logistics

MDPI

Article

Exploring the Implementation Challenges of the Electronic Freight Transport Information (eFTI) Regulation: An Empirical Perspective from Greece

Thomas K. Dasaklis [1,*], Evangelia Kopanaki [2], Panos T. Chountalas [2], Nikolaos P. Rachaniotis [3], Theodore G. Voutsinas [1], Kyriakos Giannakis [3] and Gregory Chondrokoukis [3]

[1] School of Social Sciences, Hellenic Open University, 18 Aristotelous St., 26335 Patras, Greece; voutsinas.theodoros@ac.eap.gr
[2] Department of Business Administration, University of Piraeus, 80 Karaoli & Dimitriou St., 18534 Piraeus, Greece; evik@unipi.gr (E.K.); pchountalas@unipi.gr (P.T.C.)
[3] Department of Industrial Management and Technology, University of Piraeus, 80 Karaoli & Dimitriou St., 18534 Piraeus, Greece; nraxan@unipi.gr (N.P.R.); kgiannakis@kgiannakis.me (K.G.); gregory@unipi.gr (G.C.)
* Correspondence: dasaklis@eap.gr

Abstract: *Background*: The electronic Freight Transport Information (eFTI) regulation is critical in modernizing freight transport (FT) within the European Union by establishing a framework for the electronic exchange of information. Despite its importance, there is a notable gap in the literature regarding the practical implementation challenges, especially from an empirical perspective. *Methods*: To address this gap, our study utilized a grounded theory approach, conducting interviews with a diverse group of logistics experts from Greece. The selection of experts was strategic to ensure a comprehensive range of knowledge and expertise, including insights at the policy level as well as practical experiences. *Results*: Our findings highlight several significant challenges in the implementation of eFTI, including the digital skill gap among the workforce, issues with system interoperability, and diverse capacities and resources of companies of different sizes. Economic factors, regulatory frameworks and the necessity for targeted training and leadership support were also identified as crucial for the digital transition. *Conclusions*: The study shows that uniform eFTI implementation may not work for all organizations, highlighting the necessity for customized strategies that address specific challenges in the FT chain. Our research deepens the understanding of these issues, providing actionable insights for successful eFTI adoption.

Keywords: electronic Freight Transport Information (eFTI) regulation; freight transport; implementation challenges; supply chain management

Citation: Dasaklis, T.K.; Kopanaki, E.; Chountalas, P.T.; Rachaniotis, N.P.; Voutsinas, T.G.; Giannakis, K.; Chondrokoukis, G. Exploring the Implementation Challenges of the Electronic Freight Transport Information (eFTI) Regulation: An Empirical Perspective from Greece. *Logistics* **2024**, *8*, 30. https://doi.org/10.3390/logistics8010030

Academic Editors: Vasilis Zeimpekis and Michael A. Madas

Received: 31 December 2023
Revised: 3 March 2024
Accepted: 12 March 2024
Published: 15 March 2024

1. Introduction

Freight transport (FT) encompasses the movement of goods within inland transport networks, primarily involving road transport between specific loading and unloading points. This process forms an integral part of the logistics chain, facilitating the transfer of goods across various distances and locations within a country or among countries. FT may be categorized into two main types: national and international road FT. National road FT is defined by the transportation of goods from one location to another within national borders, using a vehicle registered in that country. International road FT involves moving goods between two different countries, regardless of where the vehicle is registered. In the European Union (EU), road FT plays a critical role in the movement of goods within and among EU Member States, thus straightening the overall EU economy. According to the EU official statistics for 2022 (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Road_freight_transport_statistics, accessed on 13 November 2023), road FT saw a 6.5% increase from 2020 to 2021, measured in tonne-kilometres (tkm).

This growth followed a period of decline in 2020 due to COVID-19 lock-downs, particularly in the second quarter. However, in 2022, the total road freight transport in Europe remained constant at 1,920 billion tkm. Food products, beverages and tobacco led road freight transport in 2022 with 317 billion tkm, followed by grouped goods (228 billion tkm) and agricultural products (203 billion tkm). The most significant increases in tkm between 2021 and 2022 were observed for other goods (24.8%), equipment and material utilized in the transport of goods (7.4%), and mail/parcels (4.7%). The largest decreases were observed in furniture (−6.2%), chemicals, chemical products, and man-made fibres (−6.1%), and wood and products of wood and cork (−5.3%).

Despite its critical importance in the economy and trade, several sustainability concerns exist with respect to FT which are especially relevant to traffic accidents, elevated product costs, greenhouse gas emissions, and air and noise pollution [1]. In addition, the FT sector remains predominantly reliant on paper-based processes, although several technological solutions exist for electronic document exchange [2]. Especially in the case of EU road FT, one of the primary hurdles is the fragmented legal framework that spans the international, EU and national levels. This fragmentation results in inconsistent requirements for the acceptance of electronic documents by various authorities, creating a complex and often contradictory regulatory environment. Additionally, the IT infrastructure in this sector is also highly fragmented, characterized by non-interoperable systems and a lack of uniform standards for the exchange of electronic messages and documents. This technological disparity hinders seamless integration and communication. Furthermore, there is a significant issue with the acceptance of electronic documents among stakeholders. Many parties involved in FT are still not fully on board with adopting electronic documentation due to trust issues, a lack of awareness or the reluctance to change established practices. Combined, these factors create a challenging landscape for fully implementing eFTI, despite the clear advantages and long-standing availability of the necessary technological solutions [3].

1.1. Digital Initiatives Aimed at Modernizing and Streamlining Road FT

Arguably, the eFTI (Electronic Freight Transport Information) and the eCMR (Electronic Consignment Note for Road Transport) represent two pivotal digital initiatives focused on modernizing and streamlining road FT. In the sequence, a detailed background information framework on these initiatives is provided, encompassing their scope, outreach and benefits for the FT industry.

1.1.1. The Electronic Freight Transport Information (eFTI) Regulation

On 15 July 2020, the European Parliament and European Council adopted Regulation 2020/1056 on electronic Freight Transport Information (eFTI), aiming to improve the sustainability and efficiency of the transport sector in general while encouraging the digitization of supply chains (SC) and FT in particular. The new regulation establishes a legal framework for the electronic communication of regulatory information between the involved economic operators and FT stakeholders and the public authorities in relation to the transport of goods within the EU [4]. The eFTI regulation will officially take effect on 21 August 2024. The eFTI includes cargo details, transport instructions and various types of documents to be exchanged and its goal is to improve efficiency and transparency by allowing for the quick and accurate exchange of information between all parties involved in the road FT ecosystem. eFTI is expected to minimize errors, improve security and increase the speed of FT. The implementation of eFTI can also help to reduce costs by automating processes, decreasing processing time and reducing the need for paper-based documentation [3]. The key elements of this legal framework include the operational requirements applicable to eFTI platforms, which should be used by economic operators to make freight regulatory information available to competent authorities in electronic form in order to meet the conditions for the mandatory acceptance of this information by the competent authorities. The European Commission (EC) has released a draft for the eFTI system,

offering EU Member States flexibility in its implementation while stressing adherence to ICT specifications. The regulation promotes reusing ICT systems that meet functionality and security standards, with Member States being responsible for their maintenance and security. It introduces eFTI Gates to enhance regulatory freight information exchange, aiming for efficiency and cost-effectiveness, and emphasizes interoperability and security through harmonized standards [5].

From an operational perspective, the eFTI has several objectives all revolving around enhancing the efficiency and security of freight transport within the EU through digital means. In particular, the eFTI system is designed to enforce adherence to international transport regulations. Authorities in the EU are mandated to accept transport information in electronic form, ensuring a unified approach to regulatory compliance across all Member States. eFTI also aims at unifying disparate resources into a consolidated network of information systems. This integration facilitates smoother interactions between partners and businesses in the FT ecosystem, thus streamlining operations across the logistics sector. Standardization is another important objective of the eFTI toward harmonizing the road FT processes and the electronic documents being exchanged, fostering a more uniform operating environment. By developing compatible and interconnected IT infrastructures, the eFTI regulation promotes enhanced collaboration. This allows SC partners to seamlessly exchange vital information, leading to better-coordinated logistics operations. The envisioned eFTI infrastructure is focused on high security and the immutability of data. It will provide transaction transparency while allowing for multiple control points, thus ensuring data integrity and preventing unauthorized alterations. All together, these objectives represent a concerted effort to digitize and enhance the EU's FT ecosystem, making it more cohesive, secure and efficient for all stakeholders involved. As depicted in Figure 1, the eFTI system is designed to facilitate the electronic exchange of information related to freight transport across different Member States, with a focus on interoperability, security and compliance with regulatory requirements. The involvement of multiple access points and the participation of various economic operators and service providers indicate a complex, multi-stakeholder environment.

