The Evolution of International Transport in Response to Changing Consumer Trends in Spain

Global Bachelor's Degree in Business Management & Entrepreneurship

Final Degree Project (FDP)

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Objectives:

I chose this topic for my FDP because it blends my studies in Business Administration with my current Master's in Port Management and Intermodal Transport. Throughout my studies, I've developed a strong interest in how changing consumer trends are reshaping the transportation industry, particularly in the context of international trade and logistics. This thesis aims to explore how shifts in consumer behavior in Spain are influencing international transportation strategies, with a focus on intermodal transport and sustainability. By looking at public policies, port management, and technological innovations, I hope to understand how businesses are adapting to these new consumer expectations. I believe this topic is highly relevant to both my academic background and my professional future, as it connects directly to the current trends in the transportation and logistics sectors, which I am passionate about. This paper builds upon the author's, me, previously submitted work for "The Evolution of International Transport in Response to Changing Consumer Trends in Spain" at Universidad Europea de Valencia.

Abstract:

This Final Degree Project analyzes how evolving Spanish consumer patterns are reforming international transportation structures, focusing on intermodality, port logistics, and sustainability. Spanish e-commerce growth's rapid expansion, growing environmental awareness, and digital transformation have created a whole new series of demands for celerity, transparency, and low-emissions logistics. On the basis of a systematic review analysis of both academic and institutional resources and a case study of Inditex, this research identifies international transport strategy's main trends.

Key findings indicate that customer-driven preferences—such as next-day delivery, ethically sourced, and carbon-neutral logistics—are speeding up a shift towards intermodal networks by blending maritime and rail transportation, supported by digital platforms such as Port Community Systems. Barcelona and Valencia ports are leaders in this revolution by incorporating automation, artificial intelligence, and modernisation of infrastructure in sync with EU policies such as Green Deal, Fit for 55, and Emissions Trading System

(ETS2).

Additionally, an in-depth interview with Vicente Ferrer, Manuport Logistics Spain Managing Director, provides expert insights into the strategic port value of the Port of Valencia, its connectivity with hinterland, and its status as a logistics hub in the Mediterranean. The interview covers port expansion projects, optimization measures, and growing use of rail in response to both commercial and environmental targets.

This study concludes that responding to trends in customers by embracing sustainable and digitalised systems of logistics is both a requirement for regulatory compliance and a basis for competitiveness. Strategic alignment among businesses, infrastructure, and public policy will determine transport networks' success in a high-speed, carbon-constrained global economy.

Keywords:

- *Intermodal transport*
- *Consumer-driven logistics*
- *Sustainable port management*
- *Digital supply chains*
- *Green logistics*
- *Public policy in transport*

1. Introduction

1.1 Background and relevance of the topic

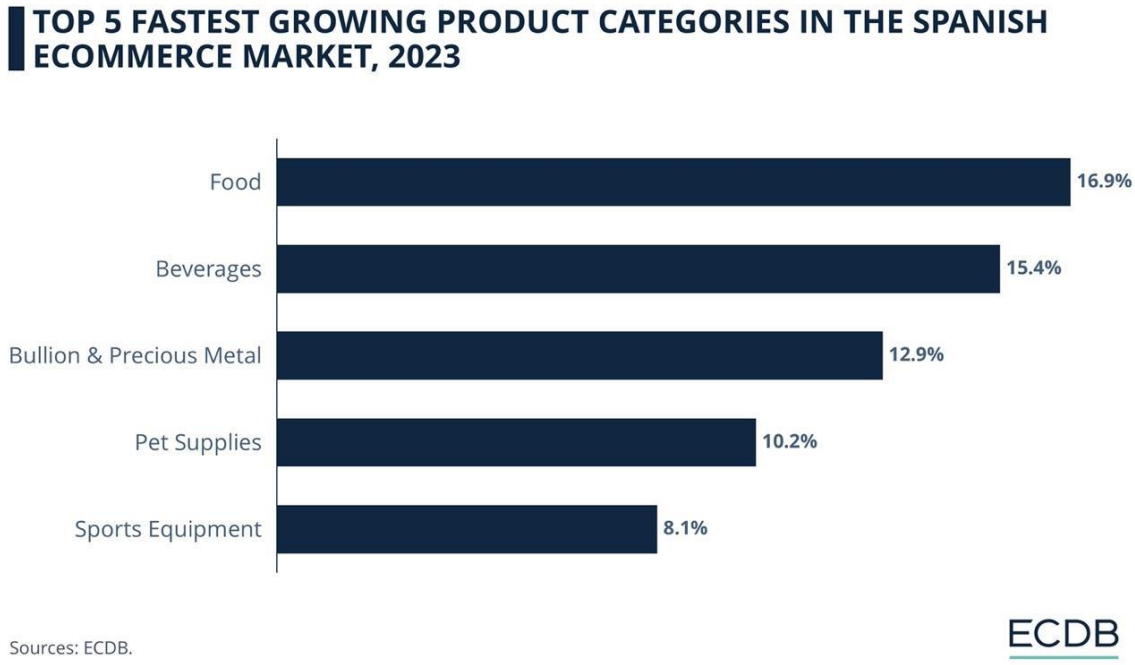
The international transport sector undergoes substantial changes because of changing consumer behaviors combined with digitalization and rising environmental sustainability needs. The changes in Spain have become most apparent because of its fast technology adoption and its expanding e-commerce sector which affects logistics operations and transport infrastructure.

The e-commerce revenue in Spain achieved €99.2 billion in 2023 while showing a 16% growth from the previous year (Stoamsaas, 2023). The exponential rise in e-commerce revenue stems from consumer preference changes which the COVID-19 pandemic accelerated because retailers needed to implement flexible and responsive logistics solutions.

The rising awareness about environmental effects from buying decisions has made consumers more conscious about their purchasing choices. Research shows that sustainability plays a major role in Spanish consumer decision making because more than 60% of consumers evaluate environmental factors when selecting products or services (Zinklar, 2023). Transport companies now face pressure to make sustainability their priority because of growing environmental concerns from consumers.

Spain’s position as a vital transportation hub between Europe, Africa and Latin America makes its transport sector developments impact global supply chains throughout the world. The European Commission identifies Spain as vital for developing sustainable intermodal transport solutions because it recognizes the importance of understanding how consumer trends affect international logistics operations (European Commission, 2023).

Figure 1: Growth of E-commerce Categories in Spain (2020-2023)



Source: ECDB (2023)

1.2 Research objectives

The primary objective of this research is to analyze how changing consumer trends in Spain are reshaping international transport strategies, focusing on intermodal logistics, port management, and sustainability practices.

Specifically, the research aims to:

- Examine the impact of the rapid growth of e-commerce on international transport logistics and infrastructure.
- Assess how increasing consumer demand for sustainable practices influences the strategic decisions of transport and logistics companies.

- Evaluate how technological advancements, particularly digitalization, support the adaptation of logistics networks to emerging consumer expectations.
- Identify the main challenges and opportunities arising from these consumer-driven shifts within the international transport sector in Spain.
- Develop practical recommendations to enhance adaptability and sustainability in international transport and logistics operations.

. Analyze the influence of global trade flows (particularly with China and the United States) and their impact on Spanish transport logistics and intermodal infrastructure.

. Investigate the role of AI and automation technologies in improving logistics performance across ports, warehouses, and last-mile delivery in Spain.

1.3. Methodology and Scope

The research will use a qualitative and descriptive design to explore how shifts in consumer behavior affect the structure of international transport and logistics systems with a focus on Spain in the European Union context. The methodology will be based on the systematic review and analysis of secondary sources, including institutional data, academic literature, and corporate sustainability reports.

Methodological Approach

The research will use a desk research approach to collect and analyse the available and trustworthy information from the secondary sources. These will include:

• The following policy and regulatory documents are provided by the European Commission, the European Environment Agency (EEA), and the Spanish ministries of Transport, MITMA and Puertos del Estado. • Papers from the

academy and sector on intermodal transport, consumer behaviour in logistics, digital supply chains, and green logistics that are retrieved from ResearchGate, UNCTAD, ITF, and OECD.

• Company level reports especially from the leading logistics intensive firms like Inditex, whose sustainability reports and annual reports give an insight into how companies are reacting to the regulatory and market pressures. • Statistics and market studies and consumer trends data, including Eurostat, the Eurobarometer, Statista, and national e-commerce and sustainable consumption observatories.

The research will be based on the following thematic axes identified in the theoretical framework: the growth of e-commerce, intermodality, digitalization, port management and environmental policy. The paper will employ a real-world case study of Inditex to demonstrate how these general trends are implemented at the company level in logistics management.

All the sources will be assessed in relation to their credibility, appropriateness, and consistency with the research goals. The main focus will be on the identification of the strategic patterns and adaptation measures with respect to the changing consumer needs and policy trends.

All the sources will be identified based on their credibility, relevance, and alignment with the research objectives.

Scope of the Study

. Geographic scope: The research will be limited to Spain, but within the framework of the logistics and policy of the European Union, particularly in terms of TEN-T corridors, the Green Deal, and Fit for 55.

. Thematic scope: The analysis will focus on the following areas of convergence:

. Consumer behaviour (e.g., the demand for speed, flexibility, and sustainability in delivery services)

. Business actions (e.g., logistics improvement, intermodality, sustainability targets)

. Public policies and regulations (e.g., CSRD, ETS2, CBAM, EU transport policy)

. And their influence on the configuration and sustainability of transport and logistics systems.

. Sectoral scope: The study will focus on freight and goods transport, with a focus on the management of international movements, ports and urban logistics. Passenger transport will be excluded.

1.4 Study Structure

This thesis is composed of six chapters, which are designed to address all the topics and make the research easy to follow:

• Chapter 1: Introduction – Discusses the background, the importance of the topic, the specific research questions, the research design, the data collection methods, and the overall structure of the thesis.

• Chapter 2: Theoretical Framework – Presents a synthesis of the literature and theoretical approaches to international transport, consumer behaviour changes, digitalization, and green logistics practices.

• Chapter 3: Consumer Behaviour Trends in Spain – Offers an analytical review of the emerging consumer trends, with an emphasis on e-commerce expansion, digital customer needs, and ecological consciousness.

• Chapter 4: Implications for International Transport – Examines the particular impacts of the observed consumer trends on logistics management, port

operations and intermodal transport in Spain.

• Chapter 5: Case Study – Presents a practical example by describing a certain logistics company, showing its strategic actions and changes in response to changing consumer requirements and sustainability standards.

