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Analysis of Implementation Barriers to Logistics Systems Integration for Omni-Channel Retailing using an Integrated ISM-Fuzzy MICMAC Approach

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ABSTRACT

Integrating logistics across channels is crucial to omni-channel (OC) retailing success. OC retailers need to re-examine current logistics strategies to adapt them to OC systems. Implementing OC logistics in retail necessitates the integration of various sub-dimensions within the logistics domain while considering technical, managerial, behavioural, and infrastructure restrictions. Logistics integration is challenging in the OC retailing environment due to the unstructured approach. The purpose of this study is to identify and prioritise barriers to OC logistics in retail, as well as to provide a framework for managing their systematic elimination. A review of the literature and expert opinion revealed twenty-six impediments. Using Fuzzy Interpretative Structural Modelling (FISM), the researchers developed a hierarchical model of the barriers. Following that, a Fuzzy Matrice d'Impacts croises-multiplication applique (FMICMAC) analysis of the barriers helped determine the relative efficacy of the barriers in causing impediment. The study contributes to the growing body of knowledge on OC retailing by resolving the logistics integration issues that impede effective OC logistics implementation. The article fills a substantial void in the literature by developing a structured framework for comprehending and prioritising the logistical problems associated with OC logistics deployment. Modelling the OC logistical barriers' interrelation offers a better understanding of their relationship dynamics, hence easing their gradual eradication. The findings contribute to OC literature by examining the critical logistics resources required for establishing OC logistics, an area of OC retailing literature that has received disproportionate attention. The study contributes to the OC literature by identifying 'soft' resources that contribute to the development of logistics capabilities. The findings fill a significant vacuum in the literature on OC logistics by examining the intricate link between the tangible and intangible logistics resources required for improving logistics capabilities.

Keywords: *barrier, integration, logistics, omni-channel, retailing*

1. INTRODUCTION

Retailers have traditionally used multiple channels (MC) to make effective responses, create valuable experiences, build strong relationships, and deliver better value propositions to their customers (Cao and Li, 2015; Eriksson *et al*., 2022; Mishra *et al*., 2021; Neslin and Shankar, 2009; Zhang *et al*., 2010). However, current advancements in mobile technologies, digitisation, e-commerce growth, and rising customer expectations are compelling retailers to rethink their MC strategies (Adivar *et al*., 2019; Cao, 2014; Ishfaq *et al*., 2016; Piotrowicz and Cuthbertson, 2014; Prassida and Hsu, 2022).

Customer expectations for a smooth experience and blurring the lines between online and physical channels necessitated their integration (Brynjolfsson *et al*., 2013; Gao and Huang, 2021; Rigby, 2011; Yumurtacı Hüseyinolu *et al*., 2018; Chen *et al*., 2022). This emerging paradigm, termed OC retailing (Galipolu *et al*., 2018; Melacini *et al*., 2018; Picot-Coupey *et al*., 2016; Davis-Sramek *et al*., 2020), enables customers to connect with retailers while retailers maintain control of the customer journey across channels via targeted activities (Beck and Rygl, 2015; Verhoef *et al*., 2015). Transitioning to an OC retailing model via cross-channel integration entails not only the adoption and utilisation of disruptive technologies (Zhang *et al*., 2010) but also the development, synchronisation, redesign, and alignment of explicit cross-channel strategies across diverse functional domains such as marketing, communication, organisation, information systems, human resources, and logistics (Hubner *et al*., 2016a; Hubner *et al*., 2016c; Manser Payne *et al*., 2017; Picot-Coupey *et al*., 2016; Piotrowicz and Cuthbertson, 2014).

With online retail pushing retail transactions from the store to the customer's doorstep, logistics is becoming the new frontline for retail strategies (Hubner *et al*., 2016c). Several OC studies claim that the success of OC strategy depends on effective synchronisation and integration of logistics systems across channels (Ailawadi and Farris, 2017; Bell *et al*., 2014; Brynjolfsson *et al*., 2013; Hossain *et al*., 2019; Hubner *et al*., 2016c; Murfield *et al*., 2017; Verhoef *et al*., 2015; Wollenburg *et al*., 2018). Several studies have demonstrated that logistical integration capabilities help OC retailers thrive in a dynamically changing environment (Eriksson *et al*., 2022; Yumurtacı Hüseyinolu, 2017).

There is a lack of research on assessment frameworks and strategies from an operations and logistic integration perspective (Brynjolfsson *et al*., 2013; Verhoef *et al*., 2015; Hübner *et al*., 2016a; Hübner *et al*., 2022; Galipolu *et al*., 2018). Further, critical capabilities that enable logistical integration are not well defined (Kozlenkova *et al*., 2015; Hübner *et al*., 2016b; Jeanpert *et al*., 2016; Yumurtacı Hüseyinolu *et al*., 2018). Furthermore, the dearth of a working action plan, along with considerable cost overrun risks, has caused some OC retailers to be wary of implementing OC logistics (Wiener *et al*., 2018; Song *et al*., 2019).

Logistics integration is challenging in the OC retailing environment due to the unstructured approach. Retailers must also adapt their technological, IT, managerial, and behavioural systems to the new trends (Bijmolt *et al*., 2021; Kembro *et al*., 2018; Momen and Torabi, 2021; Wollenburg *et al*., 2018; Song *et al*., 2021). OC logistics systems also overlap with other functional domains, complicating integration. Despite the significant impact of OC logistics on firm performance, understanding this phenomenon is limited (Murfield *et al*., 2017; Prassida and Hsu, 2022). Most prior studies on OC logistics integration have focused on conceptual frameworks, hypotheses on crucial factors involved, and qualitative distinctions between discrete and integrated logistics systems (e.g., Ishfaq *et al*., 2016; Kembro *et al*., 2018; Hübner *et al*., 2016b; Risberg, 2022). While previous research has focused on specific logistics issues (e.g., Buldeo Rai *et al*., 2019; Larke *et al*., 2018; Zhang *et al*., 2018), there has been a limited effort to examine a broader set of logistics barriers preventing the implementation of OC logistics (Jocevski *et al*., 2019; Hübner *et al*., 2016c; Song *et al*., 2019). Further, the OC literature lacks credible insights into the implementation methodologies for integrated logistics systems. Furthermore, OC literature also fails to offer a deep understanding of the interactions between the impediments to OC logistical adoption (Lin *et al*., 2022; Mirzabeiki and Saghiri, 2020).

Despite the recent heightened attention in OC logistics, most studies have focused on developed markets, such as the USA (Adivar *et al*., 2019; Cao and Li, 2015; Ishfaq *et al*., 2016) and Europe (Hübner *et al*., 2016a; Hübner *et al*., 2016b; Jocevski *et al*., 2019; Marchet *et al*., 2018). A few recent studies have been on OC retailing in emerging markets, such as China (Song *et al*., 2019; Ye *et al*., 2018). Considering the rapid rise of e-commerce and OC retailing in emerging markets such as China (PwC, 2017) and India (Standard, 2016; Mishra *et al*., 2021), there is a growing need to investigate and examine the impediments to OC logistics in these areas.

The research contributes to OC research in several ways. Firstly, the study is an early attempt to conceptualise OC logistics barriers holistically. The study adds to the increasing literature on OC retailing by stabilising the logistics integration challenges that limit effective OC logistics implementation. It provides a comprehensive understanding of the role and impact of the obstacles hindering OC logistics systems' performance, offering more specific means to deal with them.

Second, the study contributes to the body of knowledge on OC retailing by filling a significant gap regarding the lack of a systematic approach for implementing OC logistical systems. The work contributes by establishing a precise structure for comprehending the contextual linkages of the barriers. Through a structured approach, modelling the interdependence of the OC logistical hurdles enables a better understanding of their relationship dynamics, hence facilitating their progressive eradication.

Third, the study is novel. It applies a multi-criteria decision-making (MCDM) technique to model the interactions between the barriers, as there is a dearth of MCDM studies in the OC literature. The integrated MCDM-based methodology considers the OC logistical constraints to examine their hierarchical linkages and interdependence.

Fourth, the study setting was India, a crucial rising market and one of the world's fastest expanding. India is emerging as a leading global retail investment destination, akin to Brazil, China, Malaysia, Mexico, and Indonesia. Earlier OC research focused on developed markets, leaving emerging economies with a dearth of empirical studies. A growing middle-class millennial population and increasing physical retail use of e-commerce and m-commerce make India an essential backdrop for expanding OC retailing research. An MCDM approach for modelling OC in a developing market like India adds to the OC literature.

Fifth, the findings contribute to OC literature by examining the critical logistics resources required for establishing OC logistics, an area of OC retailing literature that has received disproportionate attention. Additionally, the study contributes to the literature by identifying 'soft' resources that contribute to the development of logistics capabilities. Similarly, the findings fill a significant vacuum in the literature on OC logistics by examining the intricate link between the tangible and intangible logistics resources required for improving logistics capabilities. Most of the past research has focused on specific resources and functions.

2. LITERATURE REVIEW

2.1 Role of Logistics Integration in OC Strategy

OC logistics focuses on integrating numerous cross-channel logistics service elements, allowing retailers to coordinate their logistical processes for consumer interaction (Lee *et al*., 2018), customer steering (Wollenburg *et al*., 2018), and holistic service experience delivery (Verhoef *et al*., 2015). The importance of OC logistics in cross-channel synchronisation has pushed it to the forefront of OC strategy (Galipolu *et al*., 2018; Timoumi *et al*., 2022). Although previous studies in the OC literature have addressed various aspects of integrating logistics systems across channels, there is still a lack of consistency in specific tactical techniques and building blocks for establishing successful and efficient OC logistics systems (Saghiri *et al*., 2017).

Logistics service quality (LSQ) is emerging as a significant driver for developing OC capability (Solem *et al*., 2022; Uvet, 2020; Yumurtacı Hüseyinolu *et al*., 2017). Logistic services enable retailers to initiate and regulate personal and non-personal interactions with their customers (Ieva and Zilani, 2018; Larke *et al*., 2018; Mou, 2022). Similarly, it provides customers with various ways to manage their shopping journey. In OC retail, the goal is to create and manage a consistent customer experience by integrating consumer touchpoints (Larke *et al*., 2018). Integrating logistics-related touchpoints enhance organisations ability to influence consumers' purchase decisions, segment customers, offer personalised services and deliver holistic service experience (Ieva and Zilani, 2018; Larke *et al*., 2018; Lee *et al*., 2018; Park and Kim, 2022; Verhoef *et al*., 2015; Wollenburg *et al*., 2018).

Integrating cross-channel logistics systems creates opportunities for synergy, competitive advantage, improved performance and profitability (Herhausen *et al*., 2015; Hossain *et al*., 2019; Mirzabeiki and Saghiri, 2020; Msimangira and Venkatraman, 2014). Effective cross-channel logistics integration enhances overall firm capabilities, helping the transformation to OC retailing. **Table 1** shows OC logistical aspects supporting OC strategy.

