. Bostancı, and T. Turan. 2022. "The Nexus between Human Development and Fishing Footprint among Mediterranean Countries." *Marine Pollution Bulletin* 176: 113426. <https://doi.org/10.1016/j.marpolbul.2022.113426>
- Zhang, J., X. Zhang, W. Liu, M. Ji, and A. R. Mishra. 2022. "Critical Success Factors of Blockchain Technology to Implement the Sustainable Supply Chain Using an Extended Decision-Making Approach." *Technological Forecasting and Social Change* 182: 121881. <https://doi.org/10.1016/j.techfore.2022.121881>
- Zhang, Y., L. Chen, M. Battino, M. A. Farag, J. Xiao, J. Simal-Gandara, H. Gao, and W. Jiang. 2022. "Blockchain: An Emerging Novel Technology to Upgrade the Current Fresh Fruit Supply Chain." *Trends in Food Science & Technology* 124: 1–12. <https://doi.org/10.1016/j.tifs.2022.03.030>
- Zhu, Q., C. Bai, and J. Sarkis. 2022. "Blockchain Technology and Supply Chains: The Paradox of the Atheoretical Research Discourse." *Transportation Research Part E: Logistics and Transportation Review* 164: 102824. <https://doi.org/10.1016/j.tre.2022.102824>