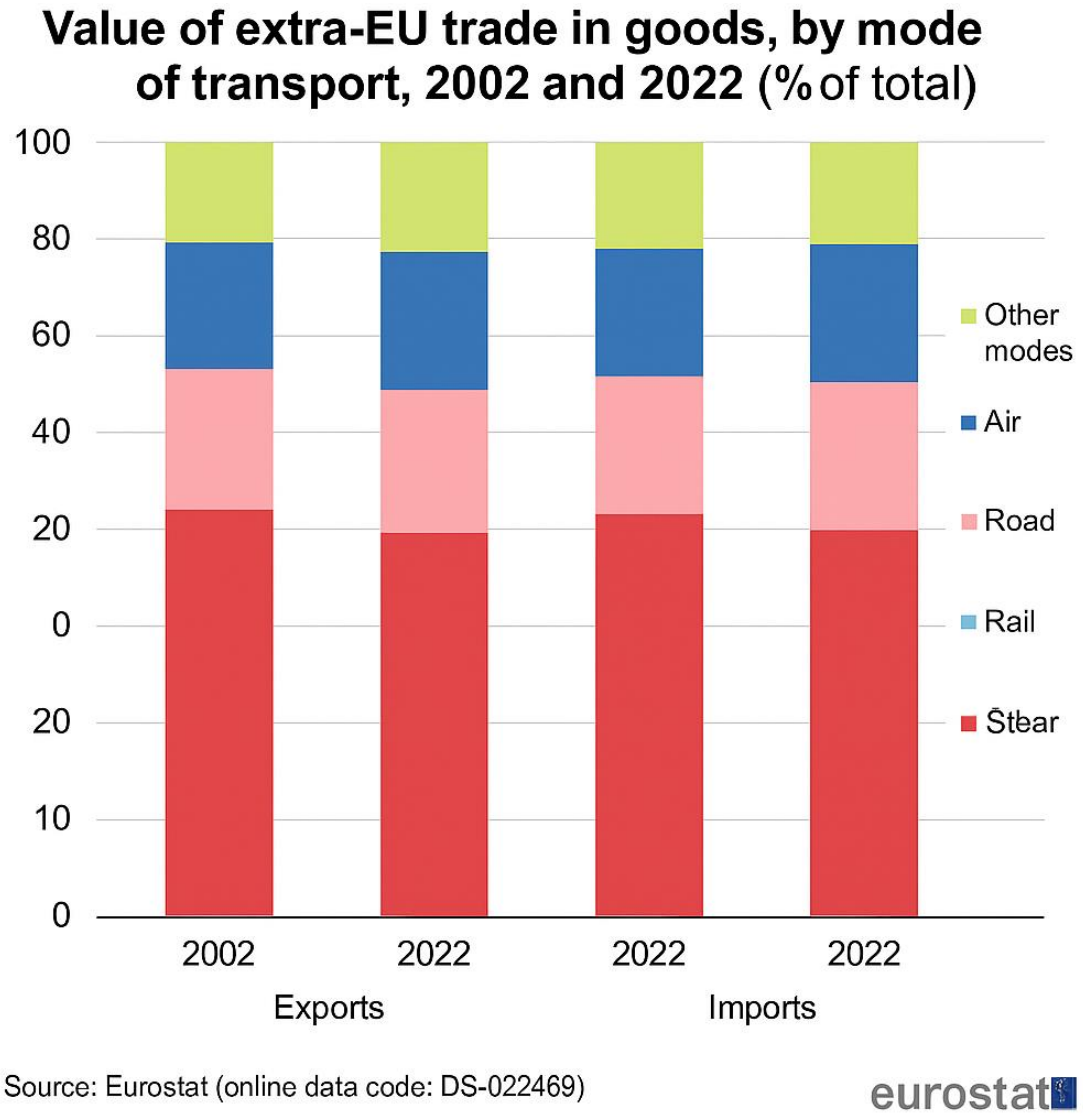
• Chapter 6: Conclusions and Recommendations – Restates the research results, addresses the implications for the industry stakeholders, identifies the main barriers and possibilities, and suggests the practical recommendations for the current and future studies.

2. Theoretical Framework: International Transport and Consumer Behavior

2.1. Overview and Evolution of International Transport

International transport has undergone a profound transformation over the last two centuries, evolving from basic maritime and land-based systems to a complex, digitized, and globalized logistics infrastructure. As a cornerstone of international trade, international transport connects producers and consumers across continents and plays a vital role in economic growth, supply chain efficiency, and geopolitical dynamics. It is important to understand its historical development and current challenges in order to analyze contemporary trends such as intermodality, sustainability, and changing consumer behavior.

Figure 2: International Transport of Goods by Transport Mode (2022)



Source: Eurostat (2023)

2.1.1. Historical Evolution and Containerization as a Turning Point

International trade experienced restrictions before the 19th century because of small-capacity ships and manual loading methods and land-based transportation limitations. The Industrial Revolution started a major transformation by introducing steam-powered ships and railways which improved speed and capacity and reliability of cross-border transport. The most transformative innovation emerged in 1956 when Malcom McLean introduced containerization which enabled smooth cargo unit transfers between ships and trains and trucks

(Rodrigue et al., 2020).

The implementation of standardized cargo units through containerization led to significant reductions in cargo handling duration and workforce expenses while enhancing security measures and enabling large-scale operations. The global maritime trade volumes experienced rapid growth as a direct result. The United

Nations Conference on Trade and Development (UNCTAD) reports that container throughput expanded by more than 15 times throughout the period from 1980 to 2020.

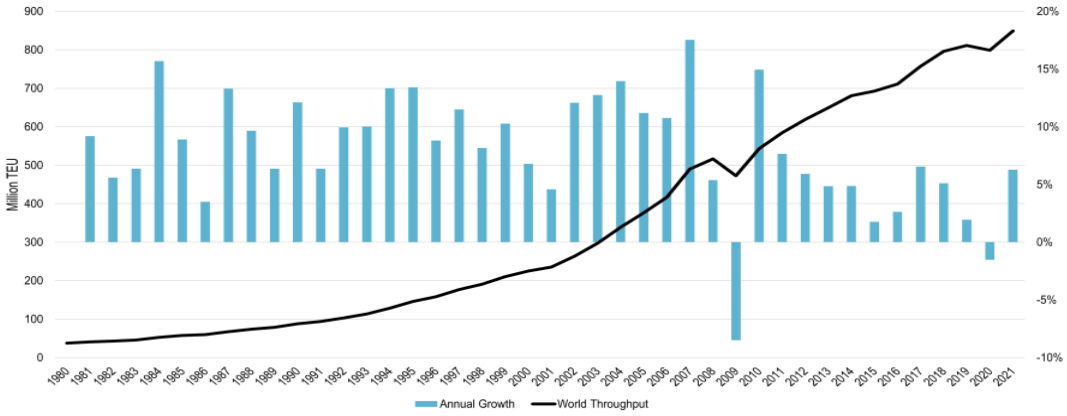


Figure 3 : *Global container throughput (TEUs) from 1980 to 2021*.
Source: UNCTAD (2022), The Geography of Transport Systems.

2.1.2. Globalization, Digital Integration, and Trade Liberalization

Transport systems started to evolve more sophisticated ways after the 1980s because of globalization as well as technological developments and trade policy liberalization. Global Value Chains (GVCs) together with World Trade Organization (WTO) creation in 1995 drove up the need for fast international

freight systems.

During this time logistics processes underwent a complete digital transformation. International logistics operations transformed their operational framework through the integration of Electronic Data Interchange (EDI) and warehouse management systems (WMS) and real-time GPS tracking and blockchain and Internet of Things (IoT) and Artificial Intelligence (AI) technologies (Notteboom & Rodrigue, 2020). These modern tools enable stakeholders from carriers to ports to customs to end clients to participate in live supply chain operations which creates transparent and responsive and secure systems.

TradeLens by Maersk and IBM serves as a modern example of digital coordination in global logistics along with Port Community Systems operating in Valencia and Rotterdam ports.

2.1.3. Post-COVID Shifts: Resilience, Nearshoring, and Strategic Autonomy

The COVID-19 pandemic revealed multiple weaknesses in the global transport system because of its reliance on distant suppliers and port congestion and container shortages. Maritime shipping freight prices surged to four times their original amount on specific routes especially between Asia and Europe (OECD, 2022). The COVID-19 crisis forced governments and businesses to reassess their logistics operations because they chose resilience over minimal costs.

The increasing interest in inventory management through “just-in-case” models together with nearshoring and supply source diversification has emerged as a response to the pandemic. These developments in Europe work toward achieving the EU’s “strategic autonomy” goal which seeks to eliminate critical dependencies and strengthen regional transport corridors like the Mediterranean TEN-T Corridor.

Spanish Example:

The COVID-19 pandemic led Spanish shippers to restructure their supply methods by selecting Mediterranean ports such as Valencia and Algeciras instead of distant transshipment terminals for better reliability and closeness. The Port of Valencia established itself as a main entry point for various import streams during the 2020-2021 period.

2.1.4. Environmental Sustainability and Regulatory Pressure

International transport operations generate 25% of worldwide CO_2 emissions while maritime and aviation sectors produce significant amounts of emissions (IEA, 2023). The rising importance of climate change has created both regulatory requirements and market incentives which force the sector to adopt green logistics solutions.

Key developments include:

• The International Maritime Organization (IMO) strategy to reduce CO_2 emissions from shipping by 70% by 2050.

• The EU Green Deal alongside the Fit for 55 Package includes the Emissions Trading System (ETS) together with the Carbon Border Adjustment Mechanism (CBAM) which directly affects both transport costs and strategies.

• New fuel alternatives including LNG and green hydrogen and biofuels have appeared for use in aviation and shipping sectors.

• The focus on using rail and inland waterways as transport methods works to decrease carbon emissions generated by road-based freight operations.

