



Electronic Freight Transport Information (eFTI)

White Paper

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• Abstract

Freight transport in the EU is accompanied by a large amount of information being exchanged among stakeholders, in both the private and public sector. Today, 99% of this information in multimodal and cross-border transport operations in the EU is printed in a variety of standard paper-based documents. Digital information exchange has the potential to significantly improve transport efficiency, while bringing significant environmental benefits. However, a low and varying degree of digital solutions adoption is observed. The main reason is the fragmented IT environment characterized by a plethora of non-interoperable systems/solutions for electronic transport information and documentation exchange between varied stakeholders. In order to promote electronic transactions, the European Commission proposed a Regulation on Electronic Freight Transport Information (eFTI) aiming to enhance the trust of Member States' (MS) authorities and economic operators regarding the compliance of eFTI platforms and eFTI service providers with specified functional requirements. Aiming to contribute to this endeavor, this paper provides a detailed overview of eFTI, including its benefits, key components and challenges and considerations involved in its implementation.

1. Introduction

The movement of goods in the European Union has increased by almost 25% from 1995 to 2015 (Figure 1). A further increase is predicted for the years to come (World Trade Organization, 2015), even though the growth rate has slowed due to the COVID-19 pandemic (Sudan & Taggar, 2021). The transportation of goods from different types of routes and modes of transport (via rail, roads, sea and air) generates a significant amount of information, which is mostly exchanged in a paper-based form through a variety of standard format documents (Glass et al., 2010). It is issued or modified by private or public parties (e.g. companies or public authorities), involving information related to contractual agreements, administrative issues or data related to the movement of goods and the goods themselves.

Although technological solutions for the exchange of electronic documents between different companies and stakeholders have been implemented for many years now (Kopanaki et al. 2018), the exchange of freight transport information is still to a great extent paper-based. According to European Commission et al. (2018) the main reasons underpinning this problem are:

- The fragmented legal framework (at international, EU and national level), forming inconsistent requirements for electronic documents' acceptance by the different authorities
- The fragmented IT environment including non-interoperable systems and varied standards of electronic messages and documents exchange
- The low level of acceptance of electronic documents by the different stakeholders.







Figure 1: EU-28 Performance for Freight Transport 1995-2015 Source: Baran & Gorecka (2019)

These create increased transaction costs, delays and significant waste of resources. Recognizing the inefficiency and the related environmental cost, due to the increased quantity of paper used and waste produced (considering the different documents exchanged and the copies produced, when modified or signed), the European Union issued a new Regulation on Electronic Freight Transport Information in 2020, aiming to provide a fully digital and harmonized environment for information exchange between transport operators and authorities (European Council, 2020).

eFTI refers to the use of digital technologies to manage and share information related to the transportation of goods (Carvalho et al., 2020). This includes data on cargo, logistics and transportation-related activities, such as shipment tracking, customs clearance and compliance with regulations (Santos & Soares, 2020). eFTI is designed to improve the efficiency, visibility and security of the freight transport process, by automating and standardizing information exchange between various stakeholders, such as shippers, carriers, logistics providers and government agencies. The main stakeholders of the eFTI system include (Aretz & Sahu, 2022; Heinbach et al., 2022; Pencheva et al., 2022):

- Freight forwarders and logistics providers: These companies are responsible for arranging and coordinating the movement of goods from one location to another. They play a crucial role in the eFTI system as they are responsible for providing and receiving electronic information.
- Carriers: Carriers are the companies that physically transport the goods. They play a key role in the eFTI system as they are responsible for providing real-time updates on the location and status of the goods being transported.





- Customs and border protection agencies: These agencies are responsible for ensuring that all goods entering or leaving a country comply with the relevant laws and regulations. They play a crucial role in the eFTI system as they are responsible for providing clearance for goods to enter or leave a country.
- Shippers: These are the companies or individuals that own the goods being transported. They play an important role in the eFTI system as they are responsible for providing necessary information such as goods' type, value and destination.
- Government agencies: Government agencies play a key role in the eFTI system as they are responsible for setting and enforcing regulations related to freight transport. They also play a role in providing infrastructure and funding for the eFTI system.
- Technology providers: These companies provide the technology and software needed to support the eFTI system. They play a crucial role as they are responsible for ensuring that the system is reliable, secure and easy to use.

The use of eFTI is becoming increasingly important in the logistics industry as global trade continues to grow and the need for efficient, cost-effective and secure transport of goods becomes urging (Aretz & Sahu, 2022). The traditional process of managing freight transport information, which relies on paperbased documents and manual processes, is time-consuming, error-prone and often leads to delays and increased costs. This can lead to inefficiencies in logistics operations, difficulty in tracking and tracing cargo and lack of standardization in data formats. eFTI aims to overcome these challenges by leveraging digital technologies such as cloud computing, IoT and blockchain, to provide real-time visibility into the freight transport process and automate the exchange of information between stakeholders.