Table 1 OC logistics aspects supporting OC strategy

Omni-channel strategy enablers/attributes	Logistics integration attributes	Reference
Enhance customer shopping value	Increased breadth of channel service configuration, transparency, flexible product delivery options, flexible return options, broader assortment selection, Consistent service across channels, Integrated and real-time information access across channels, delivery visibility, supply visibility, information consistency, process Consistency, service consistency.	Bell *et al.* (2014); Bernon *et al.* (2016); Brynjolfsson *et al.* (2013); Herhausen *et al.* (2015); Hossain *et al.* (2019); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Jocevski *et al.* (2019); Melacini *et al.* (2018); Murfield *et al.,* (2017); Picot-Coupey *et al.* (2016); Wollenburg *et al.* (2018); Saghiri *et al.* (2017); Zhang *et al.* (2018)
Enhance omni-channel channel integration capability	Integrated order fulfilment, inventory visibility, supply visibility, delivery visibility, integrated order management, integrated warehousing, integrated picking, integrated logistics infrastructure.	Ahsan and Rahman (2022); Bell *et al.* (2014); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Jocevski *et al.* (2019); Melacini *et al.* (2018); Murfield *et al.* (2017); Picot-Coupey *et al.* (2016); Saghiri *et al.* (2017); Taylor *et al.* (2019)
Enhance customer engagement capability	Increased breadth of channel service configuration, Integrated communication, LSQ, service consistency.	Bell *et al.* (2014); Hossain *et al.* (2019); Herhausen *et al.* (2015); Lee *et al.,* (2018); Murfield *et al.,* (2017); Picot-Coupey *et al.* (2016); Saghiri *et al.* (2017); Zhang *et al.* (2018); Taylor *et al.* (2019)
Enhance channel integration quality	Increased breadth of channel service configuration, transparency, consistent service across channels, Integrated and real-time information access across channels, integrated order fulfilment, delivery visibility, inventory visibility.	Bell *et al.* (2014); Gao and Huang (2021); Herhausen *et al.* (2015); Hossain *et al.* (2019); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Jocevski *et al.* (2019); Ishfaq *et al.* (2016); Lee *et al.* (2018); Saghiri *et al.* (2017); Taylor *et al.* (2019); Zhang *et al.* (2018)
Enhance omni- channel operational efficiency and cost reduction	Integrated order fulfilment, inventory visibility, supply visibility, integrated order management, integrated internal communication, organisational integration, Integrated warehousing, integrated picking, internal collaboration, interdepartmental interaction.	Bell *et al.* (2014); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Jones *et al.* (2022); Melacini *et al.* (2018); Taylor *et al.* (2019); Saghiri *et al.* (2017);
Enhance omni-channel operational effectiveness	Integrated order fulfilment, inventory visibility, supply visibility, integrated order management, increased logistics service quality, integrated logistics infrastructure, integrating stores as a material handling node, integrated assortment, integrated replenishment, integrating logistics service providers.	Bell *et al.* (2014); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Melacini *et al.* (2018); Taylor *et al.* (2019); Saghiri *et al.* (2017);
Enhance omni-channel responsiveness	Integrated network design, integrated distribution design, inventory visibility, supply visibility, integrated order management, integrated logistics infrastructure, integrating stores as a material handling node.	Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Melacini *et al.* (2018); Taylor *et al.* (2019); Saghiri *et al.* (2017);
Enhance customer service	Integrated interactions, integrated order fulfilment, delivery visibility, supply visibility, service consistency, logistics service quality (LSQ).	Herhausen *et al.* (2015); Hossain *et al.* (2019); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Jocevski *et al.* (2019); Lee *et al*., (2018); Melacini *et al.* (2018); Murfield *et al*., (2017); Picot-Coupey *et al.* (2016); Saghiri *et al.* (2017); Zhang *et al.* (2018)
Boost channel synergy and synchronisation	Integrated order fulfilment, inventory pooling, integrated logistics infrastructure, integrating stores as a material handling node, integrated assortment, integrated replenishment.	Bell *et al.* (2014); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Melacini *et al.* (2018); Park and Kim (2022); Saghiri *et al.* (2017);
Enhance omni-channel brand experience	Seamless shopping experience, information consistency, process consistency, service consistency, integrated order fulfilment.	Bell *et al.* (2014); Brynjolfsson *et al.* (2013); Hossain *et al.* (2019); Jocevski *et al.* (2019); Lee at al., (2018); Melacini *et al.* (2018); Murfield *et al.* (2017); Picot-Coupey *et al.* (2016); Saghiri *et al.* (2017); Zhang *et al.* (2018)
Improve service competitiveness	Flexible order fulfilment, flexible return options, logistics service quality, integrating logistics service providers, channel integration quality.	Bell *et al.* (2014); Bernon *et al.* (2016); Hossain *et al.* (2019); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Picot-Coupey *et al.* (2016); Saghiri *et al.* (2017); Zhang *et al.* (2018)
Infuse innovation/differentiation	Integrated interactions, innovative distribution channels, innovative last mile delivery options.	Cao and Li (2015); Saghiri *et al.* (2017); Zhang *et al.* (2018)

Table 2 OC logistics aspects supporting OC strategy (con't)

Omni-channel strategy enablers/attributes	Logistics integration attributes	Reference
Enhance supply chain integration	Integrated order fulfilment, integrated return options, integrating logistics service providers integrating stores as a material handling node, Integrated assortment, Integrated replenishment.	Hübner *et al.* (2016a); Hübner *et al.* (2016c); Saghiri *et al.* (2017); Song *et al.* (2019)
Enhance supply chain efficiency and effectiveness	Integrated and real-time information access across channels, deliver visibility, supply visibility, inventory visibility, Information consistency, process consistency; integrated order management, integrated warehousing, integrated picking, Integrated logistics infrastructure	Hübner *et al.* (2016a); Hübner *et al.* (2016c); Saghiri *et al.* (2017); Song *et al.* (2019);

2.2 Logistics Integration in OC Retailing

OC logistics is a successful strategy for delivering a seamless shopping experience (Cao, 2014; Davis-Sramek *et al*., 2020; Lewis *et al*., 2015; Murfield *et al*., 2017). Previous research on OC logistics integration identified and explored several problems in integrating the logistics systems of different channels (e.g., Difrancesco *et al*., 2021; Ishfaq *et al*., 2016; Hubner *et al*., 2016a; Hübner *et al*., 2022). However, instead of addressing the emerging challenges for designing and configuring integrated cross channel logistics networks, most studies focus on isolated logistics concerns of various logistic sub-systems (e.g., fulfilment, warehousing, distribution). Moreover, most research is qualitative and provide conceptual frameworks for addressing logistics integration issues (Chopra, 2018; Song *et al*., 2019). Several scholars advocated for additional quantitative research on OC logistics integration (Mishra *et al*., 2021; Mou, 2022). While earlier research used quantitative methods to explore various elements of OC logistics (e.g., Murfield *et al*.,2017; Melacini and Tapia, 2018; Momen and Torabi, 2021; Song *et al*.,2019), the focus of these studies was not on managing the transition to OC logistics.

Implementing OC logistics entails combining several channel logistics sub-systems into a single cross-channel system (Hübner *et al*., 2015). Rarely studied in OC logistics integration is designing and developing integrated cross-channel logistics systems. For example, Ashworth *et al*. (2006) are among the first research to propose a paradigm for aiding an OC-based business model shift. Hübner *et al*. (2016c) are a few studies that looked at integrated fulfilment solutions for merchants transitioning from MC to OC. Song *et al*. (2019) examine the impact of logistics integration capabilities on performance in the transition to OC logistics. However, OC retailing literature lacks the needed linkages to examine the progression from multi-channel to OC logistics systems and their development processes (Galipolu *et al*., 2018). **Table 2** summarises critical studies on OC logistics and their development stages.

Table 3 Summary of studies **o**n OC logistics themes

Study	Research Methodology	Logistics integration themes addressed
Swaminathan and Tayur (2003)	Literature review	Supply chain issues in e-business
Alptekinoglu and Tang (2005)	Analytical Modelling	Multi-channel distribution policy
Agatz *et al*. (2008)	Literature review	Supply chain issues in e-fulfilment in multi-channels
Lewis *et al*. (2014)	Qualitative	Technology issues
Hübner *et al*. (2015)	Qualitative	Operations Planning
Bernon *et al*. (2016)	Mixed-Method	Returns Management
Hübner *et al*. (2016a)	Qualitative	Distribution Systems
Hubner *et al*. (2016b)	Qualitative	Last mile fulfilment
Hübner *et al*. (2016c)	Qualitative	Fulfilment and distribution
Ishfaq *et al*. (2016)	Mixed method	Physical distribution
Hübner (2017)	Qualitative	Assortment Planning
Golipoglu *et al*. (2018)	Mixed method	Intellectual foundation of on omni-channel logistics
Kembro *et al*. (2018)	Literature review	Warehouse operations and design
Melacini *et al*. (2018)	Literature review	e-fulfilment and distribution
Marchet *et al*. (2018)	Mixed method	Restructuring business logistics models
Wollenberg *et al*. (2018)	Mixed method	Fulfilment
Adivar *et al*. (2019)	Mixed Method	Performance management
Jocevski, *et al*. (2019)	Qualitative	Business Models
Kembro and Norman (2019)	Case study	Logistics information systems
Saghiri *et al*. (2019)	Qualitative	Framework for implementing OC systems
Song *et al*. (2019)	Mixed Method	Logistics Integration
Taylor *et al*. (2019)	Literature	Fulfilment

Table 4 Summary of studies **o**n OC logistics themes (con't)

Study	Research Methodology	Logistics integration themes addressed
Ye *et al.* (2018)	**Case study**	**Drivers and barriers of OC**
Buldeo Rai *et al.* (2019)	Qualitative	Logistics Outsourcing
Davis-Sramek *et al.* (2020)	Quantitative	Omni-Channel fulfilment
Bayram and Cesaret (2021)	Quantitative	Omni-Channel order fulfilment
Difrancesco *et al.* (2021)	Quantitative	Omni-Channel order fulfilment
Eriksson *et al.* (2022)	Mixed Method	OC logistics in grocery retail
Hübner *et al.* (2022)	Literature review	Integration of retail stores
Lin *et al.* (2022)	Quantitative	Omni-channel facility location
Davis-Sramek *et al.* (2020)	Quantitative	Omni-Channel fulfilment

2.3 Challenges in Implementing OC Logistics

OC retailers face numerous hurdles in structuring their logistical systems for OC selling. Not all these challenges pertain to the retail macro-environment (e.g., digitisation, changing consumer behaviour) (Momen and Torabi, 2022; Piotrowicz and Cuthbertson, 2014) or are confined to the operations and logistics domain (Hubner *et al*., 2016a; Kembro *et al*., 2018; Melacini *et al*., 2018; Murfield *et al*., 2017; Kembro and Norman, 2019). Implementing OC logistics entails overcoming several obstacles, including the organisational systems and structure (Picot-Coupey *et al*., 2016), infrastructure (Melacini *et al*., 2018), strategic planning (Hubner *et al*., 2016b), IT systems (Cao and Li, 2015; Piotrowicz and Cuthbertson, 2014), technology (Melacini *et al*., 2018), human resource (Larke *et al*., 2018; Lewis *et al*., 2014) and performance management systems (Adivar *et al*., 2019). Despite rising interest in OC logistics, there is very little research on the problems of integrating OC logistics across channels (Cao and Li, 2015; Hübner *et al*., 2016a; Prassida and Hsu, 2022). Numerous researchers in the field of multi-channel research have emphasised the critical importance of examining the integration of online and offline channels, with a particular emphasis on the challenges experienced in developing cross-channel logistics systems (Bell *et al*., 2014; Bijmolt *et al*., 2021; Das *et al*., 2020; Hübner *et al*., 2016c; Picot- Coupey *et al*., 2016). Because of the operational ramifications, complexities, and performance assessment issues of cross-channel logistics systems, this particular focus has attracted limited attention in OC logistics research to date (Davis-Sramek *et al*., 2020; Eriksson *et al*., 2022; Kozlenkova *et al*., 2015). The authors of this study argue an urgent need to investigate the logistic integration constraints affecting the shift to OC logistics.