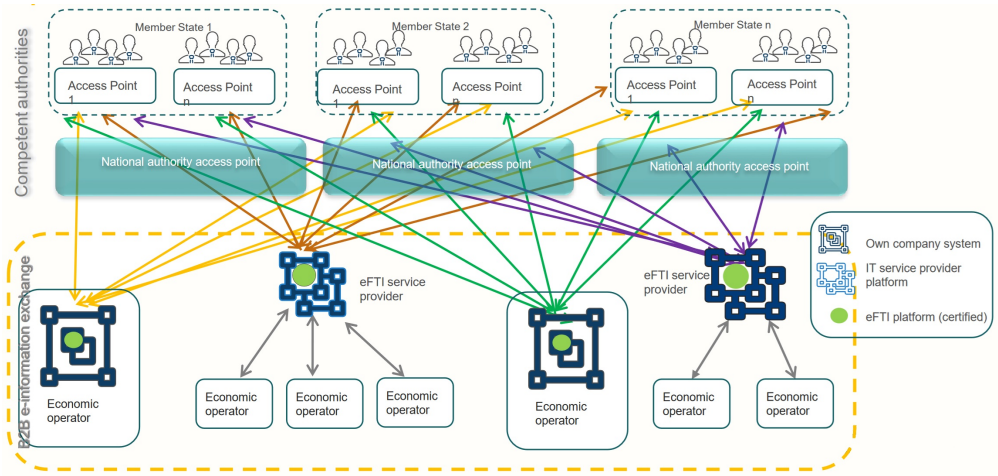

Figure 1. eFTI exchange environment—potential implementation architecture [6].

As depicted in Figure 2, the eFTI system is orchestrated to streamline the exchange of freight information, using digital tools to enhance efficiency and regulatory compliance. The logistical process begins with the entry of transport data to initiate the transfer of goods (Step 1). This information is then used to generate a unique identifier for the cargo, functioning as a digital bill of lading, which is critical for tracking and regulatory compliance (Step 2). This identifier is shared among businesses to facilitate business-to-business communication, allowing for the necessary processing and management of freight data (Steps 3–4). When required, this identifier, along with the associated transport details, is transmitted to control authorities, integrating the cargo information with regulatory

oversight (Step 5). An official with the proper authorization accesses these data, utilizing their access rights to request and retrieve the relevant information within the system (Step 6). The system then conveys the pertinent data back to the official, streamlining the process of verification and compliance checks, and bringing the cycle of digital information exchange to completion (Steps 7–9). This sequence of steps showcases the eFTI system's role in improving the efficiency, transparency and regulatory adherence of FT within the digital ecosystem.

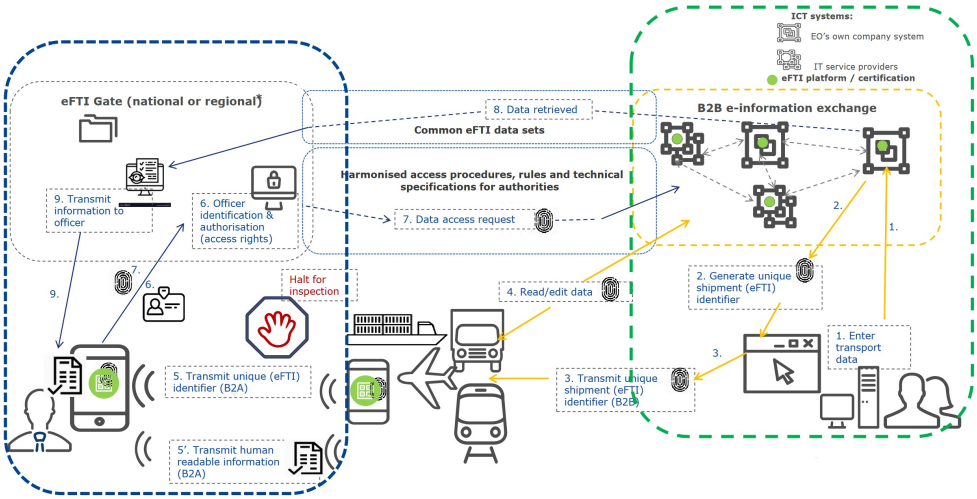

Figure 2. eFTI Regulation in practice—vision [7].

1.1.2. The Electronic Consignment Note for Road Transport (eCMR)

The Electronic Consignment Note (e-CMR) is a digital version of the traditional Consignment Note (CMR) used in the international road transport of goods. The CMR is a legal document used to provide evidence of the contract of carriage between the carrier and the consignor. It contains information about the goods being transported, the parties involved and the route, and any special instructions. According to the United Nations Convention for the Carriage of Goods, consignment notes mainly appear in commercial transportation contracts. They are frequently utilized by customs and law enforcement agencies to verify goods and details related to the consignor, consignee and carrier in international trade. The digital version of the CMR Convention has been in effect since 2008 and has been ratified by 34 nations thus far. An e-CMR is an electronically generated document that is legally compliant and contains the same information as a traditional CMR. This means that an e-CMR has the same legal status as the traditional paper-based CMR and it can be used as evidence in case of disputes. It is created, transmitted and stored electronically, replacing the paper-based CMR. Therefore, it allows for the data to be shared in real-time between all parties involved in the transport of goods, including the carrier, consignor, consignee and any intermediaries. The eCMR represents a significant advancement in the logistics and transportation sector, particularly in Europe, driven by EU regulations as a part of a broader move toward paperless logistics. The eCMR functions as both a proof of delivery and a contract among the carrier, shipper and freight forwarder, detailing loading and unloading specifics, vehicle information, and supporting photo documentation and comments. It surpasses the traditional paper-based CMR's vulnerability to manipulation and manual handover by bolstering document reliability and security with digital tools, including secure electronic signatures.

The eCMR offers a multitude of benefits to the FT sector, primarily revolving around time savings, enhanced security and optimized administrative management. One of the key advantages of the eCMR is the significant reduction in the time spent managing documents. By enabling a single entry of information that is directly integrated with Transport Management Systems (TMS), it eliminates repetitive data transfers, thus boosting productivity. This digital approach not only facilitates the real-time tracking of goods, enhancing

the traceability of transport, but also accelerates the invoicing process through the use of electronic signatures. This instant feedback mechanism is beneficial for both the client and the service provider, ensuring rapid billing once goods are delivered and incidents are reported in real time, which is crucial for insurance and liability purposes. Additionally, the eCMR contributes to the security and integrity of transport documents. With features like time-stamping and electronic signatures, the risk of falsification is greatly minimized compared with traditional paper documents, which are susceptible to loss, damage and fraud. This digital format also supports the growing trend toward "paperless" operations, leading to significant reductions in the use of ink, paper and postage, thereby lowering administrative costs and the environmental impact. The eCMR centralizes documentation, simplifying collection and archiving processes, and streamlines border controls with quick access to transportation information. Furthermore, it facilitates international document exchange, expedites the payment process by allowing for immediate invoicing post-delivery and simplifies the complaint procedure. The eCMR's capacity to provide real-time transport status updates and its potential for automation through computer software further enhance its value, making it a highly efficient and environmentally friendly solution in the transport sector.

1.2. Motivation and Contribution

The implementation of the eFTI regulation presents a significant shift in the FT industry, particularly in EU road transport. Despite the availability of numerous technological solutions for electronic document exchange, the road FT industry is faced with substantial challenges in applying these technologies, according to the literature [8–10]. Besides, the current literature is narrow in scope and predominantly concentrates on the potential benefits and technological solutions for electronic document exchange in FT, as described in detail in Section 2. Moreover, there is a notable absence of relevant literature on eFTI, highlighting a substantial gap in comprehensively understanding and tackling the challenges associated with the implementation of eFTI regulation, particularly from an empirical perspective. Therefore, there is a clear need for empirical research that specifically investigates the practical difficulties, stakeholder experiences and operational realities of implementing eFTI in road FT. Such research would not only contribute to the academic discourse but also provide valuable insights for policymakers, industry practitioners and technology developers in refining and effectively implementing the eFTI regulation. Based on this gap in the literature, the following research questions are deemed relevant:

1. What are the primary challenges and experiences associated with the implementation of eFTI in the road FT sector?
2. How do regulatory frameworks impact the adoption and implementation of eFTI in road FT, and what specific challenges do they present?
3. What economic factors influence the decision-making process for adopting eFTI in road FT, and how do these factors shape the future outlook of digital technologies in the sector?

