INNOVATIVE INTERMODAL TRANSPORTATION BUSINESS MODELS FOR PERISHABLES: A SCOPING REVIEW

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ABSTRACT

This paper reviews the literature on innovative business models applied to perishable intermodality, with a particular focus on short sea shipping. The study addresses the resistance experienced by supply chain participants to modal shift, despite the alleged associated environmental and social benefits. In this context, the business model concept is presented as a comprehensive tool for developing and executing strategies to facilitate such a transition, especially in the agri-food sector, where supply chain management plays a critical role. In short, it is about moving from theory to practice. The review highlights the preeminence of business models that promote the adoption of intermodality through digitization and collaboration. The research findings reveal a lack of attention to the design of models that prioritize the reduction of externalities or the improvement of quality and service. In the case of perishables, this should be the priority.

Keywords;

Business model; innovation; intermodality; supply chain; perishables.

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1. INTRODUCTION

In recent years, public administrations have been trying to promote a shift from road to maritime transport, through intermodality, to achieve a rebalancing of the transport sector. In theory, this shift would not only have positive effects for the environment and society as a whole, but also for the companies involved. However, members of the supply chain are still reluctant to implement this change (Raza et al., 2020; Ramalho and Santos, 2021; Pérez-Mesa, 2022). In other words, it has not been possible to translate the strategic vision into an operational reality. The strategic vision allows us to capture the essential elements of competition. But as we move toward execution, the details become more important (Richardson, 2008). In each real competitive situation, the particular characteristics of the company, the circumstances of the industry and the details of each competitor present unique challenges and opportunities. In this context, this study proposes that the business model concept can become a useful integrative framework for strategy formulation and execution. The business model (BM) concept has received considerable attention in the academic literature. In general, a business model is the way in which a company generates value and profits through its activities. It can be described as the structure that defines how a company operates, how it delivers value to its customers and how it generates profits. However, the literature on BM is fragmented and inconsistent, lacking a comprehensive and systematic framework, more so in the case of application to specific sectors where a more practical view of the concept prevails (Wirtz et al., 2016; Andreini et al., 2022).

The main objective of this article is to discover new arguments in favor of promoting intermodality for the transport of highly perishable products, beyond those merely related to shortening transit times or reducing costs. Through a review of the literature, this study aims to identify innovative examples of business models that are facilitating the implementation of intermodality in transport, i.e., the actual application of the modal shift strategy. Specifically, the aim is to promote intermodality based on short sea shipping (SSS) specifically for perishable products in the agri-food sector. While it is true that the concept of BM has been applied to the intermodality of different types of goods (Lehtinen and Bask, 2012; Flodén and Williamsson, 2016; Colicchia et al., 2017; Pencheva et al. 2022). There is virtually no work that attempts to summarize the linkage of the concepts in the case of perishable agri-food products. This particular case is particularly challenging due to the need for rigorous supply chain management, as quality and food safety can be compromised during transport. In other words, perishable products are the current battlefield where it is most difficult to apply these concepts. The BM concept creates a suitable framework that can solve the problems of implementing intermodality by applying an integrated practical vision, based on a strategic action, which abandons the classic studies (Hanssen et al., 2012; European Commission, 2015; Yakavenka et al., 2020; Filina-Dawidowicz, and Stankiewicz, 2021) that approach modal shift from the optimization of the most operational variables (time and costs, emissions reduction, basically) out of a viable business context. In summary, the aim is to answer the following questions: What is the basis for viable BM for intermodal transportation of perishable goods? What role do traditional operational variables play in these businesses? What new variables are involved? These questions are currently unanswered in the literature.

2. BUSINESS MODELS AND INTERMODALITY

Over the past two decades, the concept of a business model (BM) has gained significant importance. Numerous studies attempt to define and explain its structure. The BM is a practice-focused tool that allows describing and analyzing how a company conducts its activities. Some studies have made it clear that, although a good business model is linked to and contributes to the execution of corporate strategy, they are not the same. Business models describe how the pieces of a company fit together, regardless of competitors, with the latter task being the realm of strategy. However, we must not forget that the BM plays a fundamental role in the execution of corporate strategies by providing the structure and means to implement and achieve the objectives of an organization (Mikl et al., 2021).

In essence, a BM delineates how a company creates, delivers, and captures value for both its customers and itself (Magretta, 2002; Johnson, 2010; Teece, 2010; Tell et al., 2016). It can also be said that a BM is a relationship among different components that illustrate how the company operates (Osterwalder, 2005; Demil & Lecocq, 2010), reaching limitations if solely focused on profit generation while neglecting aspects related to sustainability (Barth et al., 2017). Following Richardson (2005), he centers his explanation on the most common components that constitute and make sense of a BM's intention. Specifically, eight fundamental elements are identified to comprehend how the BM functions, grouped into three categories: 1) value proposition, which alludes to the offering, target audience, and basic strategy enabling customer acquisition and competitive advantage; 2) value creation and delivery system, analyzing the required resources and capabilities, the organization of the value chain (system of activities and business processes), and the position in the value network (connections with suppliers, partners, and customers); and 3) value capture, focused on examining how revenue is sourced (ways in which the company receives money in exchange for its services) and the business's economics (factors determining profit).