2.4 Research Gap

Deployment of an integrated OC logistics system requires addressing different dimensions and sub-systems within the logistics domain. While prior research on OC logistics integration challenges focused on individual logistical elements, most strategies and decisions in practice rely on holistic assessment and diagnosis based on a combination of parameters representing the system dynamics. This paradigm promotes systems thinking, as compartmentalised research loses relevance in dynamic environments. Thus, a systems approach is required to address the OC logistics implementation issues, accumulating evidence-based knowledge from past literature and practice, enabling a holistic analysis of the OC logistics integration hurdles. Moreover, the systematic categorisation of logistics integration hurdles might help design methodical interventions to remove them.

Striking for breakthrough improvements by removing barriers may cause significant delays in the OC logistics transition process. Instead, a top-down, multi-phased approach can produce significant and appealing results. Previous OC logistics research has failed to provide practical insight into the complicated interrelationships of these barriers. Thus, detailed comprehension of the contextual relationships between the barriers will pave the way towards their systematic removal.

Furthermore, without a structured approach, implementing OC logistics may be complicated. Due to a dearth of implementation strategies, OC retailers and professionals find themselves in the dark. A practical, evidence-based implementation strategy can help OC retailers identify and remove barriers methodically.

3. RESEARCH METHODOLOGY

Recent years have seen increased MCDM methods to decipher complex organisational decision-making problems. MCDM approaches are also widely used in business research because of their inherent ability to simultaneously consider multiple criteria and interactions. The proposed methodology employs ISM and Fuzzy MICMAC approaches in four stages. The first stage entails identifying OC logistics integration constraints based on earlier OC literature. The ISM technique builds a hierarchical model based on contextual interactions in the second stage. The barriers are classified in the third stage using fuzzy MICMAC analysis based on mutual influence and dependence. The final stage establishes the hierarchical integrated model. **Figure 1** illustrates the fundamental steps, and the following sections discuss the methodology used in the study.

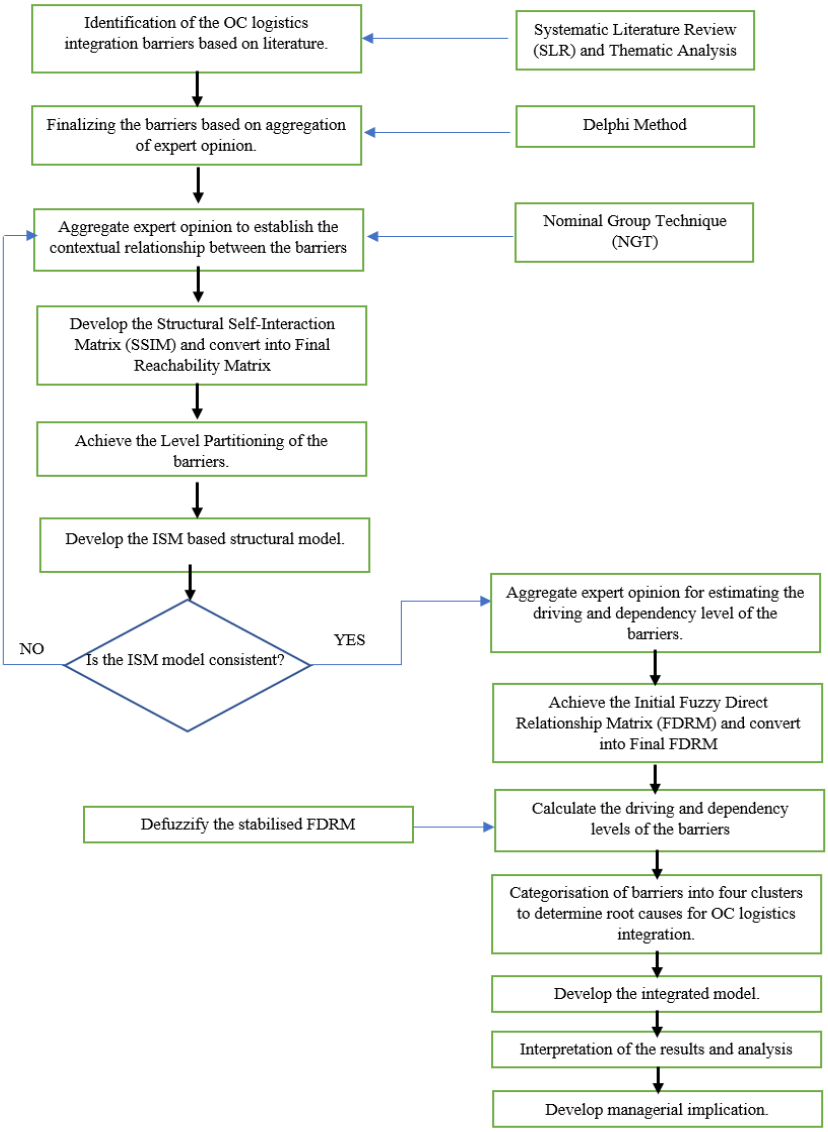

Figure 1 Conceptual diagram of the methodology

3.1 Identification of OC Logistics Barriers

The study defines barriers as limitations that prevent OC retailers from establishing or strengthening their logistics system integration. The current study used a systematic literature review (SLR) to detect OC logistical bottlenecks. SLR was chosen because it fulfils study objectives systematically, openly, and reproducibly (Liberati *et al.*, 2009). The steps of SLR are drawn from past research and are summarised here (Briner and Denyer, 2012; Snyder, 2019):

Step 1: Identify the research question: Section 2 elaborates on the research question in the present study.

Step 2: Develop a review protocol: As part of the proposed methodology, a preliminary search strategy was built by analysing all known literature on channel integration. These publications included literature reviews, quantitative research, qualitative research, case studies, books, conference papers, and grey literature. The literature analysis retrieved the terminology used to characterise OC logistical activities and implementation strategies. The current study used Briner and Deyner's (2012) context-intervention-mechanism-outcome (CIMO) approach for the search strings and final exclusion criteria. The search strings comprised of (channel), (multi), (cross), (Omni), (barrier), (failure), (obstacle), (challenge), (lack of), (pitfall), (integration), (interaction), (implementation), (execution), (strategy), (approach), (framework), (retail/ing), (migration), (industry), (business), (commerce), (logistics) etc., involving their plurals forms, delimiters, prefixes, suffixes, and their combinations using Boolean operators. ABI/INFORM, Business Source Ultimate (EBSCO), Emerald, Inderscience, JSTOR, Mendeley, ScienceDirect, Scopus (Elsevier), SpringerLink, Taylor & Francis, Wiley, and Sage were all consulted. The Google Scholar and Web of Science databases also enabled broader searches and cross-referencing. Keyword searches and cross-referencing helped identify additional relevant articles (Briner and Deyner, 2012).

Step 3: Identify and evaluate the selected studies: The proposed methodology used only electronic databases and peer-reviewed academic papers to provide greater transparency and replicability of the search process and outcomes. Further, to improve upon the quality of the identified studies, only those studies published in peer-reviewed journals and included in either of the major academic journal rankings lists: JCR-Clarivate Analytics, Academic Journal Guide/ABS (UK), ABDC Journal Quality List, and SCIMago Journal Rank (SJR), were selected for final evaluation.

Following the search protocol and removing studies that did not match the quality criteria, a total of 253 publications were selected. Purposive sampling was employed to identify publications for in-depth study, commencing with reviews of the OC retailing literature. Because the review's purpose was to comprehend the OC logistics hurdles comprehensively, articles selected for detailed reading established, analysed, and applied models or theories to explain all or a portion of the OC logistics systems. Studies selected for detailed reading examined 'generic' barriers without explicitly referencing any retailing, industrial, or geographic setting. Finally, seventy-three papers for final analysis explored the barriers to integration/migration of various OC logistical operations and dealt with multi-, cross-, and OC-retailing domains.

Step 4: Extract and synthesise data: Many methods for synthesising qualitative research exist in the literature. The present study used thematic analysis to find, analyse, organise, describe, and report themes within a data set using a standardised and systematic process, resulting in meaningful and relevant results (Braun and Clarke, 2006). The steps of thematic analysis are all adapted from earlier research (Braun and Clarke, 2006; Nowell *et al*., 2017). The qualitative data analysis programme Nvivo (1.0) from QSR International was used to conduct the thematic analysis.

The thematic analysis identified twenty-six OC logistics integration hurdles. Notably, some of the OC obstacles identified through a thematic analysis were obscure in the OC literature and necessitated separate examination. The content validity of descriptive themes from the literature was established using an iterative multi-level approach. First, three prominent OC retailing specialists in India's logistics domain were questioned independently to assess the descriptive themes' relevance and representativeness for inclusion in the instrument intended to measure OC logistics hurdles. The effectiveness of the barriers was then assessed using the Mahajan *et al*. (1976) Delphi approach. The Delphi method was applied in three steps. The questionnaire was distributed to the specialists from the chosen case study firms. The first section of the three-part questionnaire had a brief introduction and a request for basic personal information. The second section of the questionnaire explained the 26 impediments found in the literature review. The expert panel rated the hurdles' suitability on a scale of 1 to 5, with one being the least significant and five being the most. The expert opinion was compiled using the Relative Importance Index (RII) (Johnson and Lebreton, 2004). Finally, experts are asked to identify any remaining themes or barriers. The findings were summarised after expert input. The second stage was to look for obstacles with RRI values above 0.6. The experts did not find any new themes, although they did recommend several changes to the existing ones.

The survey questionnaire was re-administered to the specialists from the chosen case study firms for the second phase of the Delphi procedure. The experts were supplied with their rating, RRI ratings for specific barriers and suggestions for changes to the barrier themes, with the option to amend their assessment. The second phase of the Delphi process accepted all the previous stage's hurdles. Again, some ideas were put up to alter the barrier themes.