Furthermore, eFTI can be a key tool for compliance with regulations, as it enables the exchange of electronic data, such as electronic cargo manifests, electronic consignment notes and electronic bills of lading, which are required by the state authorities for customs clearance, security and other purposes. Additionally, eFTI can be integrated with other solutions such as digital twin, smart logistics and predictive maintenance, to support the digitalization of the logistics industry and enable new business models and service offerings.

A potential eFTI implementation could look like current digital waybills (e-CMR), which are currently used in road transport. This means that truck drivers no longer need to carry hard copy cargo documents, but instead can make use of digital versions on a mobile device. Companies that provide truck telematics software have included the e-CMR in their mobile applications for truck drivers and are communicating any CMR status update to all connected parties (Aretz & Sahu, 2022).

Therefore, eFTI should be framed as a critical component of the digital logistics ecosystem, enabling the real-time visibility, automation and standardization of freight transport information, thus improving efficiency, reducing costs and increasing security and compliance. The purpose of this white paper is to provide a detailed overview of eFTI, including the background and future planning on freight transport in the EU, the current challenges in freight transport information management, the key elements of eFTI Regulation, the eFTI system architecture and its key components, the considerations involved in eFTI implementation challenges, benefits and current limitations and the synergy of eFTI and Industry 4.0 technologies.





2. Current Challenges in Freight Transport Information Management

The management of freight transport information is a critical aspect of the logistics industry, as it involves the collection, management and sharing of data related to the transportation of goods. However, the traditional process of managing freight transport information, which relies on paper-based documents and manual processes, is often prone to errors, delays and increased costs (Figure 2). In addition, the lack of standardization and visibility in the freight transport process can make it difficult to track and trace cargo and comply with regulations.



Figure 2: Problem structure Source: Rachaniotis et al. (2021)

2.1. Inefficiencies in manual processes

The inefficiency of manual processes includes the use of paper-based documents for the collection and management of data, such as bills of lading, customs declarations and shipment tracking forms. Manual processes are often time-consuming, error-prone, and can lead to delays in the transportation of goods. For instance, in the case of paper-based bills of lading, the process of preparing, signing and transmitting them is often slow and prone to errors. This can lead to delays in the clearance of goods, as well as increased costs due to the need for manual data entry and reconciliation. In addition, manual processes can also make it difficult for shippers and logistics providers to track and trace cargo in real time. This can lead to uncertainty and inefficiencies in the supply chain, making it difficult to manage disruptions and optimize routes. Furthermore, manual processes can also make it difficult to comply with regulations, as





the collection, management and sharing of data can be challenging when done manually. This can lead to an increased risk of non-compliance, fines and penalties.

2.2. Lack of standardization in data formats

The lack of standardization in data formats refers to the use of different data formats and protocols by different stakeholders (Kim et al., 2019), such as shippers, carriers, logistics providers and government agencies. This can make it difficult to share and exchange information, as well as to integrate data from different sources. For example, different carriers may use different data formats and protocols for shipment tracking, making it difficult for shippers to access and compare information from multiple carriers. Similarly, different government agencies may have different requirements for customs declarations and other regulatory documents, which can create additional challenges in terms of compliance and data management. The lack of standardization in data formats can also make it difficult to automate and optimize the freight transport process, as it can be challenging to integrate data from different sources and systems. This can lead to inefficiencies, delays and increased costs in the logistics industry. Furthermore, the lack of standardization in data formats can make it difficult to ensure the security and integrity of data, as different stakeholders may have different security protocols and standards. This can create vulnerabilities and increase the risk of data breaches and other security threats.

2.3. Difficulty in tracking and tracing cargo

The difficulty in tracking and tracing cargo refers to the ability to access real-time information on the location, status and condition of cargo, as well as the performance of logistics providers. The lack of real-time visibility can make it difficult to manage supply chain disruptions, optimize routes and reduce transit times. For example, traditional tracking methods, such as paper-based documents, can make it difficult to access real-time information on the location and status of cargo. This can lead to uncertainty and inefficiencies in the supply chain, making it difficult for shippers and logistics providers to proactively manage disruptions and optimize routes. In addition, the lack of real-time visibility can also make it difficult to comply with regulations, as it can be challenging to access and share information on the location, status and condition of cargo with government agencies in a timely manner. Furthermore, it can be difficult to ensure the security and integrity of cargo, as it can be challenging to track and trace cargo and monitor its condition throughout the transportation process. This can increase the risk of cargo loss, theft and damage.