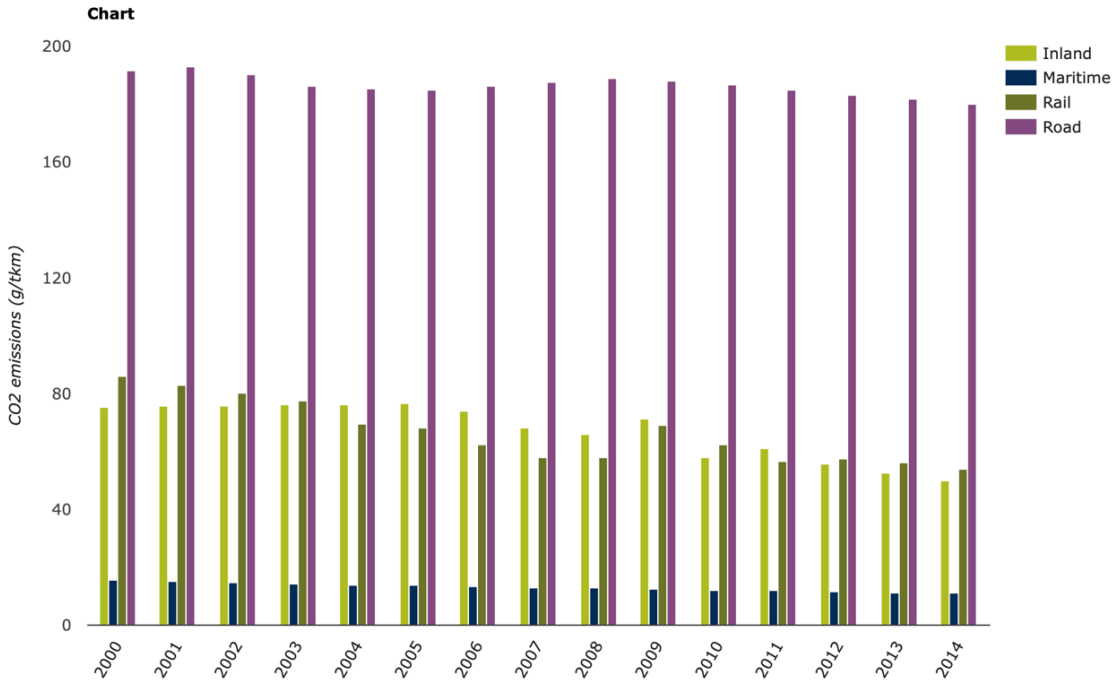


Figure 4: *CO_2 emissions per tonne-kilometer by transport mode (road, rail, maritime, air).*

Source: European Environment Agency (EEA), 2023

2.1.5. Economic Significance and Logistics Performance

The strategic role of efficient international transport systems extends beyond being logistical assets because they enable economic competitiveness. The World Bank's Logistics Performance Index (LPI) ranks countries with advanced transport infrastructure such as Germany and the Netherlands and Spain together with Spain as leaders who attract more foreign investment (World Bank, 2022).

The research by Arvis et al. (2018) demonstrates that better port logistics combined with multimodal connections can boost bilateral trade by as much as 25%. The Spanish ports of Algeciras, Valencia and Barcelona function as essential trade hubs in Mediterranean and transatlantic shipping while their

connectivity to road and rail networks through the Mediterranean Corridor supports Spanish export capabilities thus requiring additional investment in intermodal hubs.

2.2. The Role of Intermodal Transport in Global Trade

The exponential growth of global trade volumes requires efficient sustainable and resilient transportation systems. The integration of two or more transportation modes such as rail sea road and inland waterways under intermodal transport has become a fundamental logistical strategy. The implementation of intermodality improves operational efficiency and cost-effectiveness while serving as a vital component for environmental and strategic supply chain objectives at the global level.

2.2.1. Definition and Core Advantages of Intermodality

Intermodal transport means the use of multiple transport modes for a single loading unit or vehicle (usually a standard container) without unloading the goods between modes. Intermodal systems depend on standardized containers or swap bodies to minimize handling time and cargo damage and associated costs (Bontekoning et al., 2004) unlike multimodal transport which allows cargo handling during transfers.

The main advantages of intermodal transport include:

• Scale benefits that generate efficiency in rail and maritime transport operations.
• Sustainability of the environment through the replacement of road haulage with lower-emission modes rail and sea.
• A reliable and resilient system which performs well during disruptions to specific transport modes.

• Reduced congestion in urban and highway networks through optimal routing and consolidated freight flows.

Example:

An intermodal route would start with maritime shipping (e.g., from China to the Port of Valencia), proceed with rail transport to Zaragoza, and then use road transport for last-mile delivery of the freight without opening the load container.

2.2.2. Intermodality in the Context of Global Supply Chains

The just-in-time (JIT) and just-in-sequence (JIS) production models which lead global value chains (GVCs) can be supported by intermodal transport. Such models need transport solutions which are predictable, low-cost, and time definite across long distances. Intermodality presents an optimized structure that combines the advantages of rail speed with maritime reach and trucking flexibility to fulfill these requirements.

The growing environmental and regulatory challenges to road transport such as emissions restrictions, congestion charges and driver shortages also increase the strategic value of intermodal logistics.

The McKinsey (2020) research indicates that European freight emissions could decrease by 30% when rail and inland waterways replace traditional modes of transport for journeys exceeding 300 kilometers.

2.2.3. Intermodality in the European Union: Policy and Infrastructure

The European Union has positioned intermodal transport as a fundamental element of its sustainable mobility approach. The Trans-European Transport Network (TEN-T) initiative which started in the 1990s and expanded under the Green Deal and “Fit for 55” packages works to achieve the following goals:

• The development of central transport corridors that combine rail, maritime, road and inland waterway systems.

• Improved interoperability (e.g., gauge, signalling systems).

• Toward a 50% reduction in road freight by 2050 the initiative aims to shift freight traffic from road to rail and sea.

The Connecting Europe Facility (CEF) and European Investment Bank (EIB) offer co-funding opportunities for terminals dry ports and modal interchange facilities as part of the strategy.

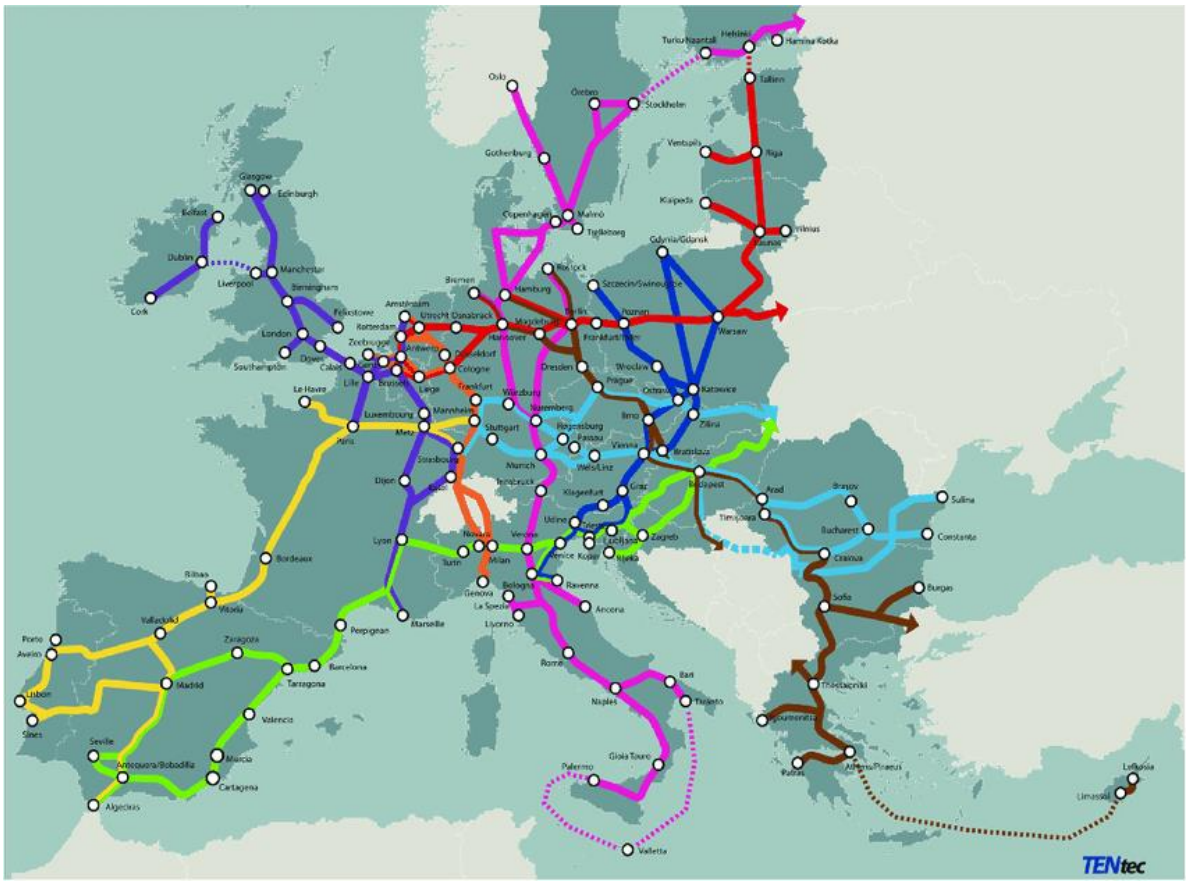


Figure 5: ***TEN-T Core Network Corridors with Spanish intermodal hubs (e.g., Valencia, Barcelona, Zaragoza).***

Source: European Commission (2023)

2.2.4. Spain's Strategic Role in Intermodal Corridors

Spain serves as an essential transportation hub in the Mediterranean and Atlantic TEN-T Corridors because these routes link southern European markets to central and northern European markets. Three Spanish ports including Valencia and Algeciras and Barcelona act as fundamental entry points for trade with Asia and the Americas and Africa. The connection of these ports to rail logistics platforms and dry ports enables strong intermodal transport systems.

Notable developments include:

. The Port of Valencia stands as Spain's biggest container port which connects inland locations through rail lines and dry terminals like Zaragoza PLAZA and

Madrid Abroñigal.

. The EU co-financed Mediterranean Rail Corridor runs from Algeciras through essential intermodal terminals in Murcia, Alicante, Castellón and Tarragona to reach the French border.

. Dry ports like Coslada and Noáin and Azuqueca operate as essential transportation nodes for container handling and customs clearance and consolidation services.

2.2.5. Intermodality and Environmental Sustainability

The major benefit of intermodal transport is its capability to support the reduction of logistics carbon emissions. Rail freight operations produce CO_2 emissions at a rate 80% lower than road transport per tonne-kilometer according to the European Environment Agency (2023). Maritime short-sea shipping produces fewer emissions per unit of freight compared to road transport especially for bulk commodities.

2.3. Changing Consumer Habits in Spain and Their Impact on Logistics

The behavior of Spanish consumers has experienced major transformations because of e-commerce growth combined with urban living patterns and technological developments and increasing environmental consciousness. The modifications in consumer behavior caused a shift within logistics operations toward providing solutions for digital consumers while adapting to urban needs and environmental requirements.

E-commerce emerged as the principal driver because Spanish online shopping activity rose from 38% in 2015 to exceed 67% by 2022 (Eurostat, 2023) and the

COVID-19 pandemic accelerated this trend. The evolution of online shopping has created more complicated small-parcel delivery requirements which demand

quick shipping and instant tracking and convenient return options. Logistics providers have answered this change through their expansion of urban micro fulfillment centers and digital delivery solutions.

The last mile delivery in Madrid and Barcelona faces increasing obstacles because of traffic congestion and emissions control rules. Operators have responded by using electric vans and cargo bikes and implementing smart lockers through Correos' CityPaq and algorithmic route planning. EU funding together with public-private partnerships supports these innovations that develop urban logistics infrastructure.