The Delphi method's third phase included repeating the steps of the second phase with the same expert group to confirm the results' dependability and validity. During this phase, all specialists reached a consensus. The Delphi process ensured that the new emergent themes attained a higher degree of abstraction, encompassing and explaining all the initial captured topics and inferred obstacles. **Table 3** summarises the identified barriers of omni-channel logistics integration.

Table 3. Summary of omni-channel logistics integration barriers

S. No	Barriers	Literature Support
1.	Lack of senior leadership commitment (C1)	Zhang *et al.* (2010); Bernon *et al.* (2013); Cao (2014); Lewis *et al.* (2014); Picot-Coupey *et al.* (2016); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Wollenburg *et al.* (2018); Ye *et al.* (2018).
2.	Financial Constraint/Cost Implications (C2)	Zhang *et al.* (2010); Bernon *et al.* (2013); Cao (2014); Picot-Coupey *et al.* (2016); Hübner *et al.* (2016b); Kembo *et al.* (2018).
3.	Ineffective internal integration (C3)	Agatz *et al.* (2008); Zhang *et al.* (2010); Bernon *et al.* (2013); Cao (2014); Cao and Li (2015); Hübner at al. (2016a); Wollenburg *et al.* (2018); Melacini *et al.* (2018); Song *et al.* (2019).
4.	Lack of SC orientation (C4)	Zhang *et al.* (2010); Kembo *et al.* (2018); Wollenburg *et al.* (2018); Melacini *et al.* (2018); Song *et al.* (2019).
5.	Lack of competencies and capabilities for OC Logistics (C5)	Oh *et al.* (2012); Gallino and Moreno (2014); Cao and Li (2015); Hübner *et al.* (2016c); Bernon *et al.* (2016); Ishfaq *et al.* (2016);Wollenburg *et al.* (2018); Davis-Sramek *et al.* *(*2020).
6.	Channel specific company goals and reward systems (C6)	Zhang *et al.* (2010); Bernon *et al.* (2013); Cao (2014); Lewis *et al.* (2014); Herhausen *et al.* (2015); Wollenburg *et al.* (2018); Zhang *et al.* (2018); Ye *et al.* (2018);
7.	Inadequate IT infrastructure and integration (C7)	Oh *et al.* (2012); Bernon *et al.* (2013); Cao (2014); Gallino and Moreno (2014); Piotrowicz and Cuthbertson (2014); Kembo *et al.* (2018); Wollenburg *et al.* (2018); Hossain *et al.* (2019); Song *et al.* (2019); Momen and Torabi (2021); Saghiri and Mirzabeiki (2021).
8.	Resistance to change and unsupportive 'teamwork culture'(C8)	Bernon *et al.* (2013); Cao (2014); Cao and Li (2015); Hübner *et al.* (2016c); Picot-Coupey *et al.* (2016); Lewis *et al.* (2014); Wollenburg *et al.* (2018); Ye *et al.* (2018); Song *et al.* (2019); Song *et al.* (2022).

Table 3. Summary of omni-channel logistics integration barriers (con't)

S. No	Barriers	Literature Support
9.	Lack of 'integrated sales and operation planning' (C9)	Agatz *et al.* 2008); Hübner *et al.* (2013); Bernon *et al.* (2013); Gallino and Moreno (2014); Wollenburg *et al.* (2018); Larke *et al.* (2018); Chopra (2018); Melacini *et al.* (2018); Hossain *et al.* (2019); Difrancesco *et al.* (2021).
10.	Siloed organizational structure (C10)	Neslin and Shankar (2009); Zhang *et al.* (2010); Rigby (2011); Bernon *et al.* (2013); Lewis *et al.* (2014); Gallino and Moreno (2014); Cao (2014); Cao and Li (2105); Hübner *et al.* (2016c); Picot-Coupey *et al.* (2016); Wollenburg *et al.* (2018); Melacini *et al.* (2018); Song *et al.* (2022).
11.	Lack of training in OC skills (C11)	Zhang *et al.* (2010); Cao (2014); Lewis *et al.* (2014); Beck and Rygl (2015) Hübner *et al.* (2016a); Wollenburg *et al.* (2018); Kembo *et al.* (2018) ; Song *et al.* (2022).
12.	Inconsistent and Ineffective performance measurement and control over physical distribution (C12)	Zhang *et al.* (2010); Hübner *et al.* (2015); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Ailawadi and Farris (2017); Adivar *et al.* (2019); Ahsan and Rahman (2022).
13.	Ineffective Total cycle time management (C13)	Bernon *et al.* (2013); Cao (2014); Gallino and Moreno (2014); Bernon *et al.* (2016); Hübner *et al.* (2016b); Hübner *et al.* (2016a); Marchet *et al.* (2018); Kembo *et al.* (2018).
14.	Un-optimized Network Design Structure (C14)	Alptekinoglu and Tang, 2005; Agatz *et al.* (2008); Cao (2014); Hübner *et al.* (2013); Hübner *et al.* (2015); Hübner (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Ailawadi and Farris (2017); Wollenburg *et al.* (2018); Kembo *et al.* (2018).; Melacini *et al.* (2018);
15.	Poor quality of human resources (C15)	Oh *et al.* (2012); Picot-Coupey *et al.* (2016); Wollenburg *et al.* (2018); Ye *et al.* (2018).
16.	Ineffective cross-channel demand management and customer service capability (C16)	Neslin and Shankar (2009); Zhang *et al.* (2010); Oh *et al.* (2012); Bernon *et al.* (2013); Cao (2014); Gallino and Moreno (2014); Cao and Li (2015); Herhausen *et al.* (2015); Hübner *et al.* (2015); Bernon *et al.* (2016); Hübner *et al.* (2016a); Saghiri *et al.* (2017); Wollenburg *et al.* (2018); Chopra (2018); Kembo *et al.* (2018); Adivar *et al.* (2019); Alexander (2019); Hossain *et al.* (2019); Bijmolt *et al.* (2021).
17.	Unoptimised and Unsynchronised replenishment and delivery schedules (C17)	Cao (2014); Herhausen *et al.* (2015); Hübner *et al.* (2015); Hübner *et al.* (2016c); Hübner *et al.* (2016a); Bernon *et al.* (2016); Wollenburg *et al.* (2018); Adivar *et al.* (2019).
18.	Ineffective Logistics network flexibility and responsiveness (C18)	Agatz *et al.* (2008); Gallino and Moreno (2014);Hübner *et al.* (2015); Bernon *et al.* (2016); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Wollenburg *et al.* (2018); Marchet *et al.* (2018); Kembro *et al.* (2018); Adivar *et al.* (2019
19.	Un-optimized and non-integrated 'material handling and physical flow' (C19)	Agatz *et al.* (2008); Hübner *et al.* (2013); Herhausen *et al.* (2015); Hübner *et al.* (2015); Bernon *et al.* (2016); Hübner *et al.* (2016a); Picot-Coupey *et al.* (2016); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Wollenburg *et al.* (2018); Melacini *et al.* (2018); Adivar *et al.* (2019); Hossain *et al.* (2019).
20.	Poor utilization and sharing of Logistics Infrastructure (C20)	Zhang *et al.* (2010); Hübner *et al.* (2015); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Saghiri *et al.* (2017); Wollenburg *et al.* (2018); Melacini *et al.* (2018); Ye *et al.* (2018); Hübner *et al.* (2022).
21.	Inability to differentiate product assortment across channels (C21)	Neslin and Shankar (2009); Zhang *et al.* (2010); Oh *et al.* (2012); Cao (2014); Hübner *et al.* (2016c); Marchet *et al.* (2018); Wollenburg *et al.* (2018); Chopra (2018); Adivar *et al.* (2019).
22.	Lack of trust and Ineffective 'collaborative communication' (C22)	Bernon *et al.* (2013); Cao (2014); Lewis *et al.* (2014); Herhausen *et al.* (2015); Wollenburg *et al.* (2018); Ye *et al.* (2018); Adivar *et al.* (2019); Hossain *et al.* (2019); Song *et al.* (2019).
23.	Unoptimized and Inflexible 'resource configuration capability '(C23)	Chopra (2018); Verhoef *et al.* (2015) ; Hübner *et al.* (2015); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Saghiri *et al.* (2017); Melacini *et al.* (2018); Wollenburg *et al.* (2018); Ye *et al.* (2018);Adivar *et al.* (2019); Lin *et al.* (2022).
24.	Ineffective Supplier and LSP Integration Capability across channels (C24)	Bernon *et al.* (2013); Piotrowicz and Cuthbertson (2014); Bernon *et al.* (2016); Ishfaq *et al.* (2016); Murfield *et al.* (2017); Marchet *et al.* (2018); Wollenburg *et al.* (2018); Adivar *et al.* (2019).
25.	Inconsistent SC Logistics operational performance (C25)	Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Wollenburg *et al.* (2018); Kembro *et al.* (2018); Melacini *et al.* (2018); Saghiri *et al.* (2017).
26.	Ineffective 'integrated inventory visibility' (C26)	Agatz *et al.* (2008); Zhang *et al.* (2010); Hübner *et al.* (2015); Verhoef *et al.* (2015); Hübner *et al.* (2016a); Hübner *et al.* (2016c); Ishfaq *et al.* (2016); Saghiri *et al.* (2017); Wollenburg *et al.* (2018); Melacini *et al.* (2018); Adivar *et al.* (2019); Hossain *et al.* (2019); Cui *et al.* (2021); Qu *et al.* (2022).

Step 5: Disseminate and use the result: The final list of twenty-six OC logistics hurdles is used to develop the hierarchal model using the ISM methodology.

3.2 ISM

Recently, several MCDM issues have been addressed using the ISM technique. Some selected applications of the ISM approach include lean manufacturing (Vinod *et al*., 2016), supply chain risk (Pfohl *et al*., 2011), world-class manufacturing practices (Haleem *et al*., 2012), risk prioritisation in supply networks (Hachicha and Elmsalmi, 2014), CPFR implementation (Panahifar *et al*., 2014), and TQM (Muruganantham *et al*., 2018). ISM is a sophisticated planning technique that finds contextual relationships between variables (Panahifar *et al*., 2014). The ISM approach use paired comparison in a structured manner to effectively organise complicated issues into tiered conceptual frameworks that highlight the variables' driving potential and dependencies (Vinod *et al*., 2016). The ISM approach helps break down fuzzy systems into sub-systems and highlights the most critical aspects (Vinod *et al*., 2016). The ISM approach finds contextual links by collecting expert subjective judgments. The ISM technique is also computationally efficient for ten to twenty-five variables (Muruganantham *et al*., 2018).

ISM is an interactive group learning method that employs words and diagraphs to organise and redirect mental schemas into visualisations of the representational system. In contrast to conventional models, ISM can deal with ordinal scales (Govindan *et al*., 2015). The ISM technique applies to MCDM problems in various domains warrants its use in this study. Using ISM, a thorough multi-level structural model of complicated OC logistics systems was deemed appropriate. The essential steps of the ISM technique are summarised below (Govindan *et al*., 2015; Kumar *et al*., 2016):

Step 1: Identify the variables: A comprehensive review of the literature identified the variables.