On the other hand, intermodality refers to the coordinated and efficient use of different modes of transportation (road, rail, maritime, air) to carry out a logistics chain or journey in an integrated and uninterrupted manner. Intermodality aims to optimize resources, reduce costs and time (Yakavenka et al., 2020), and minimize environmental impact (Rossi et al., 2021).

A priori, the intersection between business models and intermodality presents a significant opportunity for development in the transportation and logistics sector through: 1) Innovation, where transportation and logistics companies can innovate their business models to offer more efficient and attractive intermodal solutions to their customers; for example, integrated logistics services simplifying processes for customers and reducing costs (Monios & Bergqvist, 2015). 2) Improving collaboration and coordination, meaning there may be other business models based on stable organizations, where corporate collaboration within the supply chain is the key component (Stål et al., 2022). 3) Application of technology and digitalization: Technology plays a fundamental role in optimizing intermodality and improving business models in the transportation sector. In this sense, from an operational perspective, the digitalization of logistics management, (for example, the use of Blockchain, Internet of Things –IOT– or sensorization, data analysis and its massive network storage, process simulation and modeling, or the transversal use of AI, among others) represents the catalyst in the development of successful business models that can enhance corporate sustainability (Pal & Kant, 2019) and therefore accelerate the implementation of the modal shift process.

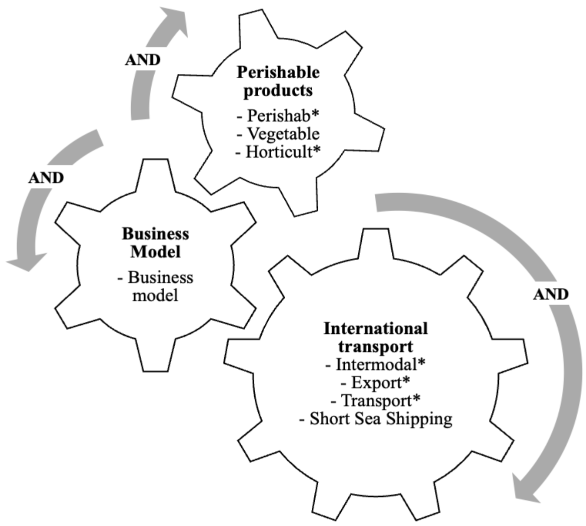
In short, business models and intermodality are closely related in the field of transportation and logistics, as both focus on efficiency, resource optimization, and delivering value to customers. Innovation, collaboration, and technology are key to maximizing the opportunities offered by these concepts. The intersection between business models and intermodality can lead to significant developments in the transportation and logistics sector. To analyze the relationship between these concepts, the following points entail a systematic exploratory review of the literature, focusing on the parts that contribute value to this type of analysis. In this regard, bibliometric examination involving the use of quantitative metrics is minimized, without delving fully into the content and context of the articles. This methodology will allow the identification, in the analysis of results, of innovative examples of business models that facilitate the implementation of intermodality in transportation, focusing on highly perishable products (e.g., vegetables) that require a maximum level of supply chain refinement with very tight transits (SSS).

3. METODOLOGY

Taking into account the proposed objectives, an exploratory systematic review or "scoping review" was carried out to try to identify the relevant literature and the current situation of the field of study (Arksey and O'Malley, 2005; Codina, 2024). The exploratory study method is based on the need to identify the totality of relevant literature. It is an iterative process, which requires researchers to engage in each stage in a reflexive manner and even repeat the steps to ensure that the literature is covered comprehensively, if necessary. This methodology aims to assess and understand the extent of knowledge on the topic under investigation (Peters et al., 2020).

In order to ensure a documented and rigorous search, as well as a clear and detailed presentation (Snyder, 2019), the methodology employed is the "SALSA Framework" which involves four critical phases: 1) planned search with established inclusion and exclusion criteria, as well as academic databases; 2) evaluation of the papers found, prefixing the criteria that match the research objective; 3) analysis of the selected articles; and 4) synthesis of the results (Grant and Booth, 2009; Booth et al., 2012). First, the problem is focused, which is nothing more than conducting an analysis of the existing literature on innovative examples of BM that encourage the use of intermodality in the transportation of perishable goods. In order for the search to be of sufficient quality, it is carried out for the two most important databases in the field of research: Scopus and Web of Science (WOS). Papers are selected between 2003 and 2023. Keywords for the study were established, classified into three themes: "business model", "international transport" and "perishable products". In the search, these keywords were linked with an “AND” and those set as sub-keywords with an “OR”. This allowed for narrowing and refining the search for relevant results. A wildcard asterisk is used to extend the search to words beginning with the same letters (Figure 1).