Therefore, the objective of this study is three-fold: (1) to identify and analyze the primary challenges and experiences reported by stakeholders in the road FT sector during the implementation of eFTI, (2) to evaluate the impact of regulatory frameworks on the adoption and effective implementation of eFTI in road FT, identifying specific regulatory challenges, and (3) to assess the economic factors affecting the decision to adopt eFTI in road FT, exploring the cost, return on investment and implications for future digital technology trends in the sector. In particular, our research contributes by offering empirical insights into the implementation challenges of the eFTI regulation, derived from interviews with a group of logistics experts. Utilizing a grounded theory approach, we delve into the perspectives of those directly involved in the logistics sector, uncovering nuanced understandings of the practical hurdles in adopting the eFTI regulation. Our findings reveal that the successful adoption of digital technologies like eFTI in logistics is contingent upon overcoming a range of challenges. These include bridging the digital skill gap within the workforce and

ensuring system interoperability, which are critical for the seamless integration of new technologies into existing logistical processes. Furthermore, the research highlights the disparity in adoption processes between large and small companies. Economic factors, regulatory frameworks and the necessity for targeted training and leadership support are identified as pivotal elements that influence the digital transition. This disparity underscores the varying capacities and resources available to different-sized companies, suggesting that a one-size-fits-all approach may not be effective in implementing eFTI regulation. Our study, therefore, offers valuable insights into the multifaceted nature of digital adoption in the logistics sector, providing a more comprehensive understanding of the challenges and facilitating more targeted, effective strategies for the successful implementation of the eFTI regulation.

The remainder of this paper is structured as follows: Section 2 focuses on a comprehensive literature review that addresses the topic of electronic document exchange, especially focusing on the eFTI and eCMR regulations. In Section 3, the methodology that has been meticulously crafted for this study is delineated, paving the way for a well-rounded investigation into the subject matter. Moving forward, Section 4 brings forth the findings of our study, offering a lucid presentation of the data amassed. These results are subsequently analyzed and discussed in depth in Section 5, where we unravel the intricate layers of the research, fostering a rich dialogue around the findings. The paper ends with some concluding remarks.

2. Literature Review

Although numerous technological solutions are available for electronic document exchange, the road FT industry faces significant challenges regarding their application. Addressing these challenges requires collaboration among stakeholders, stringent laws, investment and responsiveness to demands [1]. One solution is the concept of modal shift, which involves transitioning from road to rail, inland waterways and short sea shipping. This shift, as envisioned in European policies, aims to reduce the substantial external costs associated with FT, particularly its environmental impacts [11]. Additionally, the integration of passenger and FT, termed as co-modality or cargo hitching, has been identified as an area needing more robust quantitative analyses and a normative framework for effective integration. This approach faces challenges such as varied research and policy issues [12]. At last, the potential of Multimodal Freight Transport (MFT) is recognized for reducing external costs and improving efficiency. Despite its benefits, MFT faces barriers to implementation, categorized into areas like terminal, network, management, regulations, delivery characteristics and interoperability. Overcoming these barriers requires comprehensive strategies, aiding decision-makers in the transition toward MFT [13].

Technology and Information and Communication Technologies (ICTs) play a crucial role in enhancing the sustainability and reducing the negative impact of FT. The integration of real-time tracking, as explored by [14], demonstrates the potential for improving SC and logistics performance, though it is still in early stages. Meanwhile, the implementation of low-emission zones in Europe, as examined by [8], highlights the challenges and readiness of road FT to comply with sustainable mobility regulations, indicating a gap in the technological preparedness of current fleets. Ref. [15] emphasizes the importance of modern technologies in enhancing sustainability-focused road FT services, as well as improving quality management and competitiveness, based on survey data from 140 road FT firms [15]. Ref. [16] investigates the potential of ICTs in mitigating environmental harm, particularly CO_2 emissions in various transportation modes, underscoring the effectiveness of telephone, mobile phone and internet technologies in promoting environmental sustainability. Last, Ref. [9] discusses the interaction between ICTs and road FT in mitigating environmental concerns, specifically focusing on reducing CO_2 emissions, highlighting the significant yet underutilized role of ICTs in addressing the environmental and health impacts of FT. Arguably, all these studies underscore the transformative potential of technology and ICT solutions in making FT more sustainable and less environmentally detrimental.

Regarding regulatory initiatives like eFTI and eCMR, the available literature primarily offers insights focused on their benefits. In the case of eCMR, Ref. [17] focuses on its operational and environmental benefits, emphasizing cost savings, time efficiency, carbon footprint reduction, real-time transparency and health safety during the COVID-19 pandemic. Ref. [18] highlights the financial and operational efficiency of eCMR, including faster paperwork, increased transparency and improved logistics efficiency. Refs. [19,20] provide the historical and legal contexts of the CMR Convention, foundational to understanding the transition to eCMR, but do not directly address eCMR benefits. Other studies have focused on the transition to electronic systems and their impact on efficiency and security. For instance, in [21], the authors develop a blockchain-based document management system for road transport. Their main objective is to enhance document security, data integrity and overall efficiency. Ref. [22] investigates decentralized freight declaration and tracking, aiming to increase data security and operational efficiency. The study demonstrates the effectiveness of decentralized systems in enhancing data security within logistics operations. Similarly, Ref. [23] explores the benefits of using electronic consignment notes in a manufacturing company, evaluating the financial and time savings it offers. The findings reveal significant cost and time efficiencies associated with the adoption of e-CMR. Ref. [24] analyzes the transition to electronic documents in road freight and assesses efficiency and data integrity. The study further highlights the advantages of e-documents in data accuracy and operational efficiency. An interesting concept in the eCMR-related literature is the concept of "neutralization". Neutralization in transport documents, particularly in relation to the CMR consignment note, involves the practice of replacing or exchanging original transport documents with others, nullifying their initial effect [25–27]. This practice, not formally defined in commercial transport law, aims to obscure the actual movement of goods during transport, raising transparency and integrity concerns. Emerging primarily in European road FT, where the CMR note is prevalently used, neutralization challenges the reliability of these critical documents. Recent research suggests that new technologies, like smart tachographs, and the shift to electronic consignment notes could potentially mitigate this practice, enhancing the transparency and efficiency of international road freight transport [25].

In the case of eFTI, the available literature is relatively limited and not specifically focused on eFTI. For example, the authors in [10] discuss the challenges in logistics, including the need for timely information delivery across diverse entities with different IT systems and legal frameworks (including the eFTI). They propose the four-corner model as a solution to enable synchromodality, combined with digital twin concepts in logistics, improving the efficiency of operations and decision-making. The model focuses on interoperable, low-cost, reliable and secure data exchange between logistics stakeholders, without significant IT development requirements. In [28], the author references Regulation (EU) 2020/1056, which focuses on eFTI. While it doesn't provide specific details on the regulation, the reference indicates its relevance in the context of digital transformations in transport documentation, including the use of post-quantum digital signatures.

The analysis provided above underscores that the FT industry's journey toward sustainability and efficiency is characterized by a range of technological, policy, and regulatory challenges. In particular, the FT industry is exploring numerous technological solutions for electronic document exchange, yet faces significant challenges in applying these technologies effectively. Collaboration among stakeholders, stringent laws, investment, and responsiveness to demands are essential for overcoming these hurdles. MFT is recognized for its potential to enhance efficiency and reduce external costs. Despite its advantages, MFT's implementation faces barriers across terminal, network, management, regulations, delivery characteristics, and interoperability aspects. Comprehensive strategies are needed to guide decision-makers in transitioning toward MFT effectively. Regulatory initiatives like eFTI and eCMR provide operational and environmental advantages such as cost savings, time efficiency, carbon footprint reduction, real-time transparency and health safety. However, practices like "neutralization" in transport documents challenge the reliability

of critical documents, suggesting that new technologies and electronic consignment notes could mitigate these issues, enhancing transparency and efficiency in international road FT.

3. Methodology

In our study, we applied the grounded theory (GT) methodology combined with expert interviews to investigate the implementation challenges of the eFTI regulation. We conducted structured interviews with selected experts from the logistics industry, focusing on eliciting detailed insights into the specific challenges and considerations surrounding eFTI implementation. The interview design was tailored to probe into various aspects of eFTI, while also allowing room for experts to introduce novel viewpoints and experiences. Following data collection, we embarked on an extensive GT coding process. This involved analyzing the expert interview transcripts in depth to extract key themes and patterns relevant to eFTI challenges. For conducting the analysis, we used qualitative analysis software (MAXQDA 2022). In the sequence, we provide a detailed description of the overall methodological approach. The set of questions used is presented in Table 1.

Table 1. Interview questions and their objectives relevant to eFTI implementation challenges.

No.	Question	Objective
Q1	Can you share your experiences with implementing digital technologies like eFTI in road FT, and discuss the main challenges and differences you've observed in this transition?	Understanding practical experiences and challenges
Q2	How do regulatory frameworks influence the adoption of digital technologies like eFTI in road FT, and what are the main adoption challenges?	Assessing impact of regulatory frameworks
Q3	What are the key economic factors, such as cost and return on investment, affecting the decision to adopt digital technologies like eFTI in road FT, and, based on your experiences, what is your outlook on the future of these technologies in the sector?	Evaluating economic considerations and future trends

GT is a significant qualitative research methodology that emphasizes theory generation directly from data, contrasting with hypothesis-testing in quantitative research [29,30]. From a practical perspective, GT is a pivotal methodology in qualitative research revolving around coding as a key technique. This process involves identifying significant words or phrases from interview data, encapsulating them into codes, and iteratively building a coherent understanding of underlying themes. It is a method that efficiently shifts through data, highlighting core issues while filtering out less relevant information [30,31]. GT's coding process aids in developing a coherent theory, addressing the complexity of handling voluminous qualitative data and discerning relevant themes and patterns, especially for those new to the methodology [29]. Grounded theory, with its emphasis on theoretical sampling, constant comparison and theoretical saturation, offers a robust framework for deeply understanding complex phenomena, such as organizational structures. Comprehending the nuances of grounded theory is essential for maintaining high-quality research standards and effectively implementing this methodology [31–35]. GT also adapts to various research contexts, offering flexibility while maintaining rigorous qualitative analysis [31,36].