Logistics operations now incorporate sustainability as a key strategic element because customers increasingly want environmentally friendly deliveries with social responsibility standards. Spanish consumers prefer sustainable shipping options by more than 70% according to Nielsen (2021) which drives companies to implement carbon offsetting practices and AI-based route optimization and recyclable packaging solutions. Reverse logistics has experienced significant growth mainly within the fashion and electronics industries.

The growing consumer market demands have led to faster investment in intermodal solutions which combine rail and road to decrease emissions in extended freight operations. Inditex connects its production and distribution hubs through Galician ports and high-speed rail links while maintaining minimal environmental impact.

However, regional disparities persist. The insufficient infrastructure in rural regions creates longer delivery times and increased expenses for their residents. To eliminate the accessibility gap in Spain digital platforms together with public funds must be invested to provide modern logistics services to all regions equally.

2.4. Port Management as a Key Element in Supply Chains

Modern ports now operate as fundamental logistics hubs which transcend their role of cargo transshipment operations. These terminals serve as essential points in worldwide and continental supply networks to unite seaborne transportation systems with land-based transportation routes. The operational efficiency along with sustainable practices and digitalization processes determine the competitive position of the economy. Three Spanish ports specifically - Valencia and Algeciras together with Barcelona - lead the current transformation by functioning as access points to international markets and EU-aligned innovation centers.

The value addition of Spanish ports extends beyond their maritime operations because they maintain robust intermodal connectivity systems. Through their inland rail network Spanish ports provide efficient connectivity to major logistics centres located in Madrid and Zaragoza. The national network of dry ports and multimodal hubs is connected to Valenciaport facilities to provide support for exports together with internal distribution services (Valenciaport Foundation, 2023). The real-time connection of shipping lines to customs operations and logistics operators through Port Community Systems (PCS) digital systems enhances clearance processes and decreases delays. European Union programs such as TEN-T and the Connecting Europe Facility provided funding for various infrastructure upgrades including electrified rail terminals and automated gate systems.

EU sustainability targets align with these modernization efforts through environmental objectives that focus on shifting transportation modes. The EU has established the Mediterranean and Atlantic corridors to move half of all long distance freight from roads to rail or ships by 2050 which establishes intermodal connections as a fundamental environmental solution and not just an operational one.

The current development of Spain's port infrastructure is influenced by both sustainability policies and governance frameworks. Under Puertos del Estado Spanish ports adopt centralized planning procedures which permit local

managers to operate independently. The established framework has supported both extensive modernization undertakings and facilitates the transition to a green economy. Environmental efforts include shore-side electricity (cold ironing), alternative fuels such as LNG and hydrogen, and the electrification of port machinery. The Port of Barcelona has established a 2050 decarbonization plan which includes investments for renewable energy along with zero-emission zones according to Puertos del Estado (2022).

Strategic significance of ports became evident during the time of crises. The supply of essential goods throughout the COVID-19 pandemic relied on digital coordination systems combined with adaptable infrastructure maintained by Spanish ports. The future competitiveness of transportation systems will emerge from their capacity to embrace automation combined with data analytics and circular logistics models that meet evolving EU climate and trade regulations.

2.5. Sustainability in Transportation: Environmental Impacts and the Shift Toward Green Logistics

The transport sector is both a facilitator of economic development and one of the largest contributors to environmental degradation. In the European Union, transportation accounts for nearly 25% of total greenhouse gas (GHG) emissions, of which road freight and aviation are the most polluting modes (European Environment Agency, 2023). As climate change mitigation becomes a binding priority in EU policy, transport systems—both domestic and international—face urgent pressure to decarbonize and transition toward green logistics models.

2.5.1. Environmental Pressures and Emissions from Freight Transport

Freight transport is directly linked to CO_2 emissions, air pollutants (NO_x, PM), noise pollution, and land use degradation. Heavy reliance on road transport—particularly in last-mile delivery and regional logistics—has led to increased urban congestion, public health risks, and high energy consumption. In Spain, the transport sector alone contributed 27% of national GHG emissions in 2022, making it the largest single-emitting sector (MITERD, 2023).

Different modes of transport have varying environmental footprints. Air freight emits more than 500 grams of CO_2 per tonne-kilometer, compared to approximately 20–30 g CO_2/tkm for rail and 5–10 g CO_2/tkm for maritime short sea shipping (IEA, 2022). These figures explain the EU's strategic push for modal shift as a central pillar of its sustainability policies. The Fit for 55 package, adopted in 2021, aims to reduce transport emissions by 90% by 2050, promoting electrification, biofuels, and intermodal infrastructure as key tools (European Commission, 2021).

2.5.2. The Shift Toward Green Logistics in Spain and the EU

As a result of these challenges, the concept of green logistics is slowly but surely being integrated into the European transportation system. Green logistics is the process of embedding environmental thinking into supply chain management, which encompasses issues such as vehicle efficiency, packaging, route optimization, reverse logistics, and the use of clean energy.

Several initiatives are being taken at the EU level to lead this change:

• The European Green Deal is the long-term plan to make Europe climate neutral by 2050. In this framework, the Sustainable and Smart Mobility Strategy presents 82 specific measures to green the transport sector.

• The EU Emissions Trading System (EU ETS) has been expanded to incorporate maritime transport and road fuel distribution, making the environmental costs of carbon internal.
• The Carbon Border Adjustment Mechanism (CBAM) and Renewable Energy Directive (RED III) also affect the selection of fuel, the design of routes, and the source of energy used in transport operations.

Spain's national climate strategy is in line with EU priorities. The government has invested considerable funds in the Plan de Recuperación, Transformación y Resiliencia to reduce carbon emissions from freight transport and to increase intermodal transport and urban logistics innovation. Specific goals include:

• Increasing the proportion of rail freight to 10% of all inland freight by 2030 (at present about 5%).
• The deployment of Zero Emission Zones (ZEZs) in urban areas.

• Electrifying the public and freight vehicle fleets.

• Building hydrogen corridors and LNG bunkering infrastructure in ports.

Companies operating in Spain are putting forth aggressive ESG (Environmental, Social, Governance) goals. SEUR, DHL, and Correos Express are testing electric delivery vans, drones and AI-driven route optimization systems. For instance, Inditex and Mercadona have started using closed-loop supply chains and reusing packaging and optimizing vehicle capacity to cut down on the number of trips.

Reverse logistics and circular economy logistics are becoming increasingly important, especially in fashion and electronics sectors. Reverse flows, refurbishment, recycling, and waste minimization are being included in logistics KPIs, and not only for cost control, but also as a reputation and compliance strategy.

However, challenges persist. The initial investment in clean vehicles and

infrastructure remains high. The energy supply networks are not uniformly developed. And harmonizing regulations across municipalities and regions remains difficult. To overcome these issues, multi-stakeholder cooperation—between public authorities, transport operators, logistics firms, and consumers— is essential.

2.6. Public Policies and Their Influence on International Transportation: Regulations, Incentives, and Sustainability Goals

Policy is a very important factor in the development of the international transport system. The European Union and national governments, including Spain, are redefining the movement of goods across borders through their regulations, incentives and long-term sustainability goals. These frameworks are not only focused on improving efficiency, but also on decreasing emissions, encouraging digitalization, and increasing the resilience of the infrastructure.

2.6.1. European and Spanish Frameworks for Sustainable Transport

At the EU level, initiatives like the Trans-European Transport Network (TEN-T) and Fit for 55 package provide both direction and funding for the decarbonization and modernization of transport systems. The TEN-T corridors, including Spain's Mediterranean and Atlantic axes, are mandated to improve intermodal links and reach climate performance targets by 2030, backed by funding from the Connecting Europe Facility and NextGenerationEU.

The regulatory changes include the extension of the EU Emissions Trading System (ETS) to road and maritime transport, and the Carbon Border Adjustment Mechanism (CBAM) that internalize environmental costs and encourage logistics models. These tools create economic pressure on freight operators to switch to low-carbon technologies and optimize routes.

Spain mirrors these efforts through its Estrategia de Movilidad Segura, Sostenible y Conectada 2030, which promotes modal shift to rail, green vehicle fleets, and investment in digital infrastructure. The Plan de Recuperación, Transformación y Resiliencia (PRTR) has allocated billions of euros to support logistics hubs, rail electrification, and low-emission zones across key freight corridors.

2.6.2. Digital and Fiscal Instruments to Drive Logistics Innovation

The EU together with Spain has established multiple instruments to boost innovation in addition to their regulatory framework. The eFTI digital framework requires electronic logistics data exchange while MOVES III subsidy program supports electric fleet adoption.

The Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA) has created logistics observatories and smart transport platforms to track freight activity and evaluate policy results. The combined initiatives work to synchronize transport operations with climate targets while enhancing supply chain transparency.

The transport sector moves toward sustainability and efficiency and resilience through combined fiscal support and legal mandates despite ongoing implementation gaps that affect Member State standard harmonization.

2.7. Emerging Global Trade Drivers and Technological Trend

2.7.1. Bilateral Trade Flows with China and the United States

The Spanish economy and logistics suffer a significant influence of China and the United States. China is Spain's main non-EU import partner, primarily in electronics, textiles and industrial parts (Eurostat, 2023). On the other side, the US is an important market for Spanish agri-food sales and a great exporting partner in technological products. These flows influence import/export flows, container traffic at Spanish ports, and intermodal route planning.

Valencia, Algeciras and Barcelona have experienced upticks in container throughput – as a result of increased trade volumes with China. Some Spanish exports to the US, including olive oil, wine and pharmaceuticals, need temperature-controlled logistics and urgent shipping services. Hence, these commercial relationships highlight the necessity for fleet-footed port operations and multi-modal integration.

2.7.2. Automation and Electrification in Transport Infrastructure

Automation is changing the face of logistics with self-driving cranes, Automated Guided Vehicles (AGVs) and robot-driven warehouse solutions. Terminal automation is being embraced in the Spanish ports either, especially in Barcelona and Bilbao where their experiences suggest that increased efficiency and improved safety are resulting. For example, the BEST terminal at Barcelona is one of the

most advanced semi-automated terminals in Europe.

Electrification is also key. The introduction of electric trucks and further development of shore power infrastructure (cold ironing) at facilities such as Valencia will help Spain reach its carbonneutral targets. Electric cargo bikes and urban microhubs are increasingly common in last-mile delivery across Madrid and Barcelona.

2.7.3. AI-Powered Optimization and Predictive Analytics

Artificial Intelligence enhances logistics through:

Predictive maintenance: Reducing unplanned downtime in fleets.

Demand forecasting: Optimizing inventory and delivery scheduling.

Route optimization: Minimizing fuel use and emissions in last-mile logistics.