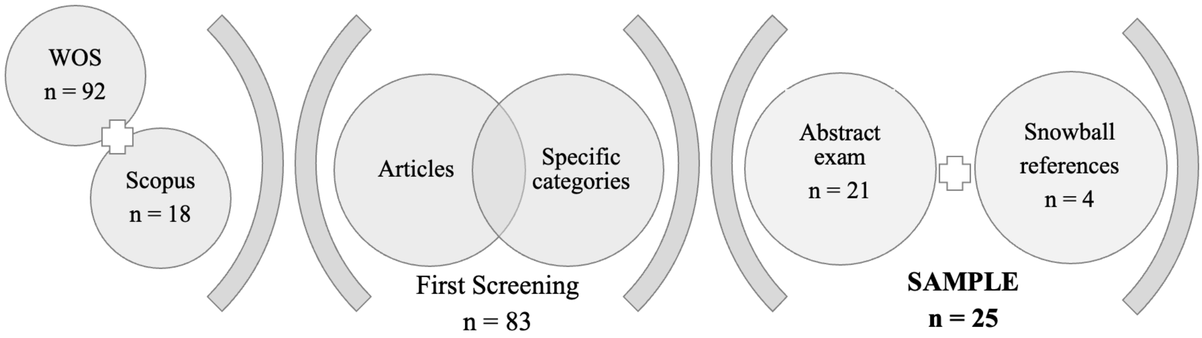
Figure 1. Search keywords.



Source: own elaboration.

After applying the search criteria described above, the total number of references found between the two databases is 110 documents. In addition, to further refine the search, a filter by document type was used, leaving only articles with the following categories: Business Economics, Agriculture, Environmental Sciences Ecology, Engineering, Food Science Technology, Computer Science, Science Technology Other Topics, and Energy Fuels (83 selected articles). By examining the abstracts, the number of references was reduced to 21 articles. Subsequently, based on the work of Petticrew and Roberts (2012), the method known as "snowballing" or "cross-referencing" is used, which studies the citations of previously selected papers finding 4 references useful in the research (Figure 2). The computation of references that can be framed in the investigated topic finally amounts to 25 documents.

Figure 2. Methodological research.



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4. RESULTS AND DISCUSSION

In the geographical distribution of the 25 references analyzed, Europe stands out as the focus of the research with 70% of the articles (Figure 3). This result shows that the European continent is a pioneer, worldwide, in trying to implement the intermodal shift using SSS to try to reduce the environmental impact and optimize the use of its abundant port areas (European Commission, 2015). The relative economic importance of Asia and the USA is not reflected in the number of papers in this area. Undoubtedly these areas are more concerned with long distance maritime trade. 24% of papers refer to the Asian region and the remaining 6% examine the issue in North America. The temporal distribution of the publications shows that between 2020 and 2023, more than 58% of the publications are concentrated, revealing that this is an emerging research topic. It can also be seen that the number of citations is increasing year after year.

Figure 3. Countries mentioned in each case study, papers and citations by year.