2.4. Data silos and lack of data integration

Data silos occur when different departments, systems, or processes within an organization have their own isolated databases, resulting in data being stored in separate and non-interconnected systems (Yu et al., 2014). This makes it difficult to access and share information between different departments, systems, or stakeholders, leading to inefficiencies and potential errors. The lack of data integration results from the inability of different systems to communicate and exchange information effectively. This can lead to data duplication, inconsistencies and inaccuracies, as well as a lack of real-time visibility into the freight transport process. The inability to access and share information in a timely manner can also result in longer response times, increased costs and reduced competitiveness.





2.5. Lack of real-time visibility and transparency

The use of paper-based documents and manual processes can create inefficiencies and hinder the ability to track and monitor the movement of cargo in real time. This can result in delays and increased costs, as well as make it difficult for logistics providers to respond quickly to changes in logistics operations. For example, if a shipment is delayed or encountering problems, it may take some time for the information to be recorded and communicated to the relevant parties, leading to further delays and increased costs. Furthermore, without real-time visibility into the freight transport process, it can be difficult for logistics providers to identify and address bottlenecks or inefficiencies in the supply chain, and to make informed decisions about resource allocation and network optimization.

2.6. Security and compliance challenges

Security and compliance challenges in traditional freight transport information management are a significant concern for logistics providers and organizations involved in the transportation of goods. The reliance on manual processes, paper-based documentation and a lack of standardization can make it difficult to ensure the security and confidentiality of sensitive information, such as customer data, trade secrets and financial information. Furthermore, the lack of automation in these processes can lead to errors and inconsistencies in the data, which can result in non-compliance with regulations, standards and laws, such as customs regulations, security regulations and data protection regulations. The consequences of security and compliance breaches can be severe, including increased costs, fines and legal liabilities. Reputational damage can also be significant, as customers, suppliers and partners may lose trust in an organization's ability to protect their sensitive information and comply with regulations.

2.7. Difficulty in managing large amounts of data

Managing large amounts of data in logistics operations is becoming more pressing as the amount of data generated by these operations continues to grow. The increased use of digital technologies and the growth of global trade have led to a massive amount of data being generated by logistics operations. This can include information related to cargo, logistics and transportation-related activities, such as shipment tracking, customs clearance and compliance with regulations. The challenge for organizations is to effectively process, analyze and use this data in a meaningful way (Kamboj and Rana, 2023). If the data is not managed properly, it can lead to inefficiencies, missed opportunities and a lack of actionable insights. The inability to effectively manage and use large amounts of data can hinder the optimization and improvement of logistics operations, leading to increased costs and missed opportunities for growth and innovation.

3. Future planning on Freight Transport in the EU

Freight transport is an essential component of the EU's economy and society. It enables the movement of goods, services and people throughout the region, helping to create the single market. As such, the EU has adopted numerous policies to ensure the efficient and safe movement of freight throughout the region, affecting its legal framework for freight transport that includes several related directives and





regulations (e.g. European Council, 2020; European Council, 2016a; European Council, 2009; European Council, 1992). The most important of these is the First Rail Freight Package, which was adopted in 2012 (European Council, 2012). This package established some new rules and regulations aimed at improving the efficiency and safety of rail freight transportation in the EU. Other directives and regulations include the Fourth Motor Vehicle Package, which establishes safety and environmental standards for motor vehicles; the Road Transport Directive, which sets out requirements for the movement of goods by road; and the Directive on Maritime Safety, which establishes safety requirements for the maritime transport of goods.

The EU legal framework for freight transport is constantly evolving, and new regulations and policies are being developed in order to address emerging challenges and to improve the efficiency and sustainability of the sector. On July 15th, 2020, the European Parliament and European Council adopted Regulation 2020/1056 concerning eFTI (European Council 2020). This Regulation is intended to promote the sustainability and efficiency of the transport sector by encouraging the digitization of supply chains and freight transport, offering improved access to goods for the relevant authorities and reducing business costs. It sets out a legal framework for the electronic communication of regulatory data relating to the transportation of goods within the European Union. This Regulation will come into effect on August 21st, 2024 and its main purpose is to establish a legal framework enabling economic operators to provide the relevant law enforcement authorities with freight regulatory information in electronic form. The Regulation also requires the use of eFTI platforms for economic operators to make freight regulatory data available to the competent authorities in electronic format in order to fulfill the conditions for mandatory acceptance of this information by the competent authorities. The schedule of implementing eFTI is presented in Figure 3.