Implementing GT, however, is not without challenges, as highlighted by various scholars. The difficulty in achieving data saturation is a key challenge, especially for novice researchers. Ref. [37] delves into the nuances of data saturation, explaining that it occurs when no new information is discovered. This concept is crucial yet often difficult to grasp, particularly in determining the point of saturation in research. Additionally, Refs. [30,36] focus on the cognitive challenges in organizing and processing qualitative data. They emphasize the need for effective data management and interpretation strategies for the

systematic development of GT. Furthermore, GT's iterative nature, involving constant comparison and theoretical sampling, adds to its complexity. Ref. [32] underscores the importance of these elements in maintaining research quality, stressing the need for empirical grounding throughout the study. Ref. [31] clarifies the method's philosophical underpinnings, aiding in methodological selection. Ref. [34] provides a practical guide to grounded theory's methodologies, making it more accessible for beginners. Ref. [38] examines the core principles of grounded theory, particularly the emergence of theories from data, offering a historical and philosophical perspective. Ref. [33] discusses the method's suitability for analyzing complex organizational structures, highlighting its benefits in providing contextually grounded insights. Finally, Ref. [35] aims to clarify issues and provide a clear, pragmatic guide, especially for novice researchers, covering the core principles and variations of grounded theory.

GT can be effectively combined with structured interviews from experts by using these interviews as a primary data source. The structured interviews provide detailed, expert insights, which are then analyzed through GT's coding and comparative methods to identify patterns, themes and relationships withing the underlying qualitative data. This approach allows for the development of theory that is deeply rooted in the specialized knowledge and experiences of experts, enriching the qualitative analysis and ensuring that the resulting theory is both grounded in data and reflective of expert perspectives. An important aspect when conducting interviews is the size of the sample (number of interviewees). According to the literature, working with a relatively small number of cases is often more effective. Such an approach allows for a deeper and more in-depth exploration of social phenomena, going beyond surface appearances and obvious meanings. This is true because in qualitative research, the importance is in understanding the dynamic qualities of situations rather than establishing statistically representative samples or proportional relationships among their components [39].

3.1. Expert Selection

In our research, the selection of experts has been meticulously made to encompass a broad spectrum of knowledge and expertise in the field, ensuring a comprehensive representation that includes both policy-level insights and hands-on experience. The sampling method used for expert selection in our study was based on non-probability sampling, particularly purposive sampling. This approach was necessitated by the specialized nature of our research topic, which demands experts with specific knowledge and experience in eFTI. By selecting individuals with expertise in the field of road FT and eFTI, we aimed to gather in-depth, relevant insights that probability sampling methods would not have provided. This decision aligns with the qualitative research design of our study, emphasizing the acquisition of detailed understanding and expertise over statistical representativeness.

Three experts were chosen to take part in our structured interviews. Expert A is Head of the Logistics Development Service in the Ministry of Development and Investment in Greece. Expert A has a deep understanding of the national logistics infrastructure and regulatory environment, especially relevant to how eFTI regulation aligns with national development strategies and investment plans. Expert A was chosen specifically to delve into the policy implications, explore the challenges and identify potential government support mechanisms critical for the effective implementation of eFTI regulation. Expert B holds a high-level managerial position in the Goods and Transport Council of the International Road Transport Union (IRU) as well as the Hellenic Federation of Road Transports. Expert B's involvement with the IRU ensures a broad, international perspective on logistics and transportation issues, which is crucial given the cross-border nature of road FT. Expert B's experience in the Hellenic Federation of Road Transports indicates an understanding of the specific challenges and opportunities within the Greek transport sector. Therefore, expert B is uniquely positioned to offer in-depth insights into the potential impact of eFTI regulation on road transport, encompassing both national and international dimensions. Moreover, they can provide expert perspectives on the industry's preparedness, as well as identify

and analyze potential barriers to its adoption. Expert C is co-owner and managing director of a logistics company that deals with temperature-controlled and dry cargo transportation. Expert C brings a practical, ground-level perspective on the logistics sector. Expert C's experience in handling various types of cargo, including sensitive and perishable goods, offers valuable insights into the operational impacts of eFTI regulation. Being a member of the Greek National Logistics Council and the board of the Hellenic Logistics Association, Expert C provides insights into industry-wide perspectives and concerns and the readiness of logistics companies for the transition to eFTI systems, especially from a practical point of view. Together, these experts provide a comprehensive view of the eFTI regulation implementation from policy, industry and operational perspectives, making them highly suitable for interviews on this subject. In Table 2, we provide a detailed description of the experts' professional background and expertise.

Table 2. Professional background and expertise of selected experts.

Expert	Professional Background and Expertise
Expert A	Head of the Logistics Development Service in the Ministry of Development and Investment in Greece. Expertise in national logistics infrastructure and regulatory environment.
Expert B	Vice President of the Goods and Transport Council of the International Road Transport Union (IRU) and General Manager in Hellenic Federation of Road Transports. Insight into both national and international road transport challenges and industry readiness for eFTI regulation.
Expert C	Co-owner and Managing Director of a logistics company covering transportation of temperature-controlled products as well as dry cargo. Member of the Greek National Logistics Council and the board of the Hellenic Logistics Association. Provides a practical perspective on the logistics sector, especially in the Greek economy.

3.2. Content Analysis and Validation

In order to perform the analysis, we utilized MAXQDA 2022, qualitative analysis software, in conjunction with the necessary steps for GT analysis specific to this software. The steps were the following:

1. Coding the data: Coding involves assigning 'codes' or labels to qualitative data (in our case, transcriptions). Based on the theoretical underpinning of the GT, this process can be divided into two phases: (1) open coding, where new codes are created for specific data segments, emphasizing the need for an open mind to avoid limiting the number of codes, and (2) selective coding, in which the focus shifts to defining significant higher-level codes and sorting lower-level codes.
2. Customizing the code system: Various subsequent coding rounds take place in which the researcher reviews the data using selective coding. Codes may be organized into hierarchies (parent codes and subcodes).
3. Category building with creative coding: Categories are formed by clustering together concepts that are similar. This typically occurs during the later stages of the selective coding phase. These categories are crucial, as they lay the foundation for the structure of the emerging theory, mainly because they help to uncover and illustrate the theoretical connections between various concepts.
4. Constructing the theory: After selective coding, the theoretical links between categories become clearer. The next step involves theoretical sampling to develop the emerging theory, especially through depicting the various emerging categories.

For assessing the reliability of our methodology, we used the Holsti Coefficient. The Holsti Coefficient is a measure used in content analysis to assess the reliability of human coders in categorizing or coding qualitative data. This coefficient calculates the degree of agreement between two or more coders which independently classify or code the same content [40]. The formula for the Holsti Coefficient is

$$\text{Holsti Coefficient} = \frac{2 \times N_{\text{agreements}}}{N_{\text{Coder A}} + N_{\text{Coder B}}} \quad (1)$$

In Equation (1), $N_{\text{agreements}}$ is the number of coding agreements between coders, and $N_{\text{Coder A}}$ and $N_{\text{Coder B}}$ are the total coding decisions made by each coder, respectively.

In our case, two researchers conducted the qualitative analysis independently, resulting in the identification of themes within the transcript. The first researcher identified 7 themes; the second researcher, 6 themes. Notably, out of these identified themes, there were 5 themes that both researchers agreed upon as being relevant. Using Equation (1), the Holsti Coefficient has a value of approximately 0.77. The value reflects a strong consensus in identifying key themes in the data, suggesting that the coding process was quite consistent and reliable. While there are some differences in the themes identified by each researcher, a Holsti Coefficient of this magnitude generally signifies a robust qualitative analysis with a high degree of inter-coder reliability.

Recognizing the importance of a holistic approach to reliability assessment, we complemented our evaluation by incorporating additional metrics. These metrics serve as supplementary tools, offering nuanced insights into the consistency of our coding process without detracting from the primary analysis (Holsti Index). Consequently, we decided to incorporate Cohen's Kappa alongside the Holsti Index. Cohen's Kappa is a statistical measure that accounts for the possibility of agreement occurring by chance. It is calculated by considering the observed agreement between coders and the expected agreement if all coding was done randomly. Cohen's Kappa is particularly advantageous as it accounts for agreement occurring by chance, providing a more nuanced understanding of inter-rater reliability. This metric is especially pertinent when evaluating the precision of categorical data coding, as it offers a standardized measure of agreement adjusted for random chance. The calculated Cohen's Kappa value is approximately 0.62. Such a value indicates a substantial level of agreement between the researchers, beyond what would be expected by chance. This suggests that the coding scheme and its application by the researchers are both highly reliable.