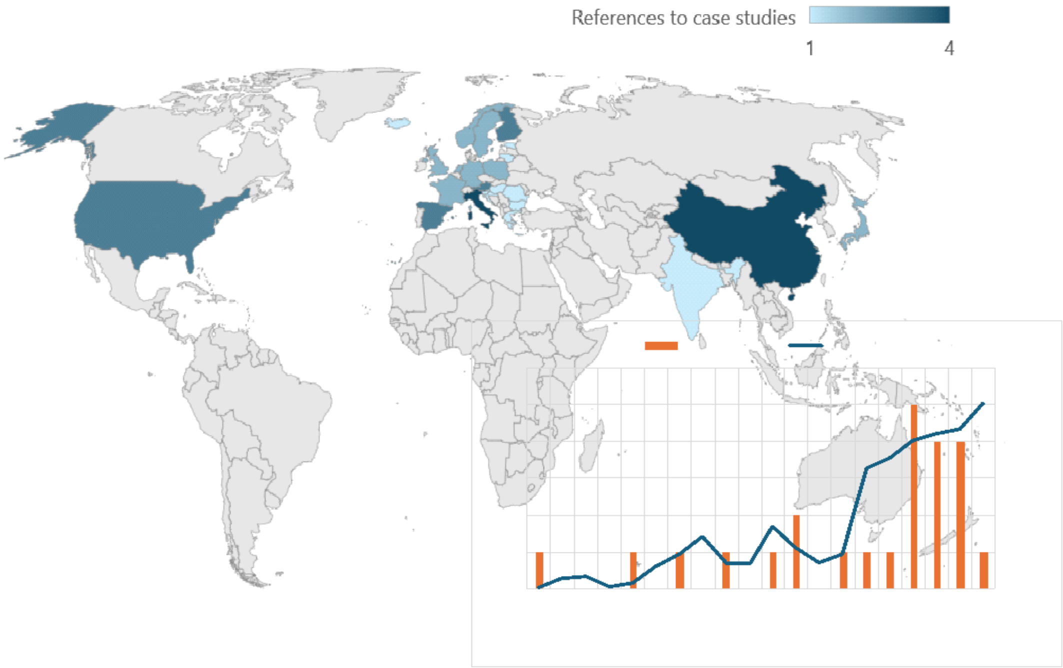

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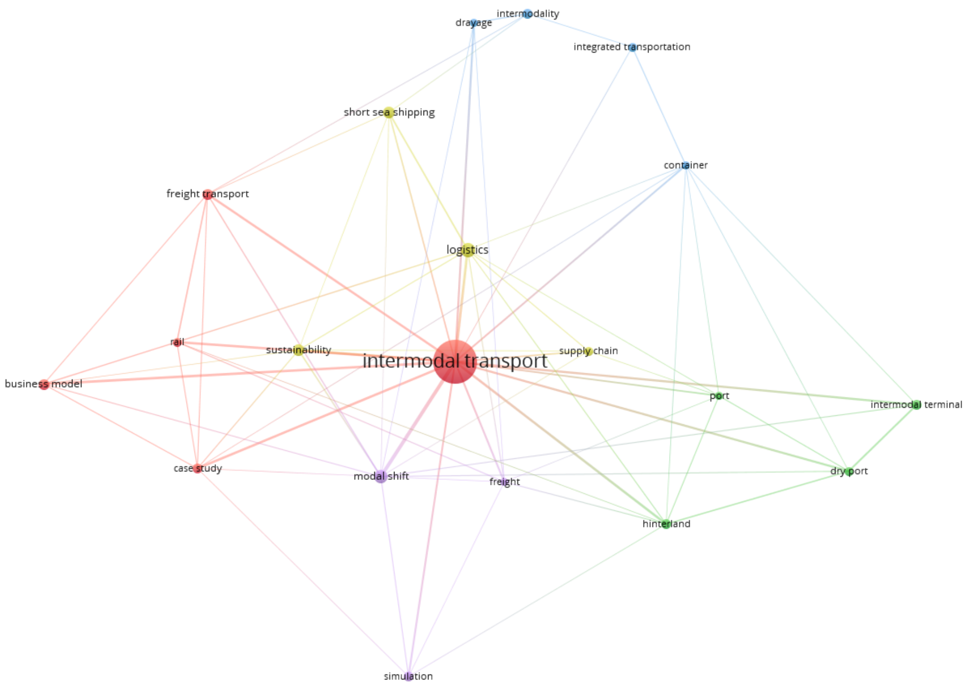
Figure 4. Top 20 keywords with their relative weight and relationships.



Source: own elaboration.

Figure 4 provides a visualisation of the 20 most repeated keywords in the articles selected for the study, giving a clear picture of the predominant thematic areas in research on business models applied to intermodality in perishable goods transport. These keywords not only identify the most commonly discussed topics in the literature, but also help to understand the emerging trends and focal points in the field.

The presence of keywords such as ‘technology’, ‘collaboration’, ‘digitisation’ and ‘efficiency’ suggests that a significant part of the literature has focused on how the implementation of new technologies and improved collaboration within the supply chain can facilitate the use of intermodality in the transport of perishable goods.

On the other hand, the appearance of terms related to ‘quality’, ‘service’ and ‘regulation’ shows the importance of qualitative and regulatory aspects affecting intermodal transport. However, there is a lack of business models that prioritise the reduction of externalities.

Furthermore, in Table 1, the references are classified according to the most utilized areas of study in research on short sea shipping (SSS) for perishable products (Pérez-Mesa, 2022). These areas include: 1) Financial factors (e.g., profitability improvements and financing); 2) Strategic aspects (e.g., new investments, infrastructure improvements); 3) Issues related to externalities generated (environmental impact); 4) Applicable or necessary regulatory issues (e.g., legal restrictions on transport); 5) Technical/technological issues (e.g., intelligent transport systems, digitalization); 6) Operational factors (e.g., time and cost reduction); 7) Human resource issues (e.g., employee training); 8) Communication/collaboration improvement needs (information standardization, cargo consolidation); 9) Actions related to service and service quality (frequency, product spoilage, cold chain). In addition, a bidirectional table is created to relate the concepts represented in Figure 5, also performing a modularity analysis developed by Blondel et al. (2008) through the Gephi software. This technique is used to detect and evaluate the structure of communities within a network. A community in a network is a group of nodes (or vertices) that are more connected to each other than to the rest of the network.

Regarding the importance of research topics according to Figure 5, it is shown that the literature on business models in the context of short sea shipping focuses on several key aspects, in order, Improvement of operational aspects (daily route management, cargo organization, etc.) closely linked to the incorporation of new technologies, the existence of communication and collaboration among the supply chain members, personnel training and strategic factors such as the need for infrastructure improvement or other investments. Some topics such as financing issues, externalities reduction, regulation, quality and service improvement have not received significant attention in the literature relating business models to SSS.

To some extent, the above results are confirmed by the modularity analysis, where two groupings of coherently related concepts (modules) can be seen:

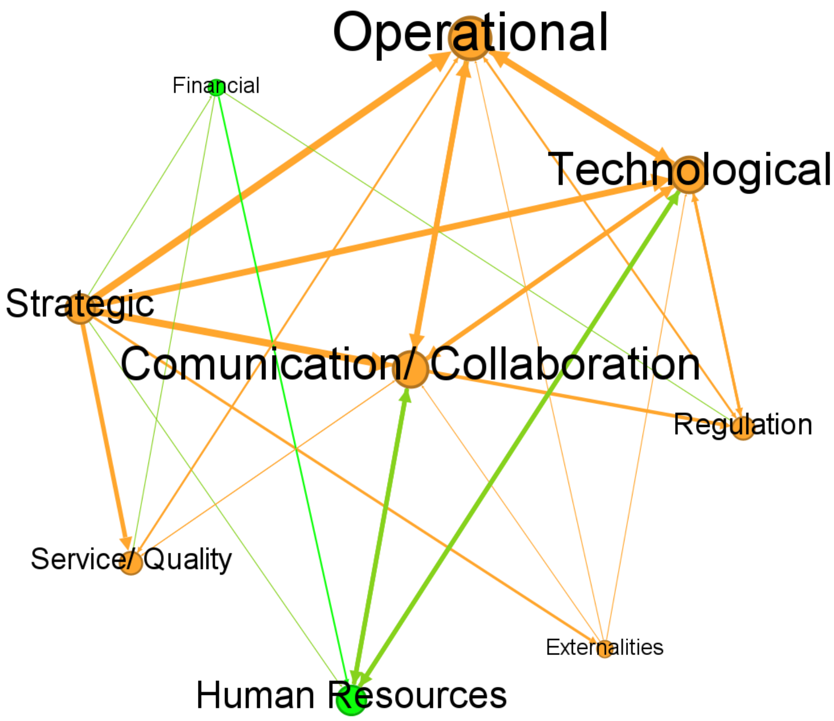
- Module 1: this group includes, in order of importance, terms associated with operational, technological and communication/collaboration aspects. It also includes strategic issues (investments, infrastructure, etc.), those related to quality and service, and regulation. The concepts within this module show a high interconnectedness, indicating that these areas share a strong functional relationship and benefit from joint optimization strategies. These results show the lack of interest in the literature to address key aspects, more so in the case of perishables, such as those related to the quality maintenance of onboard cargoes
- Module 2: this set groups words related to human resources (personnel training) and financial aspects. Although there is an incipient relationship between human resources and the application of technology and improvements in communication and collaboration, this is a potential area for analysis.

Table 1. Interrelation of references and functional areas investigated.

	Financial	Externalities	Regulation	Technological	Operational	Human Resources	Comunication/ Collaboration	Service/ Quality
Strategic	Morales-Fusco et al. (2018)	Haftor and Climent (2021), Olaniyi et Gerlitz (2019), Lehtinen and Bask (2012)	Haftor and Climent (2021), Olaniyi et Gerlitz (2019), Wagener (2017), Floden and Sorkina (2014)	Li et al. (2022), Haftor and Climent (2021), Gruchmann et al. (2020), Olaniyi et Gerlitz (2019), Wagener (2017), Floden and Sorkina (2014), Lehtinen and Bask (2012)	Grzelakowski (2022), Haftor and Climent (2021), Li et al. (2020), Mikl et al. (2020), Wagener (2017), Floden and Sorkina (2014), Lehtinen and Bask (2012), Morrison et al. (2004)	Del Vecchio et al. (2022)	Haftor and Climent (2021), Hamani and Simon (2020), Mikl et al. (2020), Olaniyi et Gerlitz (2019), Wagener (2017), Monios and Bergqvist (2015), Floden and Sorkina (2014), Lehtinen and Bask (2012)	Hamani and Simon (2020), Li et al. (2020), Mikl et al. (2020), Olaniyi et Gerlitz (2019), Floden and Sorkina (2014)
Externalities				Ban et al. (2021)	Ban et al. (2021)	Del Vecchio et al. (2022)	Climent (2021)	
Regulation	Wagener (2017)			Zhao et al. (2022), Vallera et al. (2021), Gruchmann et al. (2020)	De Langen and Douma (2010), Lambrou et al. (2008)			
Technological					Ivanov et al. (2022), Li et al. (2022), Ban et al. (2021), Lind and Melander (2021), De Andres Gonzalez et al. (2021), Gruchmann et al. (2020), De Langen and Douma (2010)	Mikl et al. (2022), De Andres Gonzalez et al. (2021), Ivanov et al. (2020), Lambrou et al. (2008), Morrison et al. (2004)	Zhao et al. (2022), Lind and Melander (2021), Gruchmann et al. (2020), Monios and Bergqvist (2015), Lambrou et al. (2008)	
Operational						Grzelakowski (2022), Lehtinen and Bask (2012)	Del Vecchio et al. (2022), De Andres Gonzalez et al. (2021), Hajdul & Mindur (2015), Monios and Bergqvist (2015), De Langen and Douma (2010), Lambrou et al. (2008)	Konstantinou and Gkritza (2023), El Yaagoubi et al. (2022)
Human Resources	Hamani and Simon (2020), Morrison et al. (2004)						El Yaagoubi et al. (2022), De Andres Gonzalez et al. (2021), Floden and Sorkina (2014)	De Langen and Douma (2010)
Comunication/ Collaboration								El Yaagoubi et al. (2022)
Service/ Quality	Li et al. (2020)							

Source: own elaboration.

Figure 5. Relationships between functional areas and modularity analysis.



Source: own elaboration.

From the detailed analysis of references based on key elements of a business model, relevant results can be extracted (Table 2). The emergence of technologies has transformed the landscape of intermodal transportation. Numerous examples of research analyze the application of digital methods to specific cases. Floden & Sorkina (2014) study the case of "FreightHub," a logistics technology company based in Germany specializing in the digitization and optimization of the supply chain and cargo transportation management. They offer digital solutions for companies looking to improve the efficiency of their cargo transportation operations, as well as the visibility and tracking of their shipments. FreightHub utilizes technologies such as artificial intelligence and machine learning to provide services ranging from cargo booking to real-time tracking and document management. Their goal is to simplify and enhance global logistics through the use of innovative technological tools. On the other hand, Li et al. (2022) investigate the capacity of blockchain to optimize supply chain operations, improving the simplification of relationships between members. González et al. (2021) also suggest the use of digital tools such as the Internet of Things and blockchain technology to enhance efficiency and sustainability in maritime logistics. At the same time, Ivanov et al. (2022) describe the benefits of cloud-based information sharing, highlighting its advantages in supply network coordination.