Step 2: Identify the experts: Experts from the identified case study firms helped finalise the identified barriers and establish the contextual relationship.

Step 3: Examine pairwise contextual relationship: Contextual linkages of the 'leads to' type between the obstacles are constructed using the consensus assessments of the decision team. The term 'leads to' refers to a relationship in which one variable leads to another. This principle was utilised to generate and establish contextual relationships (Kumar *et al*., 2016). The Nominal Group Technique (NGT) was used to obtain consensus judgments for the contextual relationships. The NGT was chosen for its ability to derive group consensus based on expert knowledge without the necessity of an extensive group (McMillan *et al*., 2016). An expert panel of twelve members from the case study firms was used to design the SSIM; however, prior research suggested three to five experts as sufficient (Kumar *et al*., 2016; McMillan *et al*., 2016). The NGT was implemented in several iterative rounds, and the aggregated compromise assessments are derived from the individual evaluations to represent the contextual interactions,

Step 4: Construct the SSIM matrix: The SSIM matrix was built by comparing the barriers pairwise (variables). The following symbols explain the link between ci and cj:

V-Barrier ci affects barrier cj

A-Barrier cj affects barrier ci

X- Barriers ci and cj are mutually reinforcing; and

O-Barriers ci and cj are unrelated.

Step 5: Develop the initial reachability matrix: The reachability matrix is generated by applying the following rules on the SSIM.

(a) If V is the aij element in the SSIM, the original reachability matrix member is replaced with one and the aji element with zero.

(b) If A is the aij element in the SSIM, the original reachability matrix member is replaced with zero and the aji element with one.

(c) If X is the aij element in the SSIM, the original reachability matrix member is replaced with one, and the aji element is replaced with one.

(d) If O is the aij element in the SSIM, the original reachability matrix member is replaced with zero and the aji element with one.

Step 6: Develop the final reachability matrix: Applying the transitivity rule to the initial reachability matrix generates the final reachability matrix. The transitivity rule states that if any element X has a relationship with Y and Y has a relationship with Z, then X necessarily must have a relationship with Z. Further, when aij is 0 (zero), there is no direct or indirect relationship between ci and cj in the final reachability matrix.

Step 7: Level partition the final reachability matrix: The reachability set, and the antecedent are derived from the final reachability matrix after level partitioning. The reachability set includes the hurdles and all others. The antecedent set includes the obstacles and roadblocks to achieving it. Top-level barriers are extracted using the reachability and antecedent sets on the intersection set operator. The top-level barriers are removed, and the process is repeated to find the next-level impediments. This process is repeated till the list is exhausted.

Step 8: Develop the directed graph (diagraph): The conical matrix develops the initial diagraph. The conical matrix is formed by rearranging the final reachability matrix by the levels obtained and includes the transitivity links. The final diagraph displays the relationship between barriers Ci and Cj using directed arrows.

Step 9: Determine the interpretive structural model: In the final diagraph, variables are replaced with statements to get the ISM model. The ISM model is then reviewed for theoretical and conceptual compatibility.

Step 10: Validate the interpretive structural model: The expert group evaluated the established ISM model. The review procedure was designed to identify and integrate conceptual discrepancies in the created ISM model. When there was conceptual inconsistency, the ISM model was compared to the resulting diagraph. The links were checked in the initial and final reachability matrices, and necessary modifications were made. The iterative process was repeated until the expert group approved the final model.

3.3 Fuzzy MICMAC

In complex systems, MICMAC analysis has become a preferred MCDM technique due to its ability to simulate the interrelationships between criteria. MICMAC analysis was used to understand the indirect and hidden interactions among the ISM-based logistic hurdles for the present study.

The justification for integrating MICMAC and ISM in this work is that MICMAC has a superior ability to capture diffusion effects via reaction paths and loops, which is necessary for developing the hierarchy of criteria indicators. Many MCDM applications use the integrated ISM-MICMAC approach (e.g., Panahifar *et al.*, 2014; Kumar *et al.*, 2016)

Ambiguity, uncertainty, vagueness, and indeterminacy are inherent aspects of real-world MCDM scenarios. However, the MICMAC technique has several inherent drawbacks in real-world applications (Gorane and Pant, 2013; Singh *et al.*, 2018). The current work uses fuzzy MICMAC to assess the interactions between OC logistics integration barriers, allowing researchers to capture more interaction possibilities. Fuzzy MICMAC measures the relevance of the criteria and the strength of the correlations. Fuzzy MICMAC applies the fuzzy theory to the classic MICMAC to examine each criterion driving force and reliance. Fuzzification boosts the sensitivity of the interactions by detecting low influences on the components that regular MICMAC analysis misses. Combining fuzzy MICMAC with ISM allows researchers to construct more complex interactions between criteria, which is not possible with ISM alone.

The steps of the Fuzzy MICMAC analysis are as follows (Gorane and Kant, 2013; Singh *et al.*, 2018):

Step 1. Identify experts: Professionals with relevant experience and knowledge identify interrelationships between OC logistical difficulties.

Step 2. Develop the binary direct relationship matrix (BDRM): After using Step 5 of the ISM approach and converting the diagonal entries to zero, the BDRM is obtained.

Step 3: Establish the evaluation's fuzzy scale: The fuzzy linguistic scale developed by Gorane and Kant (2013) is utilised in this work to replicate human thinking. **Table 4** shows the study's fuzzy linguistic scale.

Table 4. Fuzzy scale

Possibility of reachability	No	Negligible	Low	Medium	High	Very High	Full
Value	0	0.1	0.3	0.5	0.7	0.9	1.0

Step 4: Aggregate the decision maker's assessment and generate the initial FDRM: The linguistic judgements of each expert have been used to construct the initial fuzzy direct relationship matrix (FDRM). The decision-makers aggregation uses Khan and Haleem's (2015) proposed operation steps. By superimposing the possible values on the BDRM, the FDRM is initialised. The FDRM elements reflect the indirect linkages between the barriers and the aggregated possibility values acquired by aggregating the decision panel's preferences.

Step 5: Calculate the final FDRM: The final FDRM is obtained by raising FDRM's 〖(W〗 _α) to a suitably large power. This operation aids in achieving convergence and long-term stability of the initial FDRM. Individual barriers' driving power and dependency are calculated using the limit matrix's final FDRM, as shown in Eq. (1) (Gorane and Kant, 2013).

$$\lim_{k\to\infty} (\boldsymbol{W_{\alpha}})^k \quad (1)$$

Step 6: Determine the driving power and dependency of the barriers: The driving power of the individual barriers is computed by summating the row entries of the final FDRM. The dependence is calculated by summating the column entries.

Step 7: Determine the barrier categories: The categorisation of obstacles is primarily focused on their driving and dependency powers. The categorisation is achieved by applying the related operations based on Gorane and Kant (2013). Group-I comprises autonomous barriers with limited driving capability and a high degree of reliance. In contrast, Group-II comprises dependent barriers with limited driving capability but a high dependence. Group-III includes linking obstacles with a high driving force and a high degree of reliance. Group-IV includes the driving ones characterised by weak support but strong driving potential. The clustering of obstacles in the various groups helps analyse one barrier category's impact over the other or 'how' others influence a barrier category.

3.4 *Integrated Model development*

The steps for developing the integrated model are as follows (Khan and Haleem, 2015):

Step 1: Defuzzify the stabilised FDRM: The stable FDRM is defuzzified by adding row and column entries. The row aggregate values indicate the driving force, whereas the column represents individual barrier dependencies.

Step 2: Determine the effectiveness of the barrier: The force of the obstacles is determined using the crisp row and column sums. Deducting the driving force and the dependence yields the individual obstacle importance.

Step 3: Develop the hierarchical model: The hierarchical model is developed by positioning the barriers based on their effectiveness. The barriers with the highest efficacy scores are placed at the bottom of the hierarchical model. Low-effectiveness obstacles are put at the model's top, indicating their dependence on the barriers below.

3.5 *ISM and Fuzzy MICMAC*

ISM has been employed to solve numerous complicated decision-making situations in recent years. In current MCDM literature, ISM has been utilised in conjunction with MICMAC analysis to resolve complex problems (Pfohl *et al.*, 2011; Haleem *et al.*, 2012; Hachicha and Elmsalmi, 2014; Panahifar *et al.*, 2014; Muruganantham *et al.*, 2018). The present study's hybrid ISM and Fuzzy MICMAC approach use ISM to create the barriers' final reachability matrix, used to develop the MICMAC's initial FDRM. The fuzzy MICMAC technique then categorises OC logistics integration hurdles by driving power and dependency. Finally, the combined model is developed based on the efficacy of the barriers.

3.6 Data Collection

A selective multiple case study approach is utilised to collect data for exploring the contextual links between OC logistical barriers (Yin, 2014). For the research question, we picked retailing enterprises listed on the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) of India that provide well-established OC retailing services. The list also included non-listed businesses that were well-established OC retailers with national reach. The sample included well-established non-listed retailing enterprises, holding a considerable share of the Indian OC retailing sector. Initially, 36 retailing firms met the criteria and were invited to participate. The CEO (Chief executive officer) or senior manager in the Supply Chain/Logistics division was invited to participate in the study. Following initial contact with target firms, the case selection procedure selected twelve willing participants. The sample firms chosen are diverse in the present study, indicating an appropriate degree of firm-specific variability (Zikmund, 2000; Patton, 2002). During the research and reporting, a guarantee of total anonymity and secrecy was given to the participating case firms and contributing experts. **Table 5** summarises the expert participants and the sample firms.

Table 5 Summary of the specialists and the sample firm

#	Role	Years of experience in the company	Business Type	Ownership	Year of Establishment
1	Supply Chain Logistics Manager	7	Furniture and decoration	Private	2011
2	General Manager-Distribution and Logistics	5	Fashion and accessories	Private	2011
3	Director-Supply chain	15	Consumer Electronics	Public	1998
4	AVP-Supply chain and Logistics	8	Food and Grocery	Private	2011
5	Warehouse Manager	8	Sports Equipment	Private	2009
6	Director-Supply Chain	17	Jewellery	Public	1984
7	Head-Supply Chain	14	Apparel	Public	1925
8	Logistics Team Leader	20	Shoes	Public	1981
9	Senior Manager -Supply Chain	10	Kitchen and Glassware	Private	1962
10	Vice President-Supply chain and Logistics	14	Apparel (Raymond)	Public	2007
11	Director-Logistics	12	Household and consumer products	Public	2007
12	Regional Supply Chain Manager	6	Eyewear	Private	2010

4. DISCUSSION

The analysis of the data took place in two stages. In the first stage of the two-stage data analysis, ISM and Fuzzy MICMAC were utilised; an integrated model was constructed in the second stage. The following section discusses the study’s two-stage data analysis procedure.