Figure 3: The schedule of implementating eFTI Source: European Council (2020)

According to the Regulation, Economic Operators (e.g. businesses) are not so far obliged to make regulatory information available electronically to the authorities involved. However, when they choose to do so, they should adhere to the following:

- Present data in Human Readable format, if requested by the competent authority, on-site, on the operator's device.
- Use data that has been processed on a certified eFTI platform and, if possible, by a certified eFTI service provider.
- Be able to make data available in a digital form through an authenticated and secure connection to the data source of an eFTI platform and, when the data is requested for inspection, share with the authorities a unique identifying link to that data.

From their part, the involved public authorities must ensure the following:

- Have access and be able to process electronically the eFTI data made available by the operators.
- Accept regulatory information made available electronically by operators.
- Accept regulatory information for the transport of waste without the agreement referred to in Regulation (EC) No. 1013/2006 on waste transport (European Council, 2006).
- Offer formal electronic validation (e.g. digital signature), where such validation is required as part of regulatory information.

4. The key elements of eFTI Regulation

The key elements of eFTI Regulation, as identified by Potec (2022), are presented in Figure 4. These include the existing regulatory information requirements, the obligation for all competent authorities in all EU MS, the option for the economic operators, the common requirements for service providers and platforms and the one stop shop certification.







Figure 4: The key elements of eFTI Regulation Source: Potec, 2022

4.1. Existing regulatory information requirements

The regulation of freight transport within the EU hinterland involves a complex interplay of EU and national legislation that affects various modes of transportation including rail, road, inland waterways and aviation. This regulatory framework is designed to ensure the safe, secure and efficient transportation of goods and to promote fair competition within the market.

This regulatory framework involves common data specifications, which dictate the information that must be provided by transport companies to operate within the EU. These specifications play a critical role in ensuring the smooth functioning of the transportation system and are used by authorities to monitor compliance with regulations. One important aspect of these data specifications is combined transport. Combined transport refers to the movement of goods using two or more modes of transportation, such as road and rail. EU legislation regulates combined transport to ensure that it is safe, efficient and environmentally friendly (European Council, 1992). In order to comply with these regulations, transport companies must provide specific information about the goods they are transporting, the routes they are using and the modes of transportation they are utilizing.

Another important aspect of regulatory information requirements is the transport of dangerous goods and waste shipments. EU legislation requires that companies transporting these materials provide detailed information about the nature of the materials, the routes they will be taking, and the precautions they will be taking to ensure the safety of the public and the environment (European Council, 2008). This information is used by authorities to monitor compliance with regulations and to ensure that appropriate safety measures are in place. Aviation security is another critical aspect of freight transport regulation. The EU has established strict security standards for the transport of goods by air, which include requirements for the screening of cargo and the training of personnel. Transport companies must provide





information about the security measures they have in place and the personnel they have trained to comply with these regulations. The EU also has regulations in place to ensure non-discrimination of tariffs in freight transport. These regulations aim to promote fair competition by prohibiting transport companies from charging different prices for the same services based on factors such as the origin or destination of the goods. Transport companies must provide information about the tariffs they charge to comply with these regulations.

Finally, regulations concerning the means of transport and the personnel concerned dictate the specific requirements for the vehicles and personnel used in freight transport. For example, EU legislation requires that vehicles used in freight transport meet certain safety standards and that personnel have the necessary training and certifications to operate them. Transport companies must provide information about the vehicles and personnel they use to comply with these regulations.

4.2. Obligation for all competent authorities in all EU MS

The eFTI Regulation imposes obligations on all competent authorities in all EU MS to accept electronic freight transport information. Specifically, the obligation for all competent authorities in all EU MS to accept the information electronically means that all competent authorities must be able to receive, process and store electronic freight transport information to facilitate the efficient and transparent movement of goods in the EU. This requirement is essential to achieve the goal of eFTI, which is to improve the efficiency and transparency of freight transport in the EU. By obligating all competent authorities to accept information electronically, the EU aims to reduce reliance on paper-based processes, which can be time-consuming, costly and prone to errors. Furthermore, the requirement for all competent authorities in all EU MS to use the same requirements/technical specifications for acceptance means that all competent authorities must use the same technical standards for accepting eFTI to ensure that the information is consistent and can be easily processed and stored. The use of the same requirements/technical specifications for acceptance ensures that the information is of the same requirements/technical specifications for acceptance ensures that the information is of high quality and can be used to support decision-making in the EU.

4.3. Option for the economic operators

Option for the economic operators is one of the key elements of the eFTI Regulation, which sets out the rules for the exchange of information related to the transport of goods within the EU. This element is crucial for businesses and organizations involved in the transportation of goods as it provides them with the flexibility to choose how they present the required information.