These advancements have been driven by various market pressures, including growing demand, the need to maintain high quality standards, service expansion, increasing complexity in supply chain management, and global crises such as the COVID-19 pandemic. All these elements have had a global impact on maritime transportation, as explored by Grzelakowski (2022), who advocates for a strategic shift towards digital, resilient, intelligent, and eco-friendly supply chains, which could entail significant changes in business models.

Gruchmann et al. (2020), in their analysis of intermodal transportation, emphasize that collaboration is the fundamental element to promote in any business model. This arises from the need for interoperability and coordination to optimize the chain. This approach is also reflected in the works of De Langen & Douma (2010) and Lehtinen & Bask (2012), emphasizing the importance of service integration. Olaniyi and Gerlitz (2019) present an integrated value chain model highlighting the need for regulatory support. Lambrou et al. (2008) delve into this topic by analyzing business cases related to short sea shipping, presenting regulatory solutions, describing policies, and limitations in the European market, especially in the adoption of emerging information and communication technologies (ICT) in maritime operations. Authors like Zhao et al. (2022), Monios & Bergqvist (2015), and Wagener (2017) underscore that in addition to collaboration, technology is important in the application of efficient business models.

Overall, innovations in business models have the potential to bring about profound changes in the intermodal transportation sector. Del Vecchio et al. (2022) focus on the adoption of the circular economy in the agro-energy sector, presenting enablers such as brand awareness campaigns that can drive this transition. On the other hand, Morrison et al. (2004) introduced coordinated network BM to leverage the benefits of globalization through selective investments in strategic points that facilitate coordination.

In recent years, there has been a growing focus among researchers and professionals on innovation aimed at improving the efficiency and sustainability of transportation systems (Haftor & Climent, 2021). In this context, intermodality through SSS plays a prioritized role if its use can be coordinated across different sectors, not only agricultural. Concurrently, Ban et al. (2021) and Vallera et al. (2021) analyze the feasibility of electrifying freight transport through battery exchange systems, which could revolutionize the reduction of carbon dioxide emissions and enhance energy efficiency. Despite these discussions, electric trucks in an intermodal framework face significant challenges (infrastructure and charging times, autonomy and range, or higher depreciation costs), as identified by Konstantinou & Gkritza (2023).

On the other hand, and in more operational terms, as pointed out by Morales-Fusco et al. (2018) and Li et al. (2020), pricing strategy decisions by shipping companies can have a significant impact on the use of Motorways of the Sea. At this point, the application of real-time-based automatic mechanisms can play a key role in implementing effective segmentation-based strategies as a means to enhance efficiency and profitability.

Table 2. Literature analysis function of the basic components of a Business Model.

BUSINESS MODEL FRAMEWORK	VALUE PROPOSITION			VALUE CREATION AND DELIVERY SYSTEM			VALUE CAPTURE	
	Offer	**Target customer**	**Strategy**	**Resources and capabilities**	**Organization**	**Position in the value network**	**Revenue sources**	**Economic of the business**
Ban et al. (2021)	Battery exchange and charging system for freight transport	Transport operators	Generalisation of services	Own research capacity, infrastructure, financial needs	NS	Collaboration with technology providers	Payment for service and infrastructure use	Extension to all transport systems
De Andres Gonzalez et al. (2021)	Technological tool	Transport operators	NS	Internal organisation and specialised human resources	Optimisation of port flows through electronic data exchange	Need for a coordinating company	Payment by subscription to the service	Generalisation among users (increase of customers)
De Langen at al. Douma (2010)	Improving intermodal logistics organization	All members of the chain	Search for partners according to needs	Technological resources, know-how, organisation	NS	Need for participation of the whole chain	NS	NS
Del Vecchio et al. (2022)	Advice on input reduction	All members of the chain	Optimisation of resources used in transport	Institutional resources (legislation), technical problem-solving capacity	Circular value chain	NS	Charging for advice	Increase in environmentally sensitive customers
El Yaagoubi et al. (2022)	Logistics services	Transport operators	Reduce costs in rail/road/sea transport and container handling operations	Specialised human resources and technical resources in optimisation and simulation	Elimination of bottlenecks intermodal transport	Collaboration with technology providers	Segmented payment according to complexity of service	Generalisation among users (increase customers): economies of scope
Floden and Sorkina (2014)	Specialised and customised intermodal technical services and solutions	Transport operators	Self-service system, customer integration	Internal organisation and specialised human resources	Long-term collaboration between operators and shippers	Need for a coordinating company	Model improves cash flow, facilitates collections	Franchises