4. Thematic Synthesis of the Various Implementation Challenges of the eFTI Regulation

The discussion with the group of experts revealed the actual challenges and the level of readiness of the different stakeholders to adopt the changes required for the implementation of eFTI. Based on the GT approach described earlier in detail, seven (7) thematic key areas have emerged, as seen in Figure 3. In particular, we used the following four coding steps pertinent to any GT approach: (1) Coding the data, (2) Customizing the code system, (3) Category building with creative coding and (4) Constructing the theory. In the sequence, a detailed analysis and synthesis of the findings is presented.

4.1. Technology Integration and Digital Transition

Focusing on technology integration and digital transition, the interviewees provided valuable insights into how the logistics sector is adapting to and integrating digital technologies, particularly eFTI. Three main sub-themes have emerged, namely the adoption of digital technologies, integration with existing systems and software integration over hardware:

- **Adoption of digital technologies**: The logistics sector is in the midst of a significant shift toward digitalization, with technologies like eFTI being central. These technologies aim to digitalize the transport documentation process, making it more efficient and transparent.

- **Integration with existing systems**: A key aspect of this digital transition is the need to integrate these new technologies with existing TMS and Enterprise Resource Planning (ERP) systems. This integration is crucial for a seamless and efficient digital workflow. The emphasis is on cloud-based solutions for their ease of access and use, indicating a move away from traditional, hardware-intensive setups.
- **Software integration over hardware**: The focus is more on the integration of software and less on the acquisition of new hardware. The necessary hardware, like smartphones and tablets for drivers, is generally already in widespread use (mainly because of eCMR). This approach underlines a strategy where leveraging existing hardware with new software applications is seen as a cost-effective and practical method of digital adoption.

4.2. Challenges across Different Company Sizes

The interview with the experts shed light on how companies of varying sizes in the logistics sector are facing and managing the challenges associated with adopting digital technologies like eFTI. These sub-themes highlight the diverse challenges faced by companies of different sizes in integrating digital technologies. Larger companies, despite their resources, may encounter hurdles with existing complex systems, while smaller companies struggle more with the foundational aspects of digital transition, such as infrastructure and skill sets. The insights from the interviewees underscore the necessity of tailored strategies for digital adoption that consider the unique circumstances of each company, regardless of its size. Three main sub-themes have emerged, namely the varied capability for digital adoption, struggles of smaller companies and impact of company size on digital transition:

- **Varied capability for digital adoption**: The ability and readiness to adopt digital approaches like eFTI in the logistics sector vary significantly between large and small companies. Larger companies tend to have more resources and more established administrative infrastructures and are often better positioned to integrate new technologies efficiently.
- **Struggles of smaller companies**: Smaller companies, particularly individual transporters, face greater challenges. These include limited administrative infrastructure, a lack of digital skills and, often, a reliance on traditional methods. For many small transporters, especially in Greece, "the truck serves as their office", indicating a lack of traditional office-based infrastructure, which complicates the transition to digital systems like the eFTI.
- **Impact of company size on digital transition**: The size of a company directly impacts its approach to and success in the digital transition. Larger companies can more easily navigate this change, while smaller entities struggle with both the technological and mindset shifts required.

4.3. Digital Skill Gap and Workforce Challenges

Focusing on the next theme, the interviewees emphasized the challenges posed by the digital skill gap and the aging workforce in the logistics sector. The insights from the interviewees highlight the need for effective training programs and a supportive approach to help employees, particularly older ones, adapt to and embrace new digital technologies. The success of the digital transition in logistics depends significantly on addressing these workforce-related challenges. The following two main sub-themes have emerged, namely the digital skill gap and training and adaptation strategies:

- **Digital skill gap and demographic characteristics of the workforce**: A significant challenge in the logistics sector's digital transition is the existing digital skill gap among employees, especially drivers. Many workers in the logistics sector, particularly in transport, are not familiar with digital technologies, which makes the adoption of systems like eFTI and e-CMR more challenging. Besides, the logistics sector, particularly in transport, is characterized by an older workforce, with an average age around

50 years. This age group tends to have less exposure to and comfort with digital technologies. The aging workforce creates additional challenges for digital adaptation, as older employees may require more time and resources to become proficient with new technologies.

- **Training and adaptation strategies**: Overcoming the digital skill gap requires targeted training and education strategies. Companies need to invest in vocational training and support to help their employees, especially older ones, to adapt to new digital systems.

Figure 3. Emerging themes prevalent to the implementation challenges of the eFTI regulation.

4.4. Market Dynamics and Regulatory Aspects

Focusing on the next theme, the interview with the experts offers insights into how market forces and regulatory frameworks are influencing the adoption of digital technologies like eFTI in the logistics sector. The interviewees highlighted how market forces and regulatory frameworks are driving the logistics sector toward digitalization, with large companies often paving the way for wider adoption. The discussion also brought to light the challenges and considerations regarding data security and compliance, emphasizing the need for robust regulatory frameworks and standards to facilitate a smooth transition to digital systems like eFTI. The following three main sub-themes have emerged, namely the influence of market forces, regulatory frameworks, and compliance and data security and privacy concerns:

- **Influence of market forces**: Large companies in the logistics sector often lead the way in adopting new technologies, setting a precedent for the rest of the market. The adoption of digital technologies like eFTI and e-CMR by big players creates a 'pull effect,' encouraging smaller companies to follow suit to remain competitive and compliant.
- **Regulatory frameworks and compliance**: Regulatory aspects play a crucial role in the adoption of digital technologies. Regulations can act as catalysts for change, pushing the industry toward standardization and uniform adoption. Compliance with these

regulations is a significant driver for companies to adopt digital documentation and reporting systems.

- **Data security and privacy concerns**: As companies incorporate digital systems, concerns about data security and privacy become paramount. Ensuring that sensitive business data are handled securely and in compliance with regulations like GDPR is a key challenge in the digital transition to systems like the eFTI.

4.5. Education, Support and Leadership

Focusing on this theme, the interviewees delved into the strategies and approaches needed to facilitate the transition to digital technologies in the logistics sector, emphasizing the critical roles of education, support and leadership. In particular, the interviewees underscored the crucial role of education, organizational support and strong leadership in successfully navigating the digital transition in the logistics sector. The insights gained highlighted the need for practical and accessible training programs, continuous support and proactive leadership to ensure the smooth and effective adoption of digital technologies. The following four main sub-themes have emerged, namely the importance of education, the importance of training, the support from organizations and companies and the role of leadership in digital transformation:

- **Importance of education and training**: Effective education and vocational training are identified as key factors in helping employees, particularly older ones or those less familiar with technology, adapt to digital systems like eFTI and e-CMR.
- **Importance of training**: Training programs need to be practical and relevant, focusing on how to use new technologies in day-to-day operations.
- **Support from organizations and companies**: Organizations like the Hellenic Federation of Road Transport play a crucial role in disseminating information and promoting the benefits of digital adoption. They can guide companies and individuals through the transition. Companies themselves are responsible for providing ongoing support and resources to their employees during this transition.
- **Role of leadership in digital transformation**: The leadership within companies is crucial in driving the change toward digitalization. Leaders must be encouraging, supportive and proactive in addressing the challenges and opportunities of digital adoption. Good leadership involves not just persuading employees of the benefits of digital technologies but also actively supporting them through the transition.

4.6. Interoperability and Standardization

Focusing on the next theme, the interview addressed the challenges and importance of establishing interoperability and standardization in the digital technologies being adopted in the logistics sector, specifically eFTI. The interviewees highlighted the critical need for interoperability and standardization in the logistics sector's digital transition. They emphasized the challenges posed by the lack of a unified approach and the importance of collaborative efforts to establish industry-wide standards. They also pointed out the role of governments and regulatory bodies in facilitating this process, as seen in the example of Germany's approach to e-CMR. The following three main sub-themes have emerged, namely the need for interoperability, importance of standardization and efforts toward establishing standards:

- **Need for interoperability**: A major challenge in adopting digital technologies like eFTI and e-CMR is ensuring interoperability between different systems and platforms. Without interoperability, there is a risk of fragmentation where each provider or company uses different standards, leading to inefficiencies and complications in logistics operations.
- **Importance of standardization**: Standardization is crucial for the effective implementation of digital technologies across the logistics sector. It involves setting uniform formats, templates and protocols that all players in the industry can adhere to. A

lack of standardization can lead to challenges in communication and data exchange between different digital systems used by various companies.