Correos, SEUR, and Inditex use AI algorithms for real-time delivery management, capacity planning, and customer experience personalization. Integration of AI with IoT and big data platforms facilitates more responsive and sustainable logistics networks.

3. How Consumer Trends Influence Transport Management

The transport and logistics sector underwent substantial transformation during the previous ten years due to changes in how consumers behave. The logistics industry must adopt data-driven practices and sustainable operations to meet rising consumer demands for speed and traceability together with environmental awareness and e-commerce growth. The changing customer expectations have reshaped last-mile delivery systems and distribution models and drive fundamental changes in infrastructure development as well as port operations and intermodal transportation strategies. The European Union together with Spain continues to develop public policies which adapt to and direct these consumer-driven market changes.

3.1. The Rise of E-Commerce and New Distribution Models

E-commerce continues to transform consumer behaviour as previously examined in the theoretical framework which also reshapes how distribution systems operate. The growing online sales in Spain has driven logistics providers to abandon their traditional B2B and bulk-based operations by establishing high frequency consumer-centric networks. These networks have revolutionized international freight flows and distribution architecture through their emphasis on speed and visibility and responsiveness.

Decentralized distribution represents the main transformation observed in modern supply chains. Companies now establish multiple regional fulfillment centers and urban micro-hubs instead of depending on large central warehouses. The new approach enables companies to decrease delivery times and improve their capability to track local market needs by placing inventory near end consumers.

Modern transport management combines predictive approaches with digitalized operations. The supply chain movement of goods now depends heavily on real time data together with demand forecasting as well as dynamic routing. The logistics manager needs to lead the coordinated operation of transport assets across diverse geographical regions and transportation modes while ensuring environmental responsibility.

The integration of intermodal logistics has become possible because of these recent changes. Spanish operators link maritime imports with rail-based inland distribution to enhance speed while decreasing emissions because they respond to both consumer demands and environmental and regulatory requirements. The e-commerce revolution creates effects which extend past last-mile delivery because it drives transportation planning and infrastructure development throughout the complete international logistics system.

3.2. The Growing Demand for Speed, Sustainability, and Digitalization

The modern consumer demands quick dependable delivery but does not want to pay additional costs. The market demand for sustainable operations and open

transparency has developed in sync with the need for fast delivery. Nielsen (2021) reports that Spanish consumers choose companies which provide carbon neutral shipping as well as recyclable packaging and emission-reduction commitments at a rate exceeding 70%.

The combination of fast delivery with environmental responsibility has led organizations to adopt digital solutions such as tracking systems, eco-friendly routing algorithms and digital scheduling platforms. Delivery platforms that provide flexible scheduling options with consolidated order packages and green delivery choices now establish market leadership. Major logistics players use AI along with IoT and big data analytics as standard tools for optimizing route planning and improving delivery success rates while matching transport capacity

with market demand patterns.

3.3. Implications for Port Operations and Intermodal Logistics

Consumer trends create changes in upstream logistics activities that especially affect port operations together with intermodal transport systems. Higher import volumes together with reduced delivery windows force ports to speed up container processing and establish seamless intermodal connections while maintaining constant supply chain visibility. The ports of Valencia along with Algeciras and Barcelona have implemented Port Community Systems and automated terminals and strengthened inland hub rail connections.

The logistics industry needs ports to transform into data-enabled platforms that maintain agility in addition to their existing role as transfer points. The rise of containerization in consumer goods alongside time-sensitive retail flows makes port efficiency critical for supporting e-commerce and omnichannel supply chains. The rapid sustainable distribution of incoming goods depends on intermodal systems that combine rail with road networks across both national and European transportation corridors.

3.4. Adapting Supply Chains to New Consumer Expectations

Modern supply chains move toward decentralized operations and data-based decision making while delivering customer-driven responses. The traditional mass-distribution approach gives way to hybrid network structures with multiple nodes that achieve both agility and customer proximity. Inditex along with Decathlon built logistics systems which unite production sites to ports and regional warehouses through integrated platforms to provide quick product customization and fast product replenishment.

The importance of reverse logistics operations including returns and recycling and refurbishment continues to rise because fashion and electronics customers demand sustainable practices. The implementation of efficient reverse flows demands specific dedicated infrastructure and regulatory backing as well as intermodal strategies to minimize environmental damage from returned goods.

Urban logistics strategies with low-emission zones and micro-hubs and electric vehicle fleets help companies meet local sustainability goals while ensuring high service levels.

3.5. The Role of Government Regulations in Shaping Transportation Strategies and Sustainability Practices

The operational boundaries of transport systems become more defined through government policies that expand beyond consumer demand patterns. EU regulations which include the European Green Deal and Fit for 55 and the revised TEN-T framework establish specific targets for digital transformation and emissions reduction and modal shift. The EU Emissions Trading System (ETS2) and Carbon Border Adjustment Mechanism (CBAM) help internalize environmental costs which in turn shape logistics planning across the entire distribution process from procurement to delivery.

Spain implements its Estrategia de Movilidad Segura, Sostenible y Conectada 2030 and Plan de Recuperación, Transformación y Resiliencia to boost investments in intermodal hubs and digital freight corridors and electric logistics fleets. Urban mobility plans and low-emission regulations serve as essential municipal tools for cities that experience intense e-commerce operations.

Public policy meets consumer expectations through a combination that transforms transportation systems at both ends. The transportation sector now operates as a digital and sustainable adaptive industry that will determine its future competitiveness and resilience.

4. Business Strategies in the Transport and Logistics Sector

Companies within the transport and logistics sector must undergo profound strategic transformation because of environmental pressure growth alongside evolving consumer demands and complicated regulatory systems. Companies operating in Spain together with European Union nations transform their operational structures to achieve market competitiveness in digital and decarbonized fast-paced environments. The current transportation sector implements core business approaches that include cost reduction and intermodal development as well as environmental responsibility and regulatory adjustments backed by actual business data and policy regulations.

4.1. How Companies Optimize Logistics and Transport Efficiency

Organizations achieve maximum efficiency by allocating substantial funds to implement predictive planning combined with network optimization and smart inventory systems. The implementation of digital transport management systems (TMS) by companies allows them to cut their logistics costs by 8-10% and enhance on-time delivery performance by up to 30% according to McKinsey & Company in 2023.

The major Spanish logistics operators SEUR and Correos along with Inditex adopt automated warehouse systems together with route planning dynamics and multi-modal transportation to minimize delivery times and control their vehicle

capacities. The Zaragoza PLAZA logistics platform demonstrates how infrastructure planning enhances network-wide optimization by connecting by rail to Valencia and Barcelona (Fundación Valenciaport, 2023).

4.2. Cost Management and Profitability in International Trade

International logistics cost effectiveness depends on achieving scale through optimal routes combined with suitable transport modes. Road transport provides flexibility yet it is expensive and produces many emissions but intermodal strategies particularly involving maritime and rail transport enable significant cost savings. According to the International Transport Forum (ITF, 2022), rail freight reduces carbon dioxide emissions to 75% below road transport levels per tonne kilometer and it provides 40% cost savings for journeys exceeding 300 kilometers when sufficient infrastructure exists.

Spanish operators decrease their fuel and labor expenses through the implementation of dry ports and rail corridors such as the Mediterranean TEN-T corridor while maintaining compliance with low-emission zone restrictions. Large shippers now implement extended freight contracts together with freight pooling operations as a strategy to control market uncertainty and reduce operational threats (OECD, 2021).

4.3. Innovations in Intermodal Transport and Digital Transformation

Modern technological breakthroughs lead to a transformed future of integrated intermodal logistics operations. The Spanish port system uses Port Community Systems (PCS) like ValenciaportPCS to decrease administrative customs processing times by more than 25% according to Fundación Valenciaport (2022). The system allows digital communication between terminals and customs agents and shipping lines which makes port operations more efficient and creates smooth connections between ports and inland logistics terminals.

Digital transformation extends beyond ports. The European Commission predicts IoT and AI-based routing implementation across all sectors will produce two benefits: it will cut freight emissions by 15–20% while delivering yearly savings of

€100 billion to logistics operations by 2030 (European Commission, 2021). DHL and Maersk utilize predictive analytics together with digital twins and real-time cargo tracking systems to minimize disruptions and enhance customer visibility.

4.4. Sustainability Strategies and Corporate Responsibility

Organizations now treat sustainability as a core operational requirement rather than just a branding tool. The adoption of ESG (Environmental, Social, Governance) indicators in strategic planning has become a standard practice among more than 78% of logistics companies across Europe (PwC, 2022). Correos Express has introduced electric vehicle operations in more than thirty Spanish cities while DHL aims to fully electrify sixty percent of its last-mile delivery fleet before 2030 (DHL Group, 2023).

The sustainability movement extends its influence to packaging operations and infrastructure systems and the reverse logistics process. The logistics system of Inditex uses reused delivery containers together with inventory recycling to cut waste production and enhance inventory responsiveness (Inditex, 2022). These measures enable organizations to fulfill upcoming EU requirements which include the Corporate Sustainability Reporting Directive (CSRD) and the EU taxonomy for sustainable activities.

4.5. Public Policy Compliance and the Impact of Regulations on Business Strategy

The formulation of business strategy in transport logistics depends heavily on policy decisions. The EU Mobility Package and European Green Deal and Fit for 55 package require businesses to meet new requirements regarding emissions controls and digital documentation alongside driver working condition standards. The European Environment Agency (2023) reveals that the EU ETS2 which will start applying to road and building fuels from 2027 will force companies to calculate carbon costs that need to influence their future pricing models and route

planning strategies.

The PRTR of Spain allocated more than 6.5 billion euros to support sustainable mobility initiatives through funding electric fleets and smart logistics infrastructure and green port technologies (MITMA, 2022). Businesses that participate early with these programs reduce their compliance risks and obtain access to subsidies and speedier permits and preferred supplier status in green procurement chains.

Companies that fail to adapt will face increased operational costs and regulatory penalties as well as decreased competitiveness because sustainability certifications like ISO 14001 and ECOLABEL have become essential for major clients in international supply chains.

4.6- Interview with Vicente Ferrer, Managing Director of Manuport Logistics Spain

What role does the Port of Valencia play in the regional and national economy?

Thanks to being a natural generator of employment, the Port of Valencia is a very important economic engine both at the regional and national level. There are two main types of goods that enter and exit through the Port of Valencia. One is **transshipment cargo**, which is the majority of the goods moved through the Port of Algeciras. Valencia is considered by the world's leading shipping company, **Mediterranean Shipping Company (MSC)**, as the hub port of the Mediterranean. This means that, for transoceanic traffic, cargo is unloaded or loaded at the Port of Valencia and then distributed to other ports, mainly within the Mediterranean, using smaller feeder ships, thus avoiding extra costs by skipping additional stops. For example, a ship from MSC can unload 60% **of its cargo without its final**

destination being Spain. This gives a significant **boost to the port's revenues** and to the operators acting in Valencia.