Gruchmann et al. (2020)	Digital improvement in port management	Transport operators	Digital business models in maritime freight logistics	Internal organisation	Compulsory collaboration between ports and users (transport operators)	Need for a coordinating company	Co-financing between users	Cost savings: economies of scale
Grzelakowski (2022)	Various digital solutions	Transport operators and service user companies	NS	NS	Creating a global supply chain	Need for participation of the whole chain	NS	NS
Haftor and Climent (2021)	Route management with means that reduce environmental impact	Transport operators	Offerings that optimise fuel efficiency and reduce operating costs	NS	NS	Need for participation of the whole chain	NS	NS
Hajdul & Mindur (2015)	"Global Cargo Management Ecosystem"	Transport operators	Improving service efficiency	NS	Small number of participants in the chain	NS	NS	Cost savings
Hamani and Simon (2020)	Improving infrastructure and services	Transport operators and users	Improving service efficiency	Physical, infrastructure, financial and human resources	NS	Need for participation of the whole chain	Co-financing between users	NS
Ivanov et al. (2022)	Supply chain coordination mechanism in the cloud	Transport operators and users	Improving service efficiency	Technological and human resources	NS	Collaboration with technology providers	Payment by subscription to the service	Customer growth
Konstantinou and Gkritza (2023)	Specialists in infrastructure improvement	Land transport operators	NS	Technological resources, know-how, organisation	NS	NS	Co-financing between users	NS
Lambrou et al. (2008) (EUROPE)	Logistics services	Transport operators	Cargo planning and handling using intelligent technologies	Technological and human resources	NS	Fundamental collaboration with technology providers	Payment for service	NS
Lehtinen and Bask (2012)	Providing a comprehensive door-to-door service	All members of the chain	Optimal distribution of responsibilities in door-to-door service	Human resources and internal organisational capacity	NS	Need for participation of the whole chain	NS	
Li et al. (2020)	Definition of optimal pricing strategy	Transport users	Selection of pricing strategies for freight platforms	Technological resources	Small number of participants in the chain	NS	Service integration fee	Improving trade margins

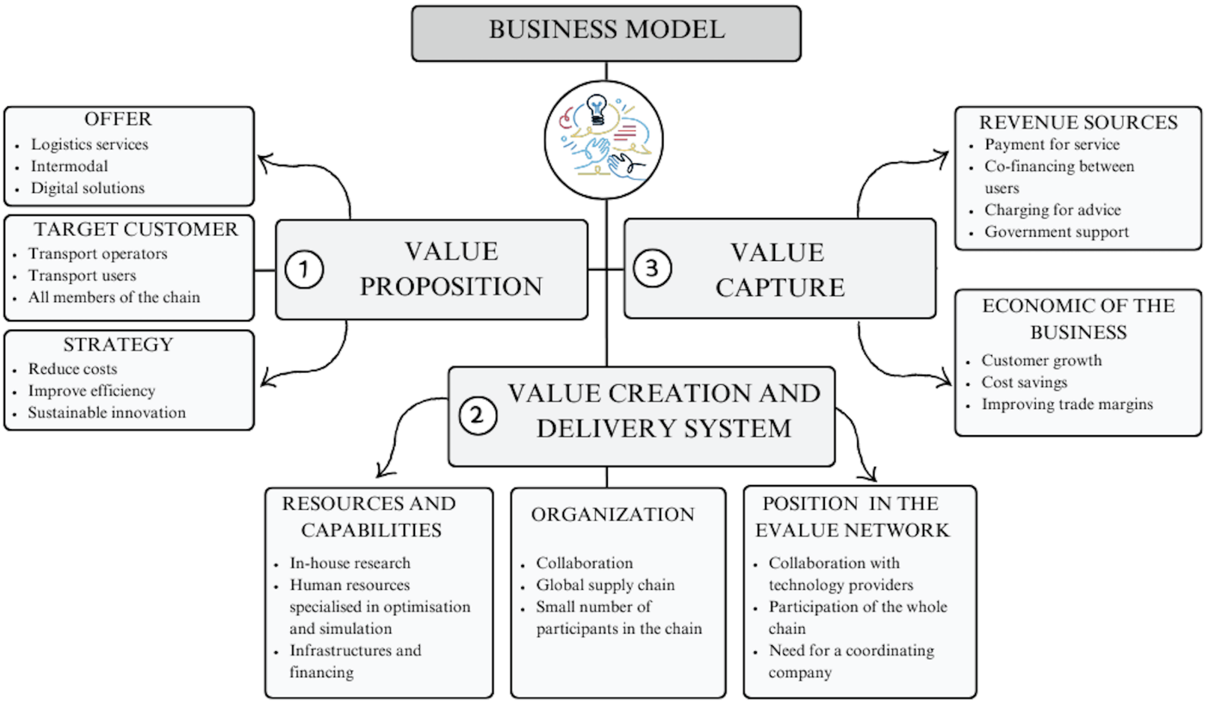
Li et al. (2022)	Blockchain application	All members of the chain	Improved trade security	Technological resources	Operation of the network chain	Need for participation of the whole chain	Service integration fee	Cost savings
Mikl et al. (2020)	Digital solutions	All members of the chain	Ad hoc services according to the chain's needs	Technological and human resources	Creating micro-chains: supplier-customer partnerships	Application to any stage with technological deficiencies	Charging for advice	Generalisation among users (increase customers): economies of scope
Monios and Bergqvist (2015)	Optimisation of communication between members of the chain	All members of the chain	Encouraging viable Joint Ventures	Ability to solve specific technical or management problems	Organisation according to needs: long or short chains	NS	Charging for advice	Improving trade margins
Morales-Fusco et al. (2018)	Definition of optimal pricing strategy	Transport users	Offers at RO-PAX	Ability to solve specific technical or management problems	Small number of participants in the chain	Necessary coordination position of the offeror	Charging for use of the service	Improving trade margins
Morrison et al. (2004)	Coordination in the form of "netchising" networks	All members of the chain	Internet for buying and selling and customer relationship maintenance	Financial, technological, human resources	Organisation according to needs: long or short chains	Need for participation of the whole chain	Charging for use of the service	Cost reduction
Olaniyi et Gerlitz (2019)	Incorporation of new fuels	The model focuses on ship owners (shipping companies)	New innovative sustainable energy sources	Financial resources, infrastructure, capacity to solve technical problems	NS	NS	Charging for Liquefied Natural Gas use	Cost reduction
Vallera et al. (2021)	Incorporation of electric batteries in transport	Intermodal transport operators	New innovative sustainable energy sources	Research capacity, infrastructure, financial needs	Small number of participants in the chain	NS	NS	Customer growth
Wagener (2017)	Promotion of logistics hubs and integrated supply chain design	All members of the chain	Optimisation of resources used in the chain, not only transport	Infrastructure, financial resources	NS	Need for participation of the whole chain	Co-financing between users	Optimising services and increasing margins
Zhao et al. (2022)	Incorporation of electrical solutions in transport	Transport operators	Intermodal distribution with electric refrigerated trucks	Institutional resources (legislation), technological resources	Small number of participants in the chain: manufacturers and logistics companies	Fundamental collaboration with technology providers	Government support and user co-funding	Increase in environmentally sensitive customers