4.1 Stage - I

The initial data analysis stage involved mapping the criteria’s relationships and developing the ISM approach’s hierarchical model. Expert opinion was used to finalise the factors found through an exhaustive literature review. The decision team’s judgments describe the contextual interactions between the barriers and build the self-interaction matrix for the structure (SSIM). Consensus assessments of contextual linkages were obtained using the NGT. The SSIM developed following Step 4 of the ISM technique is shown in **Table 6**.

Table 6 SSIM of barriers to logistics integration

Barri-er S. No	C1	C2	C3	C4	C5	C6	C7	C8	C9	C-10	C-11	C-12	C-13	C-14	C-15	C-16	C-17	C-18	C-19	C-20	C-21	C-22	C-23	C-24	C-25	C-26
C1	1	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
C2		1	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
C3			1	X	X	A	X	A	V	A	A	V	V	V	A	V	V	V	V	V	V	X	V	V	V	V
C4				1	X	A	X	A	V	A	A	V	V	V	A	V	V	V	V	V	V	X	V	V	V	V
C5					1	A	X	A	V	A	A	A	V	V	A	V	V	V	V	V	V	X	V	V	V	V
C6						1	V	X	V	X	X	V	V	V	X	V	V	V	V	V	V	V	V	V	V	V
C7							1	A	V	A	A	V	V	V	A	V	V	V	V	V	V	X	V	V	V	V
C8								1	V	X	X	V	V	V	X	V	V	V	V	V	V	V	V	V	V	V
C9									1	A	A	A	V	V	A	V	V	V	V	V	V	A	V	V	V	V
C10										1	X	V	V	V	X	V	V	V	V	V	V	V	V	V	V	V
C11											1	V	V	V	X	V	V	V	O	V	V	V	V	V	V	V
C12												1	A	A	A	V	V	V	A	V	A	V	V	V	V	V
C13													1	A	A	V	V	V	X	V	A	A	V	V	V	V
C14														1	A	V	V	V	V	V	X	A	V	V	V	V
C15															1	V	V	V	V	V	V	V	V	V	V	V
C16																1	A	V	A	A	A	A	X	X	V	A
C17																	1	V	A	X	A	A	V	V	V	X
C18																		1	A	A	A	A	A	A	V	A
C19																			1	V	A	A	V	V	V	V
C20																				1	A	A	V	V	V	X
C21																					1	A	V	V	V	V
C22																						1	V	V	V	V
C23																							1	X	V	A
C24																								1	V	A
C25																									1	A
C26																										1

The SSIM is converted to the initial reachability matrix using Step 5 of the ISM technique. The driving and dependency power of the barriers is shown in **Table 7** based on the final reachability matrix derived by applying Step 6 of the ISM approach. The potential of a barrier to affect other barriers is its driving force. Dependence power demonstrates the extent to which others influence it. A variable's driving power equals the sum of all its entries in a row and the dependence power equals the sum of all the entries in the columns of the final reachability matrix (Kumar *et al*., 2016).

Table 7 Driving power and dependency of the barriers based on final reachability matrix

S. No.	Barrier	Driving power	Dependency
1	C1	26	1
2	C2	25	2
3	C3	19	12
4	C4	19	12
5	C5	19	12
6	C6	24	7
7	C7	19	12
8	C8	24	7

Table 7 Driving power and dependency of the barriers based on final reachability matrix (con't)

S. No.	Barrier	Driving power	Dependency
9	C9	14	13
10	C10	24	7
11	C11	24	7
12	C12	9	18
13	C13	11	17
14	C14	13	15
15	C15	24	7
16	C16	5	24
17	C17	8	21
18	C18	2	25
19	C19	11	17
20	C20	8	21
21	C21	13	15
22	C22	19	12
23	C23	5	24
24	C24	5	24
25	C25	1	26
26	C26	8	21

The reachability matrices are level partitioned to develop the hierarchical order of the barriers. The level partitioning is implemented via Step 7 of the ISM approach, as shown in **Table 8**. Using Step 8 of the ISM technique, the initial directed graph (diagraph) is generated using the conical form of the initial reachability matrix. Using Step 9 of the ISM technique, **Figure 2** depicts the ISM model produced from the initial diagraph. A hierarchical structure devoid of cycles or feedback demonstrates the stability of the developed ISM model.

Table 8 Partitioning of barriers to logistics integration

Barrier S. No	Reachability set	Antecedent set	Intersection set	Level
C1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26	1	1	I
C2	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26	2	2	II
C3	3,4,5,7,9,12,13,14,16,17,18,19,20,21,22,23,24,25,26	1,2,3,4,5,6,7,8,10,11,15,22	3,4,5,7,22	IV
C4	3,4,5,7,9,12,13,14,16,17,18,19,20,21,22,23,24,25,26	1,2,3,4,5,6,7,8,10,11,15,22	3,4,5,7,22	IV
C5	3,4,5,7,9,12,13,14,16,17,18,19,20,21,22,23,24,25,26	1,2,3,4,5,6,7,8,10,11,15,22	3,4,5,7,22	IV
C6	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26	1,2,6,8,10,11,15	1,2,6,8,10,11,15	III
C7	3,4,5,7,9,12,13,14,16,17,18,19,20,21,22,23,24,25,26	1,2,3,4,5,6,7,8,10,11,15,22	3,4,5,7,22	IV
C8	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26	1,2,6,8,10,11,15	1,2,6,8,10,11,15	III
C9	9,12,13,14,16,17,18,19,20,21,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,15,22	9	V
C10	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26	1,2,6,8,10,11,15	1,2,6,8,10,11,15	III
C11	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26	1,2,6,8,10,11,15	1,2,6,8,10,11,15	III

Table 8 Partitioning of barriers to logistics integration (con't)

Barrier S. No	Reachability set	Antecedent set	Intersection set	Level
C12	12,16,17,18,20,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,21,22	12	VIII
C13	12,13,16,17,18,19,20,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,13,14,15,19,21,22	13,19	VII
C14	12,13,14,16,17,18,19,21,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,14,15,21,22		VI
C15	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26	1,2,6,8,10,11,15	1,2,6,8,10,11,15	III
C16	16,18,23,24,25	1,2,3,4,5,6,7,8,9,10,11,13,14,15,16,17,19,20,21,22,23,24,26	16,23,24	X
C17	16,17,18,20,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,13,14,15,17,19,20,21,22,26	17,20,26	IX
C18	18,25	1,2,3,4,5,6,7,8,9,10,11,13,14,15,16,17,18,19,20,21,22,23,24,26	18	XI
C19	12,13,16,17,18,19,20,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,13,14,15,19,21,22	13,19	VII
C20	16,17,18,20,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,13,14,15,17,19,20,21,22,26	17,20,26	IX
C21	12,13,14,16,17,18,19,20,21,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,14,15,21,22	14,21	VI
C22	3,4,5,7,9,12,13,14,16,17,18,19,20,21,22,23,24,25,26	1,2,3,4,5,6,7,8,10,11,15,22	3,4,5,7,22	IV
C23	16,18,23,24,25	1,2,3,4,5,6,7,8,9,10,11,13,14,15,16,17,19,20,21,22,23,24,26	16,23,24	X
C24	16,18,23,24,25	1,2,3,4,5,6,7,8,9,10,11,13,14,15,16,17,19,20,21,22,23,24,26	16,23,24	X
C25	25	1,2,3,4,5,6,7,8,9,10,11,13,14,15,16,17,18,19,20,21,22,23,24,25,26	25	XII
C26	16,17,18,20,23,24,25,26	1,2,3,4,5,6,7,8,9,10,11,13,14,15,17,19,20,21,22,26	17,20,26	IX

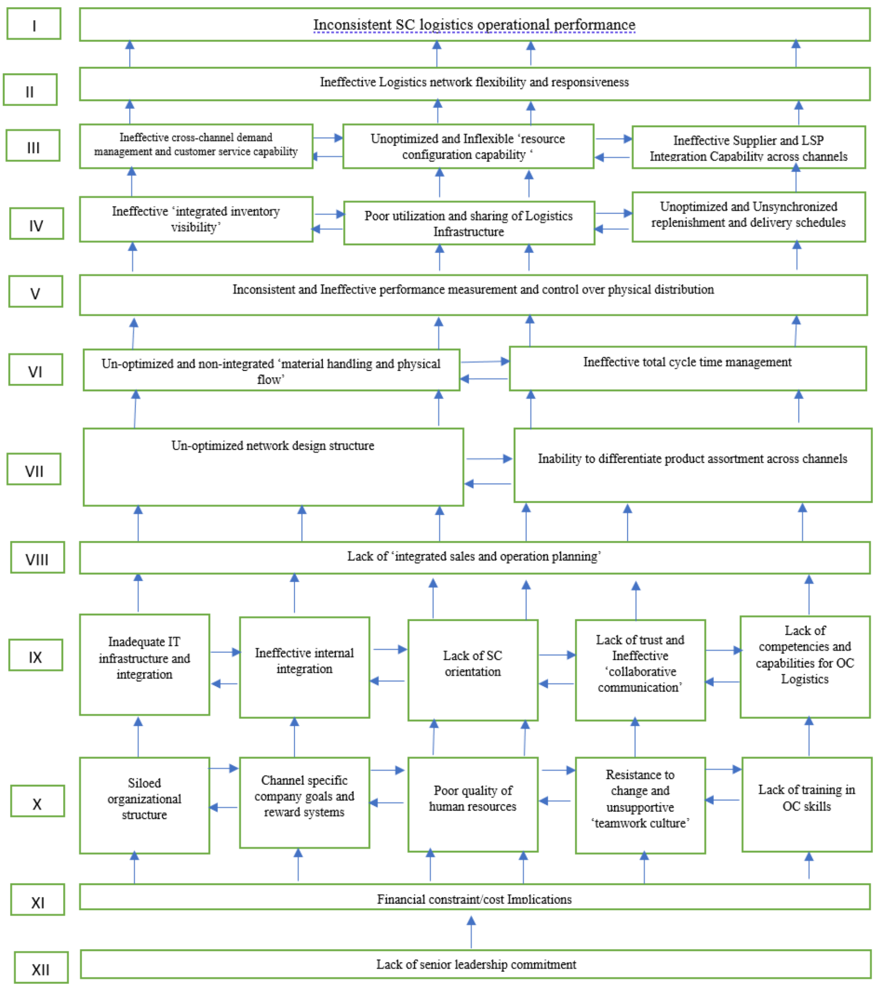

Figure 2 ISM-Based model of barriers to OC logistics integration

Following the extraction of the ISM-based hierarchical model, the barrier categories are determined using fuzzy MICMAC analysis. In-depth interviews with case study specialists revealed both direct and indirect constraints on OC logistics. The BDRM is obtained using the Fuzzy MICMAC approach's Step 2. The fuzzy evaluation scale is used to create the initial FDRM by aggregating the judgments of the decision team. The final FDRM is calculated using Step 5 of the fuzzy MICMAC technique. The driving force and the dependency of the individual barriers as determined by Step 6 of the fuzzy MICMAC analysis are shown in **Table 9**. The barrier categories displayed in **Figure 3** are generated using Step 7 of the fuzzy MICMAC analysis.