On the other hand, we have the **cargo with a destination or origin** from the Port of Valencia. The port is strategically well-located, with an extensive hinterland covering the central zone, Madrid, Castilla, and even extending to Murcia. Compared to **Barcelona**, which is the main competitor for container traffic, Valencia has a much larger hinterland, as Barcelona mainly serves Catalonia and the Aragón region. Historically, the Basque Country and northern Spain used to go through Barcelona, but this difference has diminished in recent years. The reason for this reduction in the gap is the recent development of **rail corridors**. For example, the Port of Valencia now has rail services extending to Navarra, Zaragoza, and, of course, Madrid. This facilitates the transportation of goods and optimizes costs and time.

What are the growth and development plans for the Port of Valencia?

The **main growth bet for the Port of Valencia** is the construction of the **fourth container terminal**, which has recently been assigned to MSC. Currently, there are **three container terminals** in the Port of Valencia: one managed by **COSCO**, another by **MERK**, and the third by **MSC**. These three are the largest shipping companies in the world and own container terminals at the Port of Valencia. This reflects a significant bet on the port from the world's major shipping companies. The fourth terminal has a **50-year concession** and will involve an investment of **€1.1 billion**. This marks a clear commitment to the Port of Valencia as a key player in container traffic.

This new terminal will allow larger ships, up to **430 meters in length**, to dock, with the capacity to transport **24,000 TEUs** (Twenty-foot Equivalent Units), which is the standard measure for maritime traffic. The terminal will be equipped with **cutting-edge technologies and environmentally friendly designs**, aiming to be **energy self-sufficient** and align with the port's goal of achieving **zero emissions by 2030**. Additionally, the terminal will have a **rail terminal** because **rail is considered the future of sustainable transportation**. The rail network will consist of **six tracks**, stretching **1,000 meters in length**, and will have the capacity to move **300,000 TEUs annually** by rail, aside from the ones handled by trucks. This terminal will not

only increase operations at the Port of Valencia but also **attract cargo that currently goes to other ports** like Bilbao and Barcelona. The goal is to create a **leading port**, not only in the Mediterranean but at the global level.

How is the flow of goods through the port being optimized, especially during times of high demand?

In terms of optimization strategies, there are several factors to consider. In emergency situations, like the **Dana storm**, everyone collaborates, extending working hours, expanding access where possible, and increasing shifts of stevedoring staff to meet the demand. However, under normal circumstances, there are various optimization strategies. One of them is **digitalization and automation** through digital platforms and terminal management systems to improve efficiency in handling containers and planning operations. The **automation of processes** for ship loading and unloading is being considered to reduce errors and handling time, which is crucial.

The **infrastructure** also needs continuous expansion and modernization. This is fundamental not only for docks, cranes, and storage areas but also for **land and rail connections**, which are being developed significantly. Unfortunately, the **land access** to the Port of Valencia suffers from many shortcomings, as a northern access that has been requested for years is still not available. This would greatly facilitate cargo flows towards Castellón, especially since all land traffic currently exits from the southern area, which leads to the **V-30** and creates a major bottleneck. However, rail connections, especially with other logistics centers and different areas of the country, are being significantly improved.

Another point is the **optimization of processes**. It's important to have good **planning and management** to know what resources are available at any given moment. The collaboration of all stakeholders involved in the port’s daily operations—shipping companies, port terminals, freight forwarders, customs agents, and transport companies, both by road and rail—plays a key role in optimizing the **supply chain** and reducing conflicts. Efficient management of **demand** is also critical. For instance, **preparing for the Easter period**, when operations slow down, requires forecasting and flexibility. Similarly, the **end of**

July, when many companies prepare for August holidays, demands flexible strategies to meet the surge in cargo movements.

Lastly, it’s also important to **manage maritime traffic** efficiently. This involves optimizing **routes** and managing **stops**. The smoother the operations at the port, the better it is for the shipping companies, as long delays in port operations would result in **higher costs** and slower delivery times, which ultimately add unnecessary expenses.

5. Case Study Real-World Implications of Changing Consumer Trends

5.1. Analysis of Inditex's Logistics and Distribution Network

Inditex (Industria de Diseño Textil S.A.) is the Spanish multinational fashion group based in Arteixo (Galicia) which operates one of the most advanced and agile logistics networks in the global retail industry. With more than 6,400 stores in 213 markets and an ever-expanding online presence, the efficiency of its transportation and distribution system is not only fundamental to the company's business model, but also a reference for global logistics innovation (Inditex, 2023).

The centralised logistics architecture of Inditex is based on a distribution model fully located in Spain. Any item of clothing, from Tokyo to Berlin to New York, passes through a small number of high-tech logistics hubs in Arteixo (La Coruña), Zaragoza (PLA-ZA), Elche and León, from where they are dispatched all over the world. This structure allows the company to keep full control of inventory, time-to-market and quality throughout the supply chain.

5.1.1. The Centralized Logistics Model

Inditex's vertically integrated supply chain is built to minimize lead times and improve responsiveness. Products move from production sites, which are typically in Spain, Portugal, Morocco, Turkey or Asia to central logistics hubs where they are sorted, packed and redistributed within 24 to 48 hours. This model allows every store, regardless of its location, to get new stock twice per week, a frequency that is unmatched by most global retailers (Inditex, 2023).

The Arteixo distribution centre, co-located with the company's design and corporate headquarters, handles the Zara Woman and Zara Basic lines. The

Zaragoza PLAZA platform, one of the largest logistics parks in Europe with over 280,000 m² of warehouse space, supports global e-commerce flows and connects efficiently to rail corridors and Spanish ports (Fundación Valenciaport, 2023).

5.1.2. Use of Intermodal and International Transport Modes

The company's logistics network uses a multi-modal strategy which combines maritime shipping, road transport, and rail freight to manage global distribution. Maritime routes are still essential for long-haul flows, especially for intercontinental markets such as the Americas and Asia. The company has however in the recent past raised its use of rail and short-sea shipping especially in Europe to decrease its carbon footprint and reduce congestion on road corridors.

• The Zaragoza–Valencia rail corridor is critical for moving containerized flows from Inditex's inland warehouses to Mediterranean ports to EU destinations like France, Germany and Italy.

• Inditex in 2023 formed a partnership with Maersk to test the use of low carbon maritime fuels in its transoceanic cargo, a move which shows the firm's growing support for EU decarbonization goals (Maersk, 2023).

The intermodal strategy is supported by Port Community Systems (PCS), particularly at Valenciaport, which integrates customs clearance, shipping schedules, and inland routing into a single digital platform. These systems allow Inditex and its partners to track cargo in real time and reduce administrative overheads (Fundación Valenciaport, 2022).

5.1.3. Digitalization and Automation in Logistics

Logistics efficiency of Inditex is based on the strong investment in automation and digital systems. All the garments carry RFID (Radio-Frequency Identification)

tags which enable real time inventory tracking from manufacturing to stores and customer returns. Distribution centers have automated conveyors, sorting systems, high-density storage that enable rapid order processing.

These technologies allow Inditex to:

• Decrease the order preparation time

• Dynamically route products based on demand forecasts • Synchronize e-commerce and physical store stock

In the company's 2022 Annual Report, logistics technology upgrades consumed €250 million of capital expenditure and resulted in a 12% decrease in average delivery time across international markets (Inditex, 2023).

Figure 6: Conceptual Diagram of RFID-Based Warehouse Management System Source: ResearchGate

5.1.4. Logistics Workforce and Operational Scale

The logistics operations of Inditex support over 10,000 direct jobs, with roles ranging from warehouse automation management to transport coordination. The PLA-ZA platform alone employs 1,500 people and operates 24/7 to service more than 90 countries.

This scale requires continuous coordination across transport modes and border systems, particularly in aligning with EU customs digitization initiatives such as eFTI (electronic Freight Transport Information). By adopting such technologies early, Inditex strengthens its resilience and compliance within the evolving European logistics ecosystem.

5.2. The Impact of New Consumer Behavior on Inditex's Operations

The fashion industry has experienced substantial pressure from changing customer needs which result from digital retail transformation together with rising environmental concerns and faster delivery expectations and personalization needs during the last decade. Consumer demand evolution at Inditex caused major operational changes to their logistics management systems and delivery methods as well as digital infrastructure development and reverse logistics operations.

5.2.1. E-Commerce Growth and Delivery Expectations

Online shopping represents a transformative change which stands among the most significant developments in retail industry evolution. Online sales at Inditex reached 24% of total revenue during 2023 according to the company's annual

report from 2023 while they started at 14% in 2019 (Inditex, 2023). Online sales expansion has compelled Inditex to create new logistics systems that fulfill e commerce needs alongside conventional retail store operations.

People today demand fast delivery times ranging from 24 to 48 hours no matter where their delivery destination is located. The demand forced Inditex to make the following changes:

. Inditex has rearranged its warehouse design to create separate zones for e commerce processing operations

. The company has taken two steps to improve last-mile delivery services by using both national and regional carrier networks.
. The company has boosted shipping operations from its core distribution centers based in Arteixo and Zaragoza to deliver products directly to customers

5.2.2. Rise in Returns and Reverse Logistics Complexity

The fashion industry's online sales operations lead to elevated return rates which exceed 30% in European markets according to Statista's 2023 research. The rise of reverse logistics operations at Inditex has resulted in major changes to transport volumes and packaging waste generation as well as delivery performance metrics.

The company has implemented these strategic measures to handle this development:

• The company established independent return logistics systems throughout its distribution centers
. The company has introduced two new return solutions which include store based returns and locker-based returns.
• The system combines return streams with RFID technology and inventory management systems to achieve real-time restocking capabilities

The rising operational complexity requires both circular logistics and modular packaging as essential components of Inditex's modern sustainability initiatives.

5.2.3. Demand for Transparency and Sustainability

People today seek both fast service and ethical practices which produce minimal carbon emissions. Spanish and EU consumer surveys indicate that more than 70% of individuals base their purchasing choices on environmental and labor practices (Eurobarometer, 2022). Zara under Inditex introduced Join Life as a product collection which focuses on organic textiles alongside sustainable supply chains and transportation methods with minimal environmental impact.

Logistical operations require companies to:

• Regional distribution operations now depend on rail and short-sea shipping transportation.
. The company has implemented a change of strategy that uses air freight only when speed becomes the primary requirement.
• The company invests more money to monitor carbon emissions in real time and to develop environmentally friendly delivery methods.

The change goes beyond consumer demands since it anticipates EU regulatory requirements especially those related to the Corporate Sustainability Reporting Directive (CSRD) and Product Environmental Footprint (PEF) labeling systems.