- **Efforts toward establishing standards**: The establishment of industry-wide standards is seen as a key step toward achieving interoperability. This requires collaboration among industry players, technology providers and regulatory bodies. The role of governmental and regulatory bodies in setting these standards and encouraging their adoption is highlighted as pivotal.

4.7. Economic Incentives and Long-Term Benefits

Focusing on the last theme, the interview with the experts brought to light the financial aspects of implementing digital technologies in the logistics sector, particularly eFTI and e-CMR, and the long-term benefits that can offset the initial costs. The responses illustrated the considerations of cost versus benefit in adopting digital technologies in the logistics sector. All experts emphasized the importance of viewing these costs as relative and as investments that will bring significant long-term benefits. They also highlighted the role of economic incentives in facilitating this transition, especially for smaller companies that may face greater financial challenges. The following three main sub-themes have emerged, namely the initial costs vs. long-term savings, economic incentives for adoption and benefits of digital transition:

- **Initial costs vs. long-term savings**: The adoption of digital technologies like eFTI and e-CMR involves initial costs, which may seem significant, especially for smaller companies. These costs can include investments in hardware, software and training. However, these initial expenses are viewed as investments that will yield long-term savings and efficiencies, such as reduced administrative burdens, improved accuracy and faster processing times.
- **Economic incentives for adoption**: Economic incentives, possibly provided by the state or other institutions, are considered essential to encourage companies, especially smaller ones, to transition to digital systems. These incentives could take various forms, such as tax breaks, subsidies or grants, helping to alleviate the financial burden of adopting new technologies.
- **Benefits of digital transition**: The benefits of moving to digital documentation and processes in logistics are manifold. They include increased efficiency, reduced paperwork, better compliance with regulations, and improved data accuracy and accessibility. These benefits are expected to contribute to a more competitive and streamlined logistics sector.

4.8. Thematic Synthesis

It is clear from the analysis provided that a successful digital transition in the eFTI system is a multifaceted process influenced by company size, workforce capabilities, regulatory and market dynamics, and economic factors. Effective leadership, targeted education and collaborative standardization and interoperability efforts are essential and act as cross-functional drivers to navigate these dynamics and achieve efficient eFTI adoption, as seen in Figure 4. This theory, grounded in the interview data, offers a nuanced understanding of the challenges and strategies in the implementation of the eFTI regulation in the road FT sector, emphasizing the interconnected nature of various influencing factors. These determinants are interdependent and act across functions within organizations. Addressing the disparity in eFTI adoption requires a multifaceted approach that includes fostering workforce capabilities, advancing interoperability and standardization, leveraging effective leadership, balancing economic considerations and navigating market and regulatory dynamics.

In particular, the analysis shows that company size is a significant determinant of digital adoption. Larger logistics companies are better equipped to embrace eFTI due to their resources and streamlined processes, which enhance integration efficiency. This size-related advantage creates a divide, where smaller entities may struggle to keep pace with their larger counterparts. The capabilities of the workforce, particularly in terms of

digital skills, also play a crucial role. There is an age-related disparity in digital skills, indicating that older workforce members may not be as digitally savvy as their younger colleagues to handle the prerequisites of eFTI. Regulatory and market dynamics come into play significantly, especially considerations regarding data security and compliance, emphasizing the need for robust regulatory frameworks and standards to facilitate a smooth transition to digital systems like eFTI. Economic factors influence the decision-making process regarding digital adoption, especially in terms of long-term benefits. In particular, organizations must evaluate the long-term benefits against the upfront costs associated with adopting new technologies. Economic incentives can play a pivotal role in this calculus, potentially offsetting adoption costs and promoting a more rapid integration of digital technologies. The interaction between market forces and regulatory frameworks is a determinant that impacts the pace of digital adoption. Larger logistics companies often lead the way, creating market-driven momentum that smaller entities may follow. Regulatory frameworks can act as both a catalyst and a checkpoint for digital adoption, influencing how quickly and effectively new technologies are integrated into the sector.

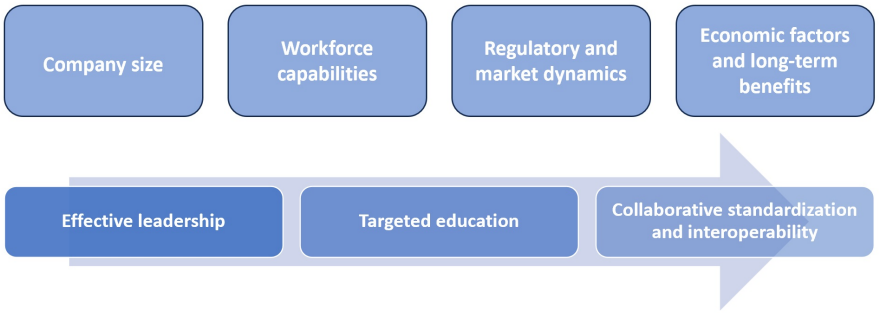

Figure 4. Synthesis of the main emerging themes.

The gap related to digital skills necessitates targeted education and training programs aimed at enhancing digital proficiency with practical, job-specific content. Such initiatives could bridge the skill gap and foster a digitally competent workforce across all age groups. Effective leadership acts as a keystone determinant, underpinning the successful navigation through eFTI adoption. Leaders who are proactive and supportive can instigate change by creating an ecosystem that encourages digital adoption. Their role extends to ensuring that the organization has robust support systems in place to provide the necessary resources and information for smooth transitions. The role of regulatory bodies is critical in setting these standards and ensuring compliance, which in turn supports collaborative standardization across the industry. This standardization is necessary to avoid fragmentation and facilitate a unified approach to successfully implementing eFTI. In general, industry-wide standards seem essential to ensure compatibility among digital tools and to maintain a seamless digital environment.

5. Discussion

The analysis of the interrelationships among the themes related to the adoption of eFTI in road FT in the logistics sector reveals a complex and dynamic ecosystem. In this landscape, the disparity in digital adoption between large and small companies is a critical issue. Larger companies, equipped with more financial and infrastructural resources, navigate the digital transition with greater ease. In contrast, smaller companies grapple with significant challenges, not the least of which is a pronounced digital skill gap within their workforce. This gap is more pronounced in smaller entities, where limited resources impede the provision of effective training and development programs. The workforce's digital skill gap is a pivotal concern, demanding proactive leadership and innovative training approaches. Leaders within logistics companies are called to be change agents, navigating their organizations through the turbulent waters of digital transformation. Their role is crucial in making strategic decisions regarding investment in digital technologies,

balancing the immediate costs against long-term benefits. Economic considerations are inherently tied to company size. Financial capabilities influence how companies perceive and manage the cost-benefit analysis of digital adoption. This is particularly relevant in decisions regarding investment in workforce training and development—a critical factor in closing the skill gap. Simultaneously, the sector is influenced by market and regulatory dynamics. Regulatory bodies often spearhead standardization efforts, setting the pace and direction for digital adoption. Market trends further influence these efforts, shaping the strategies and decisions of company leadership. In turn, these dynamics impact how companies, both large and small, adapt to and embrace standardization and interoperability initiatives. The role of interoperability and standardization cannot be overstated. Efficient interoperability can lead to significant cost savings and enhance the return on investment for digital technology. However, achieving this requires a skilled workforce capable of managing and operating standardized systems. This need loops back to the importance of targeted training and development programs.

The comparative analysis of the GT results of this study (themes related to the adoption of eFTI in FT within the logistics sector) and the relevant literature reveals a nuanced ecosystem characterized by disparities in digital adoption across companies of varying sizes and resource capacities. This complex landscape, as identified in the analysis, highlights the significant challenges smaller companies face, particularly in terms of digital skill gaps and the need for strategic leadership to navigate digital transformation. In particular, the critical issue of digital adoption disparity aligns with the broader challenges identified in the literature regarding the application of technological solutions in the road FT industry. The emphasis on collaboration, stringent laws, investment and responsiveness to demands [1] mirrors the necessity for proactive leadership and innovative training approaches highlighted in the analysis. Moreover, the potential of eFTI to improve efficiency and reduce environmental impacts, as discussed in the literature [11–13], underscores the importance of addressing the digital skill gap to fully leverage these benefits. The transformative potential of technology and ICT solutions in making FT more sustainable and less environmentally detrimental [8,9,14–16] further illustrates the critical role of digital competencies within the workforce. The analysis's emphasis on the necessity of targeted training and development programs to manage and operate standardized systems is thus supported by the literature, which highlights the need for modern technologies and ICTs in enhancing sustainability and operational efficiency. Regarding regulatory initiatives like eFTI and eCMR, the literature underscores their benefits in terms of operational and environmental efficiency, real-time transparency and security [17,18,21–23]. This aligns with the analysis's identification of regulatory bodies as key players in standardization efforts and the importance of interoperability and standardization in achieving cost savings and enhancing investment returns. The discussion of "neutralization" [25] and the challenges of ensuring data accuracy and operational efficiency further reflect the analysis's focus on the need for skilled workforce and secure, efficient digital systems.