Firstly, the regulation gives economic operators the option to present the information electronically or use paper. This allows businesses to choose the method that best suits their needs and capabilities. For example, small businesses that are not yet equipped with electronic systems may prefer to use paper-based methods, while larger organizations that have invested in electronic systems may choose to use





electronic methods to improve efficiency and reduce costs. However, if an economic operator opts for electronic methods, there is an obligation to use certified eFTI platforms or service providers. This ensures that the information provided is accurate, consistent and that it meets the technical specifications set out by the regulation. By using certified platforms and service providers, businesses can be confident that the information they provide will be accepted by the competent authorities and that it will be used in compliance with the regulations.

4.4. Common requirements for service providers and platforms

The eFTI regulation aims to establish a harmonized and efficient system across the EU. One of the key elements of this regulation is the set of common requirements for service providers and platforms. These requirements are crucial in ensuring that the eFTI system operates effectively and efficiently. There are two key issues that the common requirements address, which are the functionalities of the platforms and the obligations of the service providers.

First and foremost, the eFTI regulation specifies the functionalities that the platforms must possess. The platforms must be capable of receiving, processing and transmitting electronic freight transport information, including all relevant data and documents, between the competent authorities, economic operators and other relevant parties. Furthermore, the platforms must ensure the security and confidentiality of the information transmitted and stored, in accordance with the EU data protection regulations. Additionally, the platforms must provide an easy-to-use and intuitive interface for users, ensuring that the information is presented in a clear and concise manner.

Secondly, the eFTI regulation outlines the obligations of the service providers. The service providers must provide access to the platforms, ensuring that the functionalities specified in the regulation are available to all users. Furthermore, the service providers must provide technical and administrative support to the users, helping them to resolve any issues they encounter while using the platforms. Additionally, the service providers must ensure the security and confidentiality of the information transmitted and stored on the platforms, as well as comply with all relevant EU data protection regulations.

4.5. One-stop shop certification

The One Stop Shop (OSS) certification is a key element of the eFTI Regulation, aimed at facilitating the efficient and effective management of freight transport across the EU hinterland. The eFTI Regulation sets out a harmonized framework for the presentation, management and exchange of information related to freight transport between all relevant stakeholders, including economic operators, competent authorities, service providers and platforms. The OSS certification system is an integral part of this framework, providing a streamlined and efficient mechanism for ensuring the technical compatibility and compliance of eFTI systems.

One of the key features of the OSS certification system is the harmonization of rules for third-party certification. This means that all eFTI platforms and service providers must meet a common set of





technical and functional requirements to receive certification. This helps to ensure that all eFTI systems are interoperable and capable of exchanging information with each other, regardless of where they are located in the EU. The common set of requirements helps to promote consistency, reduce confusion and prevent fragmentation, which can occur when different standards are applied in different MS.

Another important aspect of the OSS certification system is that certification is valid EU-wide. This means that a platform or service provider that has received certification in one MS will be recognized in all others. This helps to promote the cross-border use of eFTI systems and facilitates the exchange of information between competent authorities, economic operators and other stakeholders across the EU. It also eliminates the need for separate certifications to be obtained in each MS, reducing administrative burden and costs for eFTI providers.

5. eFTI System architecture and key components

The architecture of the eFTI System is designed to provide a centralized and standardized information exchange between various stakeholders. The key components of the eFTI System architecture are: the eFTI Certified Platform, the eFTI Service Providers, the National Authorities Access Points, the MS Access Points and the Economic Operators. These components work together to provide a centralized and standardized platform for exchanging information related to freight transport within the EU. This enables stakeholders to improve the efficiency and effectiveness of their operations and to fully comply with regulations and standards. Figure 5 presents a potential implementation architecture of the eFTI System.



Figure 5: eFTI potential implementation architecture Source: Potec, 2022

5.1. eFTI Certified Platform





An eFTI Certified Platform is a secure, cloud-based platform that serves as a central repository for the exchange of information between different stakeholders. It is built on an industry-standard security framework and complies with the EU's security and privacy policies. The platform is used to store, validate and process information and provides secure access to the information to authorized stakeholders. It provides the necessary infrastructure and services to enable the secure and efficient exchange of data and documents between economic operators, national authorities and MS (Aretz & Sahu, 2022). The platform is also designed to be highly scalable and customizable, allowing it to be adapted to meet the specific needs of each customer. The platform also provides a secure interface for third-party applications to access and interact with the platform. Finally, the platform is constantly monitored to ensure that the highest level of security is maintained.