NS=Not specified.

Source: own elaboration.

In summary, as depicted in Figure 6, services and solutions are offered to reduce costs, improve organizational efficiency, and promote sustainable innovation. The digitalization of processes is a fundamental aspect that appears to be the focus of companies' efforts. These services are aimed at both specific members and all participants collectively in the supply chain. The generation and delivery of value are achieved through internal research, specialized resources, and the availability of appropriate infrastructure and financing. Additionally, collaboration and coordination among chain participants are essential. As a result, the main objective sought with the use of the business model is to increase customers, reduce costs, and increase profit margins, through different sources of income that involve expanding both users and the range of transported products. Another increasingly widespread source of income involves technical consultancy, as it allows for stable collaboration between provider and customer.

Figure 6. Synthesis of results.



Source: own elaboration.

From this analysis, it can be inferred that the provision of intermodal perishable services aligns with current trends in business models. The topics addressed in the literature are becoming a standard, regardless of the sector under consideration (Xu & Talib, 2020). For instance: 1) digitalization and digital transformation; 2) digital platform economy; 3) sustainability and Corporate Social Responsibility (CSR); 4) circular economy; or 5) open innovation, collaboration, and ecosystems. This leads us to consider that perhaps the focus on certain "trendy" issues is disorienting companies when it comes to focusing on the most relevant aspects (Lingens, 2023).

5. CONCLUSIONS

This study has highlighted significant key elements for the evolution of BM in the field of transportation and logistics, aiming to facilitate effective modal shift. Digitalization and emerging technologies such as Blockchain, IoT, and AI are pivotal in driving successful business models that enhance sustainability and facilitate the transition towards efficient transportation modalities. Collaboration within the supply chain, through long-term contracts among different stakeholders, is essential for better coordination and efficiency. Thus, BM fostering closer relationships among chain members will have greater opportunities. Additionally, circular models focusing on waste reduction and resource efficiency are crucial.

The development of collaborative digital platforms improves visibility, communication, and traceability throughout the supply chain, reducing delivery times and costs. A key point to exploit is the selection of appropriate pricing strategies, which can enhance the efficiency and profitability of intermodal logistics platforms. At this juncture, leveraging cloud-based information, complemented with other relevant data, and applying predictive AI-based models could yield significant benefits.

It is evident that process optimization through new technologies such as IoT, AI, modeling, and simulation allows for better resource allocation and operational cost reduction. Furthermore, the implementation of virtual strategic alliances among different stakeholders promotes a more resilient supply chain by sharing risks, benefits, and information. It is important to emphasize that issues related to externalities reduction, regulations, and quality improvement are addressed cross-sectionally in the literature, not representing fundamental elements for defining business models, unlike digitalization. These aspects are crucial in any modal shift decision by service users, particularly in the case of highly perishable products. Until these issues become the fundamental focus of BM, there won't be a "takeoff" of this system. On the other hand, digitalization seems to be the fundamental theme around which BM oriented towards perishable intermodality pivot. However, although this aspect is crucial, it remains merely a facilitating tool that favors and thus contributes to other key points: sustainability, quality, etc. In other words, this focus could be misguided. It is, service providers must be aware that the fundamental objective should be to improve the quality of the product delivered to its destination, promoting its economic and environmental sustainability. Within this framework, new technological tools have enormous potential in coordinating and collaborating tasks among supply chain actors, but they should not be an end in themselves.

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