Table 9 Effectiveness of the barriers to logistics integration

S. No.	Barrier	Driver power	Dependence	Effectiveness
1	C1	16.2	0.0	16.2
2	C2	16.2	0.0	16.2
3	C3	12.3	6.4	5.9
4	C4	12.3	6.4	5.9
5	C5	12.3	6.4	5.9
6	C6	14.6	3.5	11.1
7	C7	12.3	6.4	5.9
8	C8	14.6	3.5	11.1
9	C9	9.1	7.6	1.5
10	C10	14.6	3.5	11.1
11	C11	14.6	3.5	11.1
12	C12	4.6	11.7	-7.1
13	C13	5.4	11	-5.6
14	C14	8.4	9.8	-1.4
15	C15	14.6	3.5	11.1
16	C16	2.3	15	-12.7
17	C17	4.0	13.5	-9.5
18	C18	0.0	15.6	-15.6
19	C19	5.4	11.0	-5.6
20	C20	4.0	13.5	-9.5
21	C21	8.4	9.8	-1.4
22	C22	12.3	6.4	5.9
23	C23	2.3	15	-12.7
24	C24	2.3	15	-12.7
25	C25	0.0	15.6	-15.6
26	C26	4.0	13.5	-9.5

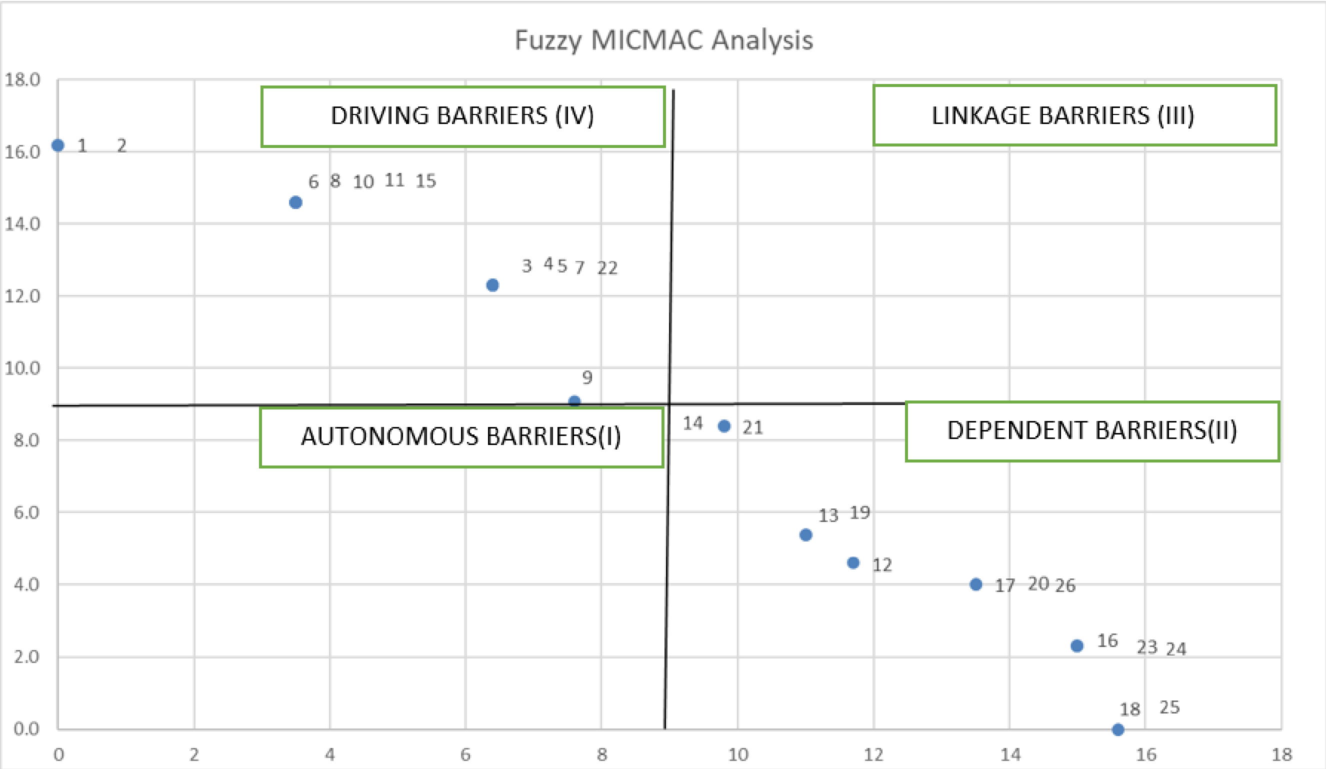

Figure 3 Fuzzy MICMAC analysis of barriers to OC logistics integration

4.2 Stage - II

The integrated hierarchical model was constructed by prioritising the obstacles according to their impact on the other barriers. Using Step 1 of the integrated model development approach, the stabilised FDRM is defuzzified. The effectiveness of each barrier is determined and summarised in **Table 9**. **Figure 4** illustrates the generated cohesive model using Step 3 of the integrated model development approach.

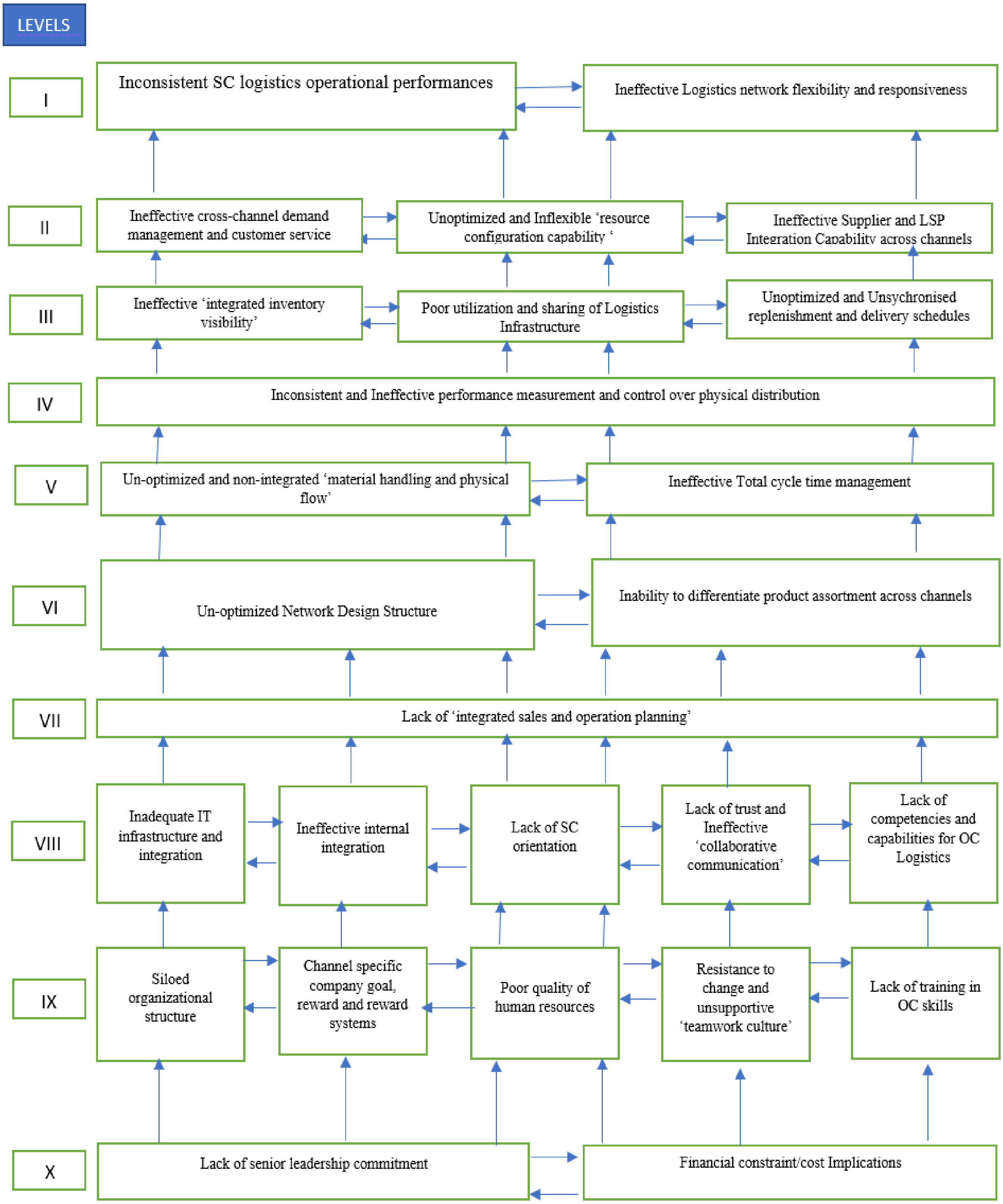

Figure 4 Fuzzy ISM-based integrated model of OC logistic integration

5. RESULTS AND DISCUSSION

The study examined key impediments to OC logistics deployment in emerging markets. The study is unique because it identifies barrier themes not before revealed or recognised in OC logistics literature. Most past studies on OC logistics considered explicit challenges within the logistics domain as distinct within their analysis scope. Table 10 presents the twenty-six barriers categorised into strategy-related and development-related barriers. The strategy-related hurdles are divided into managerial, cultural, organisational, financial, and logistics-performance barriers. The development-related constraints include IT, logistics-resources capability, and logistic-integration capability-related barriers.

Table 10. Classification of omni-channel logistics integration barriers

Types of Barriers	Definition
Strategy-related Barriers	
Managerial	Lack of Senior Management Commitment
	Lack of training in OC skills
	Inconsistent and Ineffective performance measurement and control over physical distribution
Cultural	Siloed Organizational Structure
	Resistance to change and unsupportive 'teamwork culture'
	Lack of SC orientation
	Lack of trust and ineffective 'collaborative communication'
Organisational	Channel Specific company goals and reward systems
	Lack of competencies and capabilities for OC logistics
	Poor quality of human resources
	Ineffective internal integration
	Lack of 'integrated sales and operations planning'
Financial	Financial constraints/cost implication
Logistics-Performance	Inconsistent SC logistics operational performance
	Ineffective logistics network flexibility and responsiveness
Development-related barriers	
IT	Inadequate IT infrastructure and integration
Logistics Resource – Information Resource	Ineffective total cycle time management
	Ineffective 'integrated inventory visibility'
	Unoptimized and unsynchronized replenishment and delivery schedules
Logistics Resource - Knowledge resource	Un-optimized Network Design Structure
	Inability to differentiate product assortment across channels
	Un-optimized and Non-integrated 'material handling and physical flow'
Logistics Resource - Infrastructure	Poor utilization and sharing of Logistics Infrastructure
Logistics Integration Capability	Ineffective cross-channel demand management and customer service *(Customer Service capability)*
	Unoptimized and Inflexible 'resource configuration capability' *(Resource Integration Capability)*
	Ineffective supplier and LSP integration capability *(Organizational Integration Capability/Supply Management Capability)*

The findings suggest that tangible and intangible logistical resource-related limitations hinder the development of logistics capabilities and successful logistics performance development. Barriers to OC logistics migration include logistic-resource-related barriers such as 'logistics-information', 'logistics-knowledge', and 'logistics-infrastructure'. 'Logistics-information' are intangible resource-related barriers that cumulatively contribute to undermining effective inventory management, obstruct the integration of 3PL services, and hamper agility and flexibility. In the context of OC logistics,' logistics-information' could impede the retailers' ability to improve logistics performance by increasing logistics costs.