5.2. eFTI Service Providers

eFTI Service Providers are responsible for creating, managing and maintaining the systems and networks required for the functioning of the eFTI system. They provide the necessary technical infrastructure and services to enable the secure transmission of documents and data, as well as services related to the eFTI System. These services can include data integration, support and maintenance of the system, including updates and bug fixes, as well as training and user support. eFTI Service Providers are responsible for ensuring that all components of the system are up to date, secure and reliable, as well as providing regular updates and patches to ensure that the system remains up to date and secure. Furthermore, the eFTI service provider is responsible for providing the necessary support, maintenance and training to ensure the efficient and effective use of the eFTI system. Additionally, the eFTI service provider is responsible for monitoring the system to ensure its optimal performance and availability. eFTI Service Providers are expected to maintain the confidentiality of all exchanged data and must adhere to the security requirements established by the eFTI System.

5.3. National Authorities Access Points

National Authorities Access Points are the primary means for national authorities to access the eFTI platform. These access points provide a secure and unified interface for the exchange of data between the national authorities and other stakeholders, such as companies and IT service providers. The access points enable the national authorities to monitor and regulate the freight transport operations within their jurisdiction. They facilitate the flow of information between the national authorities and other stakeholders, including the monitoring of freight transport operations, the implementation of safety measures and the enforcement of regulations. Additionally, the access points provide an effective way for the national authorities to track and analyze performance metrics, such as the time it takes to deliver shipments, the number of shipments that fail to meet the agreed upon deadline and the cost of freight transport.





5.4. Member States Access Points

MS Access Points are the virtual portals used by MS to access and interact with the eFTI platform, as well as exchange information with other MS. The Access Points provide MS with the ability to monitor freight transport operations within the EU, including the ability to view, submit and update freight transport data, view freight transport statistics and view freight transport reports. Furthermore, the Access Points enable MS to engage in data-sharing and collaboration with other MS to ensure the efficient and effective management of freight transport operations across the EU. The Access Points also enable MS to access and utilize eFTI tools such as the risk assessment tool, the market access tool and the performance measurement tool. Finally, the Access Points provide MS with the ability to access, view and manage eFTI-related documents, such as legal and regulatory documents.

5.5. Economic Operators

Economic Operators are the companies and organizations that use the eFTI platform for digital document exchange. These operators are responsible for providing and securely exchanging the necessary data and documents to and from the eFTI platform. This includes documents related to freight transport operations such as cargo manifests, bills of lading, customs declarations, etc. Economic operators are also responsible for monitoring and managing their freight transport operations on the eFTI platform. This includes tracking the status of shipments, managing documentation and ensuring timely delivery of goods. Furthermore, these operators can use the eFTI platform to share data and documents with other stakeholders such as companies and national authorities, to ensure compliance with international and domestic regulations. The eFTI platform provides these operators with the tools they need to streamline their freight transport operations and ensure they remain compliant.

6. Implementation of eFTI

The implementation of an eFTI system is a complex and multi-faceted process that requires careful planning, coordination and execution. It involves the integration of multiple components, such as hardware, software, communication networks and data management systems, as well as the involvement of different stakeholders, such as shippers, carriers, logistics providers, and government agencies. In this section, we will discuss the key steps and considerations for implementing an eFTI system, including the identification of stakeholders and their needs, the selection of hardware and software components, the design and testing of the system and the deployment and maintenance of the system.

6.1. Identifying the right technology solution

One of the key steps in implementing an eFTI system is identifying the right technology solution. This involves assessing the specific needs of the organization and its stakeholders, and selecting the hardware and software components that best meet those needs. For example, organizations may need to consider





factors such as data storage capacity, processing power, scalability, and compatibility with existing systems, when selecting a data management system. In addition, organizations may also need to consider factors such as security, compliance and integration with other systems, when selecting hardware and software components for data collection, communication and analytics. It's also important to consider the cost of the solution, and the return on investment (ROI) over time. Organizations should also consider the scalability of the system and its ability to adapt to future changes in technology and business requirements. In addition, organizations may also need to consider the level of support and maintenance required for the system and ensure that they have the resources and expertise to maintain and support the system over time (Haoues et al., 2017).

6.2. Data migration and integration with existing systems

Data migration and integration with existing systems involves the transfer of data from existing systems to the new eFTI system, and the integration of the eFTI system with existing systems to ensure seamless and accurate data exchange. For example, organizations may need to migrate data from legacy systems, such as paper-based documents or older software systems, to the new eFTI system. This can be a complex and time-consuming process and requires careful planning and execution to ensure that data is accurately and completely transferred (Morris, 2006). Once data migration is completed, organizations will need to integrate the eFTI system with existing systems, such as enterprise resource planning (ERP) and customer relationship management (CRM) systems, to ensure seamless and accurate data exchange. This can be done using standard integration methods, such as APIs, or by customizing the eFTI system to meet the specific needs of the organization. Additionally, it's also important to consider the data governance and security aspects of the integration and migration process, to ensure data integrity, security and compliance (Aretz & Sahu, 2022).