Based on the analysis, it is clear that implementing the eFTI regulation in the road FT sector is not a linear process but rather a multifaceted journey requiring a nuanced understanding of various interrelationships. In line with the initial research questions and based on the findings of our analysis, the following conclusion can be drawn:

Q1: The integration of digital technologies like eFTI in logistics, as derived from expert interviews, presents a complex ecosystem of adaptation, challenges and evolving practices. The sector is navigating a significant digital shift, with eFTI spearheading a move toward more efficient and transparent transport documentation processes. This transition is not just a technological upgrade but a holistic integration, weaving new digital solutions into the existing fabric of TMS and ERP systems. The focus has notably shifted from hardware-heavy setups to software-centric solutions, leveraging widespread devices like smartphones and tablets. This strategic emphasis on software integration highlights a cost-effective and practical approach to digital adoption, crucial in an industry where margins and efficiencies are paramount.

However, the journey is not without obstacles. A striking observation is the disparity in digital adoption capabilities across different company sizes. Larger firms, equipped with more robust resources and infrastructural capacities, navigate this digital integration with relative ease, albeit grappling with complexities inherent in their existing large-scale systems. In contrast, smaller companies, especially those operating at a more individual or localized level, are often limited by foundational challenges. These entities frequently struggle with basic digital infrastructure and skills, highlighting a digital divide that underscores the need for tailor-made digital adoption strategies.

A significant obstacle in this digital journey is the prevailing digital skill gap, particularly pronounced among an aging workforce. The logistics sector, traditionally reliant on a demographic group less attuned to rapid digital advancements, faces a challenging task in bridging this gap. Herein lies the importance of targeted training and adaptation strategies, a crucial investment in human capital to bring the workforce up to speed with these technological changes.

Q2: The adoption of digital approaches like the eFTI in logistics is inextricably linked to the regulatory landscape. Regulatory frameworks emerge as both catalysts and checkpoints in this digital journey. The market dynamics underscore a trend where larger companies are the vanguards of digital adoption, creating a ripple effect across the sector. However, this transition is not merely market-driven but significantly influenced by compliance with regulatory mandates. As such, regulatory frameworks are dual-edged swords, propelling the industry toward standardization while also raising concerns around data security and privacy, especially in an era where data breaches and cyber-attacks are increasingly common. Another critical aspect brought to light is the need for interoperability and standardization, a cornerstone for efficient and seamless digital adoption. The industry faces challenges posed by a lack of unified standards, leading to potential fragmentation and inefficiencies. The role of government and regulatory bodies in facilitating a standardized approach, as seen in Germany's handling of e-CMR, is pivotal in creating a conducive environment for industry-wide digital adoption.

Q3: Economic factors play a decisive role in the adoption of digital technologies in logistics. The deliberation over initial costs versus long-term benefits is a central theme in these decisions. While the upfront costs associated with digital transitions, such as investments in software, hardware and training, can be daunting, especially for smaller players, these are viewed as investments toward long-term efficiencies and savings. The narrative also highlights the role of economic incentives, such as tax breaks or subsidies, in easing the financial burden of this transition for smaller entities. Looking toward the future, the sector's outlook on digital technologies remains optimistic. The anticipated benefits extend beyond mere operational efficiencies to encompass broader aspects like compliance, data accuracy and the streamlining of logistics processes. This optimistic future is not just a vision but a trajectory set by the current momentum toward digitalization, poised to redefine the logistics sector's landscape.

Limitations and Future Research

While the interview approach and the use of GT provide valuable insights, they come with certain limitations. The interview analysis is based on responses from only three participants, which limits the diversity and breadth of perspectives. This small sample size may not adequately represent the wider logistics sector, potentially leading to conclusions that are not generalizable across different regions, company sizes or industry sub-sectors. The experiences and opinions of these individuals might be influenced by their specific roles, backgrounds and organizational contexts. This can introduce a level of subjectivity, where the conclusions drawn might reflect personal biases or specific organizational cultures rather than industry-wide trends. For instance, although the study's focus was on eFTI regulation, the experts frequently referred to the eCMR initiative, with which they were more familiar due to its greater maturity.

Some limitations relevant to the GT should also be kept in mind. GT is an interpretive method, meaning that the researcher's perspectives and understanding can significantly influence the analysis and theory development. This subjectivity can lead to different researchers arriving at different theories based on the same data, potentially affecting the consistency and replicability of the findings. GT aims to develop a theory that is 'grounded' in the data, but this also means that the theory is not fixed and can evolve with additional data or in different contexts. While this is a strength in understanding complex social phenomena, it can be a limitation when seeking to establish definitive conclusions or broad generalizations. The process of coding, categorizing and developing theory in GT can be complex and time-consuming, often requiring deep immersion in the data. This might limit its practicality in research scenarios where time or resources are constrained. These limitations highlight the need for careful interpretation of the findings and suggest that additional research, possibly involving a larger and more diverse group of participants and different methodological approaches, would be beneficial to fully understand the nuances of digital transformation in the logistics sector.

Based on these limitations and given the importance of the eFTI regulation for the EU road FT industry, future research should aim to include a larger and more diverse pool of participants from different regions, company sizes and industry sub-sectors. This could provide a more representative perspective of the actual implementation of the eFTI regulation and enhance the generalizability of the findings. In addition, comparative studies could uncover region-specific or sub-sector-specific challenges and practices with respect to eFTI. This would be valuable for understanding how eFTI regulations might be tailored or implemented differently across various contexts. Besides, longitudinal research could track how the implementation of eFTI regulation evolves over time, considering the influence of technological advancements, policy changes and economic shifts. Multiple case studies could also provide in-depth narratives of successful and challenging implementations of the eFTI regulation in practice, offering practical insights and lessons learned. Future studies could also assess the impact of eFTI implementation on the overall efficiency and resilience of SC networks. By examining key performance indicators before and after eFTI adoption, researchers can quantify the regulation's contribution to operational improvements. Conducting comprehensive economic analyses to evaluate the costs and benefits associated with eFTI implementation could also support decision-making processes for businesses and policymakers. This includes assessing the return on investment and long-term financial impacts of transitioning to eFTI. Finally, further research could focus on the technological prerequisites for implementing eFTI effectively, including infrastructure needs, data security concerns and integration challenges with existing systems. This could help in identifying best practices for technology deployment and integration.

6. Conclusions

The analysis of the interview with logistics experts reveals a multifaceted landscape of digital transformation within the logistics sector. Key conclusions include the recognition that technology integration and digital transition are pivotal, with a focus on integrating new technological approaches like eFTI with existing systems, predominantly through software rather than hardware. However, this transition is not uniform across the sector; larger companies with more resources face distinctly different challenges compared with smaller companies, which struggle with limited infrastructure and digital skills. A significant digital skill gap, particularly evident in the older workforce, necessitates targeted training and gradual adaptation strategies.

The dynamics of market forces and regulatory frameworks are instrumental in shaping the pace and nature of digital adoption, with large companies often setting the trend and regulatory bodies ensuring standardized and secure practices. Education, support from organizations and strong leadership emerge as critical components in facilitating a smooth transition to the eFTI system. Furthermore, the importance of interoperability and standardization is underscored, especially in light of the challenges posed by diverse and

incompatible digital systems. Finally, while the initial costs of digital adoption may be daunting, especially for smaller players, the long-term benefits, coupled with potential economic incentives, present a compelling case for embracing digital transformation approaches like the eFTI. These findings highlight the complexity of adopting eFTI in logistics and the need for a holistic approach that addresses the varied challenges across different segments of the sector.

Author Contributions: Conceptualization, T.K.D. and E.K.; methodology, T.K.D. and E.K.; resources, P.T.C.; writing—original draft preparation, T.K.D. and E.K.; writing—review and editing, N.P.R., P.T.C., T.G.V. and K.G.; supervision, G.C.; funding acquisition, N.P.R. and G.C. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the University of Piraeus Research Centre.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are contained within the article.

Acknowledgments: We acknowledge the support from the Municipality of Piraeus for the project "Supporting the creation and development of a Knowledge and Innovation Community for the Blue Economy in Piraeus." Special thanks to the administrative and technical staff for their invaluable assistance (https://kics.gr/).