'Logistics-knowledge' is another intangible resource-related barrier in this study that prevents retailers from maximising their distribution capacity, channel-integrated order fulfilment, returns, and delivery service. It complicates the process of synchronising replenishment and delivery schedules across channels with the firm's suppliers and third-party logistics providers. 'Logistical-infrastructure' refers to tangible logistics resources and location-related barriers in this study. These resources and barriers include distribution centres, warehouses, retail networks, transportation facilities, and value-added facilities. It produces location-specific disadvantages by limiting the leverage retail enterprises can build through developing unique supply sources, marketplaces, material handling nodes, and network opportunities.

Logistic integration capability-related barriers hamper logistics process integration. It limits the retailer's capacity to provide flexibility in order fulfilment, reducing the possibility of delivering a superior and consistent consumer experience across channels. The study divides logistics integration capabilities bottleneck into three categories: customer service, resource integration, and supply management. After recognising their critical role in achieving OC goals and objectives, the organisation should prioritise their elimination. Notably, the study examines the 'soft' side of OC logistics hurdles, including management, cultural, organisational, financial, information technology, logistical-resource, logistics-capability, and logistics-performance barriers. The impact of these' soft' impediments in hampering the migration to OC logistics has been wholly underestimated in OC retailing literature, particularly in the context of OC logistics.

The ISM model in **Figure 2** provides valuable insights by illustrating the barriers and their dependencies clearly and concisely. The diagraph, formed from the reachability matrix demonstrating the direct linkages, is founded on the ISM model's strength of successfully presenting facts through indirect dependencies. The ISM method can assist managers in visualising and communicating the inter-dependencies of the OC implementation hurdles.

Apart from providing retail managers with a structured approach for overcoming barriers, the ISM model also provides managers with a viable implementation strategy for attaining cross channel logistical integration. The ISM based model also revealed that organisations should prioritise barriers based on the implementation stage rather than reducing or eliminating them all at once. Additionally, the integrated ISM model shown in **Figure 2** explains the hierarchy of barrier categories. Level I and Level II are performance hurdles for OC logistics, followed by capabilities obstacles for OC logistics. Level IV barriers are logistics services, followed by performance metrics integration. Logistics process control barriers are found at Level VI, followed by logistics process integration barriers. At Level VIII, logistical planning-related difficulties are encountered, followed by organisational internal integration-related barriers at the first and second tiers. Finally, at Level XI, there are financial constraints, followed by hurdles relating to management commitment.

The ISM model shows the barriers' dependency but not their direct links. The ISM model also fails to assess the strength of the interactions. The present study used Fuzzy-ISM to overcome the limitations of traditional ISM. **Figure 4** shows the integrated ISM model produced from the fuzzy-ISM after defuzzification. The integrated model's hierarchical structure is similar to the standard ISM model, proving its utility in providing managers with an integrated framework. A more sophisticated and robust integrated model confirms the fuzzy approach's utility in upgrading the classic ISM.

A lack of senior leadership commitment (C1) and financial constraints/cost implications (C2) are identified as the critical hurdles with the highest driving power in **Figure 4**. It is evident from the results that senior management is critical in successfully managing this transformation, as it affects the entire organisation and demands dedication and involvement. Early in the OC transformation, senior management becomes overbearing in developing a transformative management system, as validation of the existing strategy, organisation, and retail business model impacts the entire organisation. Concerning the obstacle, 'financial constraints/cost implications' were judged a high priority for retailers at the outset of the OC journey, contrary to the findings of Picot-Coupey *et al*. (2016) in developed markets. One possible explanation is that retailers in developed markets are larger and more financially stable than those in emerging markets. Small retailers dominate the retail sector in emerging nations, confined by financial resources and inexpensive capital.

Siloed organisational structure (C10), channel-specific company goals and reward system (C6), poor quality of human resources (C15), resistance to change and unsupportive teamwork culture (C8), lack of training in OC skills (C11) are significant hurdles with high driving power and are placed close to the critical bottom level barriers. The results point to a significant organisational overhaul at the start of the OC logistics transformation. Concerns about human resource training levels and corporate management must be overcome. Fear of skill shortage hinders retailers since interdisciplinary talent is required for both internal and external integration of logistical services. The OC literature has given far less attention to this point, as most studies focus on developed markets. Because of their importance in creating relationship capabilities and cooperative behaviour, channel-integrated governance systems are a major early implementation hurdle. They must be redesigned to allow for logistics integration. Still, researchers in OC literature have severely neglected this contention concerning emerging markets.

Next to critical first level barriers inadequate IT infrastructure and integration (C7), ineffective internal integration (C3), lack of SC orientation (C4), lack of trust and ineffective collaborative communication (C22), lack of competencies and capabilities for OC logistics (C5) are also classified as dominant barriers with the high driving power. The findings support prior OC retailing studies indicating optimal logistics integration of online and offline channels depends on inter-and intra-organizational integration. A shared vision can help establish trust, foster inter-departmental cooperation, and increase organisational cohesion through enhancing cross-functional collaboration. The channel members' desire for a unified SC inevitably leads to organisational unity. However, supply chain partner integration depends on management's commitment to building trust through a culture of flexibility and innovation. Logistics integration reconfigures multiple business processes' interactions with business partners to restructure the logistics network. Thus, deploying cross-functional teams spanning diverse sections and partner companies across channels can help manage customer demand.

Inadequate IT infrastructure and integration (C7) can hinder OC logistic strategy. Operational data integration is challenging for retail organisations that struggle to integrate information systems among supply chain partners. Incorporating logistics-related data also hampers retailers' capacity to restructure logistics processes and improve supply chain associate coordination. Integrating information systems can significantly enhance communication and information sharing between channel and supply chain. An integrated information system can also help manage complicated channel-integration difficulties and combine intra- and inter-organisational systems and business processes, among other things.

Inconsistency SC logistics operational performance (C25) and infective logistics network flexibility and responsiveness (C18) are identified as logistic performance limitations by the integrated ISM model shown in **Figure 4**. Other logistics-related constraints include ineffective cross-channel demand management and customer service (C16), unoptimised and inflexible resource configuration capabilities (C23), ineffective supplier and LSP integration capability (C24). Logistical performance hurdles can impede operational efficiency and competitive advantage for a firm. The capability to integrate logistics processes can help retail organisations achieve OC logistics.

The fuzzy-MICMAC analysis depicted in **Figure 3** can be used to ascertain the relative importance of one barrier category to another, as well as the effect of other obstacles on itself. A deeper look at **Figure 3** reveals that most barriers in the independent barrier category are related to strategy, whereas many barriers in the dependent barrier category are tied to development. Strategy-related impediments obstruct the effective removal of development-related restrictions. These findings confirm that failing to clearly define the OC logistics strategy early in the transformation process might cause considerable delays in implementing the OC logistics. Also, the fuzzy MICMAC analysis found no autonomous barriers, meaning that all identified obstacles affect.

OC retailers can use the study's findings to better understand the interactions between barriers. Retail managers could use the fuzzy diagraph to determine the strength-based dependencies between barriers. Because only those obstacles that significantly impact the relationship are included in the fuzzy diagram, it simplifies the final diagram. Due to the findings, retail managers might prioritise obstacles to decrease their influence on others.

5.1 Managerial Implications

The study helps senior management identify the components that retail firms must overcome to establish integrated logistics systems across channels. The subset of logistics hurdles helps plan for a better response. The findings can help managers systematically allocate scarce resources to overcome OC logistics integration hurdles.

With the rapid advancement of digital technologies and changing consumer expectations, emerging market OC retailing enterprises find it difficult to alter their business models. Emerging market retailers must rethink their OC approach to satisfy shifting consumer expectations and the evolving understanding of market competition. The findings help OC retailing enterprises' top management allocate their limited resources for logistics system integration. The study's findings redefine logistics' role in the evolving OC retail scenario. Although this study focuses on OC commerce, the results apply to managers in other industries that use OC to deliver products and services.

Companies could use the present research findings to understand significant barriers to successfully implementing OC retailing in an emerging and developing retailing setting. Concerning OC logistics, the report presents the following advice for OC retailers and supply chain managers:

- OC retailers should increase their organisational management skills through managerial, cultural, and organisational level 'soft' interventions to achieve organisational integration.
- Training existing human resources in OC skills will help build their competencies and SC orientation while recruiting talent will help establish their OC capabilities.
- The OC retailers must recognise the value of both tangible and intangible resources in improving logistical and operational efficiency.
- The OC retailers should grasp the implications of logistics resources.
- Logistics integration requires OC retailers to integrate resources both upstream and downstream.
- OC merchants must invest in appropriate logistics resources to strengthen their resource integration expertise.
- The OC merchants must leverage, employ, and share their current infrastructure and supply chain partners to establish a flexible resource configuration capability through internal operations reinforced by external supply chain partners.

5.2 Limitations and future research

While the comprehensive MCDM technique used in this study gives valuable information to academics and practitioners in OC retailing, the generalizability of the results is limited. The analysis is based on a small sample of cases in a single emerging market. Due to this constraint, the findings should be regarded as exploratory. The logical conclusion of this research is that a cross-national study incorporating enterprises from emerging and developed markets is required. An extensive and diversified sample size would result in statistically conclusive interview results, improving the findings' quality and trustworthiness. The integrated ISM model was developed with the assistance of experts. As a result, the possibility of response bias influencing the study's conclusion cannot be ruled out. The barriers were classified and analysed using a 'generic' approach. Future research should concentrate on finding and analysing retail-specific obstacles. Researchers can investigate implementation problems in terms of area, sector, firm size, and years in operation by examining context-specific impediments.

Future research could usefully explore retail context-specific constraints, leading to more effective analysis based on the environment. Further, since the present research is based on a small group of retail specialists, a logical evolution of this work would be to experimentally investigate the significance of the reported hurdles and statistical validation of the recommended ISM model. The suggested ISM-based model may be validated using structural equation modelling (SEM). Additionally, future studies should focus on novel combinations of obstacles through a higher abstraction level grouping.

The current paper investigates the challenges to OC retailing in India's young retail economy and within a developing regulatory environment. This research has thrown up many questions in need of further investigation. A further study could assess OC logistics integration hurdles in a mature market setting.

DISCLOSURE STATEMENT

This is to acknowledge that no financial benefit has arisen from the direct applications of my research and there is no conflict of interest.

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