6.3. Training and support for stakeholders

Providing training and support for stakeholders involves educating stakeholders on how to use the system and ensuring that the system is used effectively and efficiently. For example, organizations will need to provide training for users on how to use the system, including data entry, navigation and reporting. This may involve on-site training, online training, or a combination of both. It's also important to provide training materials and documentation that users can refer to after the training. In addition, organizations will need to provide ongoing support for the system, including troubleshooting, maintenance and upgrades. This may include a dedicated support team, or a designated contact person for users to reach out to with questions or issues. Furthermore, it's also important to consider the provision of ongoing training, to ensure that users are up-to-date with the latest features and capabilities of the system, as well as any changes in regulations and standards.

6.4. Project Management and Coordination





Project management and coordination is a critical aspect of implementing an eFTI system, as it involves multiple stakeholders and teams with different responsibilities, skills and perspectives. Effective project management and coordination are crucial to ensuring that the eFTI system is implemented successfully, within the specified timeline and budget. The project manager is responsible for ensuring that all project activities are aligned with the overall project goals and that resources are effectively utilized to meet the project requirements. They also coordinate the activities of different teams and stakeholders, such as logistics providers, carriers and government agencies, to ensure that all components of the eFTI system are integrated and working together. Project management and coordination also includes monitoring the project's progress and making any necessary adjustments to ensure that the project remains on track and that the end result meets the project goals (Hamzane and Belangour., 2019). Ultimately, successful project management and coordination are key to delivering an eFTI system that can help organizations improve their logistics operations and meet their business objectives (Hartel, 2022).

6.5. Testing and Quality Assurance

Testing and Quality Assurance is a crucial step to ensure that the system is functioning as intended and meets the requirements of the stakeholders. This component involves the process of testing and verifying the system before it is deployed to ensure its readiness. This includes testing data migration, integration and other functionalities to make sure that the system is working as expected. The goal of testing and quality assurance is to identify any issues or bugs in the system and to make sure that the system meets the requirements of the stakeholders. This includes verifying that the system is able to handle the volume of data and the number of stakeholders, that it provides accurate and real-time information and that it meets security and privacy requirements. The testing process also helps to identify any areas where improvements can be made, such as improving the user interface or enhancing the functionality of the system.

6.6. Deployment and Go-live

The deployment and go-live component is a critical step in ensuring the success of the project. Once the system has been thoroughly tested and verified to meet the requirements of the stakeholders, it can be deployed to production. During this phase, the eFTI system is deployed in a live environment, making it available for use by all relevant stakeholders, such as logistics providers, carriers and government agencies. One of the key components of this stage is training the users of the system. This is to ensure that they are able to effectively use the system and understand its functions and features. Proper training is essential to the success of the system as it ensures that users are able to perform their tasks efficiently and effectively. Another important component of this stage is the transfer of data from the old system to the new one. This involves migrating data from the existing system to the eFTI system, ensuring that all relevant information is available in the new system. This is important because it ensures that the new system is able to provide a complete and accurate view of the freight transport process.





6.7. Ongoing maintenance and support

Ongoing maintenance and support of an eFTI system is an essential part of ensuring its long-term success. This component includes a range of activities that must be performed regularly to keep the system running smoothly and to address any issues that may arise over time. Some of the key activities involved in ongoing maintenance and support include fixing bugs, making updates and upgrades to the system and providing technical support to users. It is important for organizations to allocate sufficient resources for ongoing maintenance and support, both in terms of personnel and financial resources. This will ensure that the system continues to meet the needs of the stakeholders and to provide value over the long term. Additionally, regular monitoring and testing should be performed to identify any potential issues and to ensure that the system is functioning correctly. This may involve conducting regular performance tests, security scans and monitoring the system for any signs of performance degradation or other issues.

6.8. Metrics and monitoring

Metrics and monitoring refers to the importance of tracking the performance of the eFTI system to ensure it is meeting the requirements and expectations of the stakeholders. The component involves establishing metrics to measure the system's performance and to identify areas for improvement. Monitoring mechanisms are also put in place to continually track the system's performance, so that any issues that may arise can be quickly detected and addressed. By measuring the system's performance, organizations can make informed decisions on how to optimize and improve the system, ensuring that it continues to meet the changing needs of the stakeholders.