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Nkesah, S.K. Making road freight transport more Sustainable: Insights from a systematic literature review. *Transp. Res. Interdiscip. Perspect.* **2023**, *22*, 100967. [CrossRef]
2. Evangelia Kopanaki, P.K.; Georgopoulos, N. From traditional interorganisational systems to cloud-based solutions: The impact on supply chain flexibility. *J. Organ. Comput. Electron. Commer.* **2018**, *28*, 334–353. [CrossRef]
3. Chountalas, P.; Dasaklis, T.; Giannakis, K.; Kopanaki, E.; Rachaniotis, N.; Voutsinas, T. Electronic Freight Transport Information (eFTI). White Paper. 2023. Available online: https://efti.gr/wp-content/uploads/2023/03/eFTI-White-Paper_en.pdf (accessed on 19 December 2023).
4. Parliament, T.E.; the Council of the European Union. Regulation (EU) 2020/1056 of the European Parliament and of the Council of 15 July 2020 on Electronic Freight Transport Information (Text with EEA Relevance). Official Journal of the European Union. Technical Report. 2020. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32020R1056 (accessed on 19 December 2023).
5. European Commission's Directorate General for Mobility and Transport. Commission Implementing Regulation (EU) . . . /... Laying down Common Procedures and Detailed Rules for Accessing and Processing Electronic Freight Transport Information by Competent Authorities in Accordance with Regulation (EU) 2020/1056 of the European Parliament and of the Council. Technical Report. 2023. Available online: https://op.europa.eu/en/publication-detail/-/publication/deea48e0-7275-11ee-9220-01aa75ed71a1/language-en (accessed on 3 November 2023).
6. Potec, L. The EU Regulation 2020/1056 on Electronic Freight Transport Information (eFTI): An Overview. 1st Meeting of the Group of Experts on the Operationalisation of eCMR, UNECE Inland Transport Committee, Working Party on Road Transport, 4–5 July 2022. Available online: https://unece.org/sites/default/files/2022-07/ECE-TRANS-SC1-GE22-Presentation-7e.pdf (accessed on 14 November 2023).
7. Varjas, V. eFTI Implementation and Latest Developments Intervention at "Multimodality in Practice—Challenges in the Western Balkans Region and the Belgian Solution", 14 December 2022. Available online: https://www.transport-community.org/wp-content/uploads/2023/04/20221214-Transport-Community-eFTI-implementation_VV2.pdf (accessed on 14 November 2023).
8. Settey, T.; Gnap, J.; Beňová, D. Examining the impact of the deployment of low emission zones in Europe on the technological readiness of road freight transport. *Transp. Res. Procedia* **2019**, *40*, 481–488. [CrossRef]
9. Chatti, W. Information and communication technologies, road freight transport, and environmental sustainability. *Environ. Econ.* **2020**, *11*, 124–132. [CrossRef]
10. Carvalho, A.; Melo, P.; Oliveira, M.A.; Barros, R. The 4-corner model as a synchromodal and digital twin enabler in the transportation sector. In Proceedings of the 2020 IEEE International Conference on Engineering, Technology and Innovation, ICE/ITMC, Cardiff, UK, 15–17 June 2020. [CrossRef]
11. Jonkeren, O.; Friso, K.; Hek, L. Changes in external costs and infrastructure costs due to modal shift in freight transport in North-western Europe. *J. Shipp. Trade* **2023**, *8*, 24. [CrossRef]

12. Cavallaro, F.; Nocera, S. Integration of passenger and freight transport: A concept-centric literature review. *Res. Transp. Bus. Manag.* **2022**, *43*, 100718. [CrossRef]
13. Karam, A.; Jensen, A.J.K.; Hussein, M. Analysis of the barriers to multimodal freight transport and their mitigation strategies. *Eur. Transp. Res. Rev.* **2023**, *15*, 43. [CrossRef]
14. Wang, Y.; Potter, A. The application of real time tracking technologies in freight transport. In Proceedings of the 2007 Third International IEEE Conference on Signal-Image Technologies and Internet-Based System, Shanghai, China, 16–18 December 2007; pp. 298–304. [CrossRef]
15. Kadlubek, M. Relevance of modern technologies for sustainability-focused road freight transport service management in a competitive market. *Procedia Comput. Sci.* **2022**, *207*, 2013–2022. [CrossRef]
16. Chatti, W. Moving towards environmental sustainability: Information and communication technology (ICT), freight transport, and CO_2 emissions. *Heliyon* **2021**, *7*, E08190. [CrossRef]
17. Casado, J.M.P.; Funes, A.G.; Doncel, J.G.G. Digital Transformation: Advantages and opportunities of E-CMR in international cargo logistics. *Esic Digit. Econ. Innov. J.* **2021**, *1*, 84–102. [CrossRef]
18. Dmitrieva, O.; Rudakova, E.; Alexandrova, J.; Majerčák, P.; Majerčák, J. Customs procedure of customs transit for the carriage of goods by roads in russia. *Transp. Res. Procedia* **2021**, *53*, 204–211. [CrossRef]
19. Czapski, W. Application and interpretation of the CMR convention from an international law perspective. *Unif. Law Rev.* **2006**, *11*, 545–568. [CrossRef]
20. Ferrer, J.C. The CMR convention—A pillar of international carriage of goods by road. *Unif. Law Rev.* **2006**, *11*, 517–521. [CrossRef]
21. Heines, R.; Rüttimann, S.; Jung, R. Design of a DLT-based Document Management System in Road Transport. In Proceedings of the Hamburg International Conference of Logistics, Hamburg, Germany, 23–24 September 2021; Volume 31, pp. 275–299.
22. Li, T.; Vos, J.; Erkin, Z. Decentralized Private Freight Declaration & Tracking with Data Validation. In Proceedings of the 2022 IEEE International Conference on Pervasive Computing and Communications Workshops and other Affiliated Events, PerCom Workshops, Pisa, Italy, 21–25 March 2022; pp. 267–272. [CrossRef]
23. Licite-Kurbe, L.; Ozolina, Z. Gains from introducing E-CMR by international manufacturing company. In Proceedings of the Engineering for Rural Development, Jelgava, Latvia, 25–27 May 2022; Volume 21, pp. 146–152. [CrossRef]
24. Poliak, M.; Tomicová, J. Transport document in road freight transport—Paper versus electronic consignment note CMR. *Arch. Automot. Eng.* **2020**, *90*, 45–58. [CrossRef]
25. Poliak, M.; Tomicová, J.; Jaśkiewicz, M.; Zhuravleva, N.; Fedorko, G. Neutralization of transport documents in road transport. *Transp. Probl.* **2021**, *16*, 87–99. [CrossRef]
26. Poliak, M.; Tomicová, J.; Jaśkiewicz, M. Identification the Risks Associated with the Neutralization of the CMR Consignment Note. *Transp. Res. Procedia* **2020**, *44*, 2–29. [CrossRef]
27. Tomicová, J.; Poliak, M.; Zhuravleva, N.A. Impact of using e-CMR on neutralization of consignment note. *Transp. Res. Procedia* **2021**, *55*, 110–117. [CrossRef]
28. Moskvin, V. Post-Quantum Digital Signatures in Transport Documents. In Proceedings of the 2022 Intelligent Technologies and Electronic Devices in Vehicle and Road Transport Complex, TIRVED, Moscow, Russia, 10–11 November 2022. [CrossRef]
29. Allan, G. A critique of using grounded theory as a research method. *Electron. J. Bus. Res. Methods* **2003**, *2*, 1–10.
30. Turner, B.A. Some practical aspects of qualitative data analysis: One way of organising the cognitive processes associated with the generation of grounded theory. *Qual. Quant.* **1981**, *15*, 225–247. [CrossRef]
31. Cho, J.Y.; Lee, E.H. Reducing confusion about grounded theory and qualitative content analysis: Similarities and differences. *Qual. Rep.* **2014**, *19*, 64. [CrossRef]
32. Charmaz, K.; Thornberg, R. The pursuit of quality in grounded theory. *Qual. Res. Psychol.* **2021**, *18*, 305–327. [CrossRef]
33. Martin, P.Y.; Turner, B.A. Grounded Theory and Organizational Research. *J. Appl. Behav. Sci.* **1986**, *22*, 141–157. [CrossRef]
34. Chun Tie, Y.; Birks, M.; Francis, K. Grounded theory research: A design framework for novice researchers. *Sage Open Med.* **2019**, *7*, 2050312118822927. [CrossRef] [PubMed]
35. Timonen, V.; Foley, G.; Conlon, C. Challenges when using grounded theory: A pragmatic introduction to doing GT research. *Int. J. Qual. Methods* **2018**, *17*, 160940691875808. [CrossRef]
36. Walker, D.; Myrick, F. Grounded theory: An exploration of process and procedure. *Qual. Health Res.* **2006**, *16*, 547–559. [CrossRef]
37. Aldiabat, K.M.; Le Navenec, C.L. Data saturation: The mysterious step in grounded theory methodology. *Qual. Rep.* **2018**, *23*, 245–261. [CrossRef]
38. Kelle, U. "Emergence" vs "forcing" of empirical data? A crucial of "grounded theory" reconsidered. *Forum Qual. Sozialforschung* **2005**, *6*. [CrossRef]
39. Crouch, M.; McKenzie, H. The logic of small samples in interview-based qualitative research. *Soc. Sci. Inf.* **2006**, *45*, 483–499. [CrossRef]
40. Holsti, O.R. *Content Analysis for the Social Sciences and Humanities*; Addison-Wesley: Reading, MA, USA, 1969.