5.2.4. Digital Expectations and Experience Integration

The modern consumer requires digital visibility of their orders through features including real-time tracking alongside delivery date predictions and flexible return capabilities. Inditex has adopted this behavioral trend by making changes to its app and online platform which now shows real-time order status along with location tracking.

. The company uses logistics data to make front-end interfaces available to customers (store availability and delivery slot booking).

. AI-based demand forecasting systems now help prevent both stockout situations and excessive production.

The system now provides transparent responses which unite physical and digital retail into a single experience known as phygital and matches logistics operations to marketing approaches and store designs and customer experience.

5.2.5. Summary and Strategic Implications

Logistics innovation and transformation now depends heavily on consumer behavior beyond its traditional role as a commercial factor. The modifications Inditex made to meet these expectations included building expanded logistics operations and digital supply chain implementation as well as balancing delivery speed with sustainability measures. The market will see escalating changes because consumers and regulators will continue to demand higher environmental responsibility along with precise delivery and transparent operations.

5.3. Strategic Responses and Adaptation Measures

Inditex implemented multiple strategic adaptations to deal with rapidly changing consumer demands and growing regulatory along with environmental limitations. The changes surpass basic logistical modifications because they represent an extensive transformation of the company's transportation and distribution methods together with its sustainability framework. Inditex implements global

logistics architecture changes to stay competitive and compliant through digital supply chain optimization and transport flow rearrangement and intermodal solutions.

5.3.1. Investments in Logistics Infrastructure and Capacity Expansion

The operational pressures from e-commerce growth and speed requirements drove Inditex to increase its logistics network size through major infrastructure developments. The company dedicated €1.8 billion to logistics infrastructure development between 2022 and 2023 which involved growing the Zaragoza (PLA-ZA) and Arteixo facilities while advancing automation platforms and internal data handling systems (Financial Times, 2023).

The Zaragoza logistics complex represents the largest facility in Spain and functions to support omnichannel distribution between retail stores and online operations which enables quick international and regional delivery services. The platform incorporates intermodal transportation features which include rail service connections to ports and cross-docking facilities because Inditex has adopted a modernized transport system that promotes both flexibility and sustainability.

5.3.2. Digitization and Real-Time Data Integration

The core element of Inditex's solution involves digitizing its entire logistics operations. Real-time tracking from manufacturing through to final delivery is possible because every product includes an RFID tag. The warehouse management system (WMS) which Inditex operates internally tracks RFID tags seamlessly with transport monitoring systems and inventory management tools.

The RFID-based infrastructure achieves high stock accuracy levels of 99% while enabling product rerouting to busy locations in real-time thus improving delivery speed and decreasing stockpiling.

The company applies digital twins at its major warehouses for predicting operational scenarios which leads to better planning capabilities and process enhancements (Inditex, 2023).

5.3.3 Intermodal Transport Partnerships and Low-Carbon Logistics

The combination of sustainability requirements with operational performance needs drove Inditex to take decisive action in optimizing its transportation mode distribution. The 2023 launch of a strategic partnership between Inditex and Maersk brought about the transition of certain transatlantic maritime freight to biofuel shipping which cuts CO_2 emissions up to 84% per voyage (Maersk, 2023).

European distribution operations of Inditex rely more heavily on rail freight corridors which include the Mediterranean Corridor that links PLAZA Zaragoza to Valencia and Barcelona. The established routes enable mass transportation of goods to reach France Germany and the Netherlands through environmentally friendly routes compared to conventional road transport.

The use of rail freight at Zaragoza operations reported Fundación Valenciaport in 2023 that reduced emissions by 52% for each tonne-kilometer compared to using road transport (2023).

5.3.4. Agile Supply Chain Resilience and Flexibility

The supply chain design of Inditex embraces agility as its fundamental operation. The organization can manage disruptions effectively to minimize service quality deterioration.

Examples of agility-based strategies include:

• The lead time between design and store delivery takes approximately

three weeks.

• The store receives new inventory replenishments at a rate of twice per week.

• The warehouse system has modular elements which enable shifts between serving retail and e-commerce peak periods

The supply chain attributes boost customer satisfaction along with speed performance and inventory security and maximize resource utilization according to Inditex (2023).

5.3.5. Integration of Logistics with Customer Experience

Logistics operations now receive strategic development that focuses on improving the customer experience. Through the Zara app and website, consumers receive:

• Real-time order tracking

• Delivery ETA updates

• Seamless in-store returns and exchanges

Inditex demonstrates its focus on developing end-to-end digital experiences by synchronizing these digital services with backend logistics systems which align operational agility with user expectations.

5.4. The Role of Sustainability Initiatives and Compliance with Environmental Regulations in Shaping Inditex's Success

Logistics-intensive companies such as Inditex face mounting pressure from consumers together with investors and regulators to decrease their environmental footprint which extends across their complete supply chain. Sustainability functions as an essential operational strategy for Inditex because the company implements its international transport system through sustainability principles.

Through its commitment to EU climate policy and circular economy targets together with ESG reporting frameworks the company developed both regulatory strength and market benefits. This section demonstrates the environmental initiatives undertaken by Inditex together with their relationship to established sustainability protocols and European climate regulations.

5.4.1. Net-Zero Commitments and Carbon Mitigation Targets

The company has made a net-zero emissions promise for 2040 while establishing short-term objectives for emission reduction.

• The organization aims to cut Scope 1 and Scope 2 emissions by 90 percent until 2030.
• Inditex plans to reduce its Scope 3 emissions by 50 percent through 2030 compared to the base year of 2018 (Source: Inditex, 2023)

These targets meet the requirements of the Science-Based Targets initiative (SBTi) while following the 1.5°C pathway established by the Paris Agreement.

To reach its targets Inditex transforms its logistics operations by:

• The company shifts its transportation methods to rail and sea transport for all possible routes
• Partnerships with Maersk Biofuel Pilot allow the company to use low carbon marine fuels.

• The company invests in electric vehicle technology while enhancing load distribution for last-mile delivery routes.

5.4.2. Integration of Renewable Energy and Clean Infrastructure

Since 2022 all Inditex-owned logistics centers have used 100% renewable power for their electricity needs. For instance:

• The Arteixo and Zaragoza platforms operate using solar energy generated on-site while receiving their power from green certification.
• Inditex's global HQ is a LEED Gold–certified building, combining solar panels, rainwater harvesting, and passive ventilation systems.

The implemented measures help Inditex fulfill EU Energy Efficiency Directive requirements as well as REPowerEU strategies that mandate better energy performance and cleaner infrastructure adoption (European Commission, 2022).

5.4.3. Circular Logistics and Waste Minimization

Inditex established reverse logistics systems because of rising circular economy policy requirements and changing consumer preferences toward sustainability through its store-based collection and recycling program with local NGOs and container and packaging reuse initiatives reaching 80% in 2023 and sustainable mono-material paper packaging for all online orders.

The company implements circular KPIs across its transportation system through backhaul utilization rates and emissions measurements from returned items to

fulfill EU Circular Economy Action Plan requirements.

5.4.4. Regulatory Compliance and ESG Reporting

The company fully complies with:

- The Corporate Sustainability Reporting Directive (CSRD) requires Inditex to submit E, S and G reports for all sustainability areas.
- The EU Taxonomy for Sustainable Economic Activities, disclosing environmental performance and transport-related emissions
- The EU Emissions Trading System (ETS2) through its logistics providers, especially in road freight and maritime partnerships

Non-financial reporting by Inditex includes logistics KPIs that include:

- Emissions per tonne-kilometer
- % of freight transported by low-emission modes
- Packaging-to-product ratio for shipped items

Example:

The 140-page Inditex 2023 Statement of Non-Financial Information demonstrates extensive environmental reporting about logistics facilities and product lines.

5.4.5. Environmental Strategy as a Competitive Asset

Inditex strategically uses sustainability as a business advantage instead of treating environmental regulations as additional expenses. The company applies environmental regulation as a strategic tool to achieve multiple goals through:

- Brand positioning (Zara’s Join Life collection accounts for 50%+ of global sales)

• Investor attraction, supported by inclusion in the Dow Jones Sustainability Index
• Eligibility for green finance, such as bonds or EIB-backed investments

The established approach provides Inditex with operational sustainability for the future and keeps its operations compliant with regulations across all markets while developing long-term resistance to the carbon-constrained global economy.

6. Conclusions and Future Perspectives

Consumer expectations along with technological advancements and regulatory requirements now drive international transport transformation. This TFG studied the fundamental evolution of logistics models by using theoretical principles and the practical example of Inditex to show how systems now integrate digital technologies and achieve sustainability while becoming more agile.

6.1. Key Takeaways from the Research

1. Logistics transformation primarily stems from how consumers behave.

The rise of e-commerce combined with consumer demands for quick delivery and environmental awareness has transformed global supply chain operations into their new structure.

2. Digital tools have become critical enablers of logistics performance.

RFID technology along with predictive analytics digital twins and real-time tracking systems have become essential elements for achieving visibility and resilience while maintaining customer satisfaction within international transport networks.

3. Intermodal logistics together with efficient port operations are vital elements for achieving sustainability objectives.

The transition from truck to rail and maritime short-sea shipping operations supports both environmental emission reduction and supply chain cost reduction strategies. Smart strategic nodes have emerged from ports which now perform as more than just cargo gateways.

4. The alignment between environmental regulations and corporate strategy

becomes more noticeable in current times.

The company Inditex uses sustainability as its main competitive tool instead of using it for regulatory compliance purposes. Logistics strategy now includes EU climate policy integration through initiatives like Fit for 55 and CSRD and ETS2.

6.2. Implications for Port Management and Intermodal Transport

Spanish and European ports need to transform their operations because traditional infrastructure functions no longer meet current needs. The requirements of high-frequency and low-emission transport flows necessitate that ports enhance their digital capabilities by adopting Port Community Systems (PCS) and eFTI-compliant data exchange.

The priority for rail-port connectivity requires strategic funding of dry ports combined with rail terminals and TEN-T corridor electrification initiatives.

The successful operation of sustainable and efficient last-mile logistics depends on port authorities working together with urban logistics platforms.

The successful alignment between Inditex's logistics strategy and port capabilities at Zaragoza, Valencia and Barcelona enables the creation of scalable and environmentally responsible European distribution networks.

6.3. Challenges and Opportunities for Businesses in the Sector

Logistics and transport companies face a dual challenge:

• Adapting to consumer expectations for speed, transparency, and flexibility • Complying with evolving sustainability regulations and cost structures (e.g., emissions pricing)

Yet these challenges also present opportunities. Companies that invest in intermodal transport, digital traceability, and ESG-aligned logistics are better positioned to:

• Access green financing and public support (NextGenEU, CEF, EIB) • Differentiate themselves in procurement processes

• Attract sustainability-conscious customers and partners The Inditex case exemplifies how large-scale retail logistics can use infrastructure, digital tools, and environmental targets to drive strategic adaptation.

6.4. Potential Areas for Further Study, with a Focus on Sustainability and Policy Evolution

The analysis presented in this TFG provides a comprehensive overview yet leaves multiple research opportunities unexplored.

• Quantitative evaluation of emissions savings from modal shift strategies across Spanish logistics corridors

• Comparative studies between companies that integrate digital logistics platforms and those that do not

• Analysis of policy impact from future EU regulatory packages, such as the expansion of the ETS to maritime and road transport (ETS2)

• Emerging circular logistics models, particularly in high-return sectors like fashion, electronics, and pharmaceuticals

• Urban logistics innovation, including microhubs, electric cargo bikes, and last-mile optimization algorithms

Future research should analyze how consumer trends intersect with technological progress and policy adjustments because they will determine the sustainable and competitive logistics models of the next decade.

7. References

· Arvis, J. F., Saslavsky, D., Ojala, L., Shepherd, B., Busch, C., Raj, A., & Naula, T. (2018). *Connecting to Compete 2018: Trade Logistics in the Global Economy (LPI Report)*. The World Bank. https://lpi.worldbank.org

· DHL Group. (2023). *Sustainability Roadmap 2030*. https://www.dhl.com

· European Commission. (2021). *Fit for 55: Delivering the EU's 2030 Climate Target on the Way to Climate Neutrality*. https://ec.europa.eu · European Commission. (2021). *Smart and Sustainable Mobility Strategy*. https://transport.ec.europa.eu

· European Commission. (2022). *REPowerEU Plan – Clean Energy and Energy Efficiency Package*. https://eur-lex.europa.eu/legal content/EN/TXT/?uri=CELEX:52022DC0230

· European Commission. (2023). *TEN-T Regulation and Fit for 55 Overview*. https://transport.ec.europa.eu

· European Commission. (2023). *Transport and Mobility Statistics*. https://ec.europa.eu/eurostat

· European Environment Agency. (2023). *ETS2 and Transport Sector Implications*. https://www.eea.europa.eu

· European Environment Agency. (2023). *Greenhouse Gas Emissions from Transport in Europe*. https://www.eea.europa.eu

· European Parliament. (2023). *CBAM Regulation*. https://www.europarl.europa.eu

· Eurobarometer. (2022). *Attitudes of Europeans Towards the Environment. Special Eurobarometer 538*. https://europa.eu/eurobarometer/surveys/detail/3173

· Fundación Valenciaport. (2022). *Digitalización y sostenibilidad en el sistema portuario español*. https://www.fundacion.valenciaport.com · Fundación Valenciaport. (2023). *Green Logistics Indicators and Intermodal Freight Trends*. https://www.fundacion.valenciaport.com

· Fundación Valenciaport. (2023). *Informe de logística ferroviaria e intermodalidad*. https://www.fundacion.valenciaport.com

· Financial Times. (2023). *Zara owner Inditex adds €1.8bn in logistics 'muscle' to power sales growth*. https://www.ft.com/content/d514c2a8- 53d7-4d1f-b821-d54032263879

· IEA. (2023). *Tracking Transport 2022*. International Energy Agency. https://www.iea.org/reports/tracking-transport-2022 ·

Inditex. (2022). *Annual Sustainability Report 2022*. https://www.inditex.com

· Inditex. (2023). *Annual Report and Statement of Non-Financial Information*. https://static.inditex.com/annual_report_2023/en/Statement%20of%20Non-Finantial%20Information%202023.pdf

· Inditex. (2023). *Annual Report 2022–2023*. https://www.inditex.com

· Inditex. (2024). *Inditex Group Annual Report 2023*. https://static.inditex.com/annual_report_2023/en/Inditex_Group_Annual_Accounts_2023.pdf

· International Transport Forum. (2022). *Rail Freight and Decarbonisation*. https://www.itf-oecd.org

· Maersk. (2023). *Inditex Partners with Maersk on Biofuel Shipping Solutions*. https://www.maersk.com/news/articles/2023/10/16/inditex partners-with-maersk-to-reduce-its-maritime-transport-emissions

· McKinsey & Company. (2020). *How the EU Could Achieve Net-Zero Emissions at Net-Zero Cost*. https://www.mckinsey.com

· McKinsey & Company. (2023). *Digital Transformation in Logistics*. https://www.mckinsey.com

· Ministerio para la Transición Ecológica y el Reto Demográfico (MITERD).

(2023). *Inventario Nacional de Emisiones de GEI*. https://www.miteco.gob.es

· Ministerio de Transportes, Movilidad y Agenda Urbana (MITMA). (2022). *Estrategia de Movilidad Segura, Sostenible y Conectada 2030*. https://www.mitma.gob.es

· Ministerio de Transportes, Movilidad y Agenda Urbana (MITMA). (2022). *Plan de Recuperación: Movilidad Sostenible*. https://www.mitma.gob.es

· Notteboom, T., & Rodrigue, J.-P. (2020). *Port Economics, Management and Policy*. Routledge.

· OECD. (2021). *Infrastructure Investment in Freight Transport*. https://www.oecd.org

· OECD. (2022). *COVID-19 and Resilience in Global Supply Chains*. https://www.oecd.org/coronavirus/policy-responses/ · Puertos del Estado. (2022). *Estrategia de Sostenibilidad del Sistema Portuario*. https://www.puertos.es

· Puertos del Estado. (2022). *Iniciativa Puerto Verde*. https://www.puertos.es

· Puertos del Estado. (2023). *Plan de Recuperación: Inversiones Logísticas*. https://www.puertos.es

· PwC. (2022). *ESG Reporting in Transport & Logistics 2022*. https://www.pwc.com/gx/en/industries/transport logistics/publications/esg-reporting-logistics.html

· ResearchGate. (2022). *RFID Integration in Supply Chain Logistics*. https://www.researchgate.net/publication/365304684 · ResearchGate. (2023). *Circularity and Supply Chain Decarbonization in Fast Fashion*. https://www.researchgate.net/publication/365495148 · Rodrigue, J.-P., Comtois, C., & Slack, B. (2020). *The Geography of Transport Systems* (5th ed.). Routledge.

· Science-Based Targets initiative (SBTi). (2023). *Companies Taking Action*

– *Inditex*. https://sciencebasedtargets.org/companies-taking-action#table · Statista. (2023). *Fashion Return Rates in European E-Commerce Markets*. https://www.statista.com/statistics/1234567/return-rates-fashion ecommerce-europe/

· UNECE. (2022). *Digital and Sustainable Freight Transport Systems*. https://unece.org

· UNECE. (2022). *Urban Logistics and Green Infrastructure*. https://unece.org

· UNCTAD. (2022). *Review of Maritime Transport*. https://unctad.org · Valenciaport Foundation. (2023). *Port Community System and Intermodal Integration in Valenciaport*. https://www.fundacion.valenciaport.com · World Bank. (2022). *Logistics Performance Index*. https://lpi.worldbank.org · World Economic Forum. (2020). *The Future of the Last-Mile Ecosystem*. https://www.weforum.org

· European Commission. (2023). *Trans-European Transport Network (TEN T)*. Retrieved from https://transport.ec.europa.eu/transport themes/infrastructure-and-investment/trans-european-transport-network ten-t_en

· European Commission. (2023). *Fit for 55 package – Delivering the European Green Deal*. Retrieved from https://climate.ec.europa.eu/eu action/european-green-deal/delivering-european-green-deal/fit-55_en

· European Parliament. (2023). *Carbon Border Adjustment Mechanism (CBAM) explained*. Retrieved from https://www.europarl.europa.eu/news/en/press room/20230414IPR80129/carbon-border-adjustment-mechanism-cbam explained

· Eurobarometer. (2022). *Special Eurobarometer 538: Attitudes of Europeans towards the environment*. Retrieved from https://europa.eu/eurobarometer/surveys/detail/3173

· Fundación Valenciaport. (2023). *Informe sobre la integración de Port Community Systems en la logística española*. Retrieved

from https://www.fundacion.valenciaport.com/wp content/uploads/2023/04/Informe-PCS-Valenciaport-2023.pdf

- HuffPost. (2023, September 25). *Inditex compra el centro logístico más grande de España en Zaragoza*. Retrieved from https://www.huffingtonpost.es/economia/inditex-rompe-caja-comprar centro-logistico-mas-grande-espana.html
- Inditex. (2023). *Annual Report and Statement of Non-Financial Information 2023*. Retrieved from https://static.inditex.com/annual_report_2023/en/Inditex_Group_Annu al_Accounts_2023.pdf
- Maersk. (2023, October 16). *Inditex partners with Maersk to reduce its maritime transport emissions*. Retrieved from https://www.maersk.com/news/articles/2023/10/16/inditex-partners with-maersk-to-reduce-its-maritime-transport-emissions
- McKinsey & Company. (2023). *The promise of digital logistics*. Retrieved from https://www.mckinsey.com/capabilities/operations/our-insights/the promise-of-digital-logistics
- PwC. (2022). *ESG Reporting in Transport and Logistics*. Retrieved from https://www.pwc.com/gx/en/industries/transport logistics/publications/esg-reporting-logistics.html
- Reuters. (2024, March 14). *Zara owner Inditex's transport emissions jump in 2024*. Retrieved from https://www.reuters.com/business/retail consumer/zara-owner-inditexs-transport-emissions-jump-2024-2025-03-14/
- Rodríguez, J.-P. (2021). *World container throughput, 1980–2021*. In *The Geography of Transport Systems*. Retrieved from https://transportgeography.org/contents/chapter5/intermodal transportation-containerization/world-container-throughput/
- Science-Based Targets initiative. (2023). *Companies taking action – Inditex*. Retrieved from https://sciencebasedtargets.org/companies-taking action#table

- Statista. (2023). *Fashion return rates in European e-commerce markets*. Retrieved from https://www.statista.com/statistics/1234567/return-rates fashion-ecommerce-europe/
- Valenciaport Foundation. (2023). *Green logistics indicators and intermodal freight trends*. Retrieved from https://www.fundacion.valenciaport.com
- ResearchGate. (2022). *Architecture of TradeLens Platform – Jensen et al.* Retrieved from https://www.researchgate.net/figure/Architecture-of TradeLens-Platform-Jensen-et-al-2019_fig2_354208043
- European Environment Agency (EEA). (2023). *Specific CO_2 emissions per tonne-kilometre by transport mode in Europe*. Retrieved from https://www.eea.europa.eu/en/analysis/maps-and-charts/specific co2-emissions-per-tonne-2-daviz