7. eFTI implementation challenges

There are several challenges that may arise during the implementation of the eFTI system, including technical, integration, security, organizational, legal and regulatory, interoperability, cost and resource, and user adoption challenges.

7.1. Technical Challenges

eFTI is a complex and technical system that requires a high level of expertise and experience to implement effectively. There are many technical issues to consider, such as:

- Data management: The system must be able to handle large amounts of data and provide fast and reliable access to the information. This requires effective database design, data management and backup procedures.
- Network infrastructure: The network infrastructure must be able to support the transfer of large amounts of data and be reliable, secure and fast.





- System scalability: The eFTI system must be able to handle increasing volumes of data and transactions as the number of users grows. This requires a system architecture that is scalable and able to handle increased demands.
- Technical expertise: The technical implementation of eFTI requires a high level of technical expertise, including software development, database administration, network infrastructure and security. This makes it a complex and challenging project to implement effectively.

7.2. Integration Challenges

Integrating the eFTI system with existing systems and networks can pose a significant challenge in its implementation. Companies and national authorities have different systems in place, and integrating the eFTI system with these existing systems can be complex and time-consuming. The compatibility of the eFTI system with other systems is critical to ensure seamless communication and exchange of data and documents between the different stakeholders (Aretz & Sahu, 2022). The challenge lies in ensuring that the eFTI system is able to communicate effectively and efficiently with existing systems and that data can be transmitted and processed accurately. The complexity of the integration can vary depending on the type of systems in place, their complexity and the level of customization required. Ensuring that the integration is done correctly requires expertise and experience in the areas of software, hardware, databases, networks and security solutions.

7.3. Security Challenges

Security is a top priority for the eFTI system as it deals with sensitive data and documents. Ensuring the confidentiality and protection of this information is crucial to the success of the system. This requires the implementation of strong security measures, including access control, encryption and firewalls, to prevent unauthorized access to the system. Regular security assessments and audits must also be conducted to ensure the system remains secure and any vulnerabilities are addressed in a timely manner. Additionally, all eFTI Service Providers and IT service providers must adhere to the security requirements established by the eFTI System, including the implementation of strict data protection policies and procedures. The eFTI system must also be able to detect and respond to security incidents, such as data breaches, in an efficient and effective manner (Kumar, 2022).

7.4. Organizational challenges

Organizational challenges refer to the difficulties associated with managing the various stakeholders involved in the eFTI system, including economic operators, national authorities, Member States and eFTI Service Providers. These challenges can include:





- Ensuring participation: It is important to ensure that all stakeholders, particularly economic operators and national authorities, are fully engaged and participating in the implementation and use of the eFTI system (Papathanasiou et al., 2020).
- Defining roles and responsibilities: Clearly defining the roles and responsibilities of each stakeholder, including eFTI Service Providers, economic operators and national authorities, is essential for the effective implementation and operation of the eFTI system.
- Coordination: Coordinating the various components of the eFTI system, including the eFTI Certified Platform, IT service providers' platforms, companies' systems, national authorities' access points, member states' access points and eFTI Service Providers, can be complex and time-consuming, requiring clear lines of communication and effective project management.

Overall, the organizational challenges associated with the eFTI system require careful planning and coordination between all stakeholders, including clear communication, effective project management and a commitment to ensuring the successful implementation of the system.

7.5. Legal and regulatory challenges

The European Union has strict privacy and data protection regulations (European Council, 2016b), and it's important that the eFTI system adheres to these regulations to ensure the security and privacy of sensitive data and documents. Additionally, there may be different national regulations in different MS that need to be considered and complied with to ensure the seamless exchange of data and documents between economic operators and national authorities. This can be a complex and time-consuming process and requires a thorough understanding of EU privacy and data protection regulations, as well as national regulations in different MS. Failure to comply with these regulations can result in legal and financial penalties, making it essential that these legal and regulatory challenges are carefully considered and addressed during the implementation of the eFTI system.

7.6. Interoperability challenges

Interoperability is a critical aspect of the eFTI system as it requires seamless integration between different IT systems and networks, both within and between organizations (Khan et al. 2023). This can be a challenge, especially when there are different systems, standards and protocols in use. To overcome these challenges, it is essential to establish common standards and protocols that can be used by all participants in the eFTI system. Additionally, it is important to ensure that the eFTI system can seamlessly integrate with existing systems and processes. This requires careful planning, coordination and the development of interfaces and protocols that allow different systems to communicate and exchange data effectively. The ultimate goal is to ensure that the eFTI system is able to provide a secure and efficient platform for exchanging data, documents, and information between economic operators, national authorities and MS (Aretz & Sahu, 2022).





7.7. Cost and resource challenges

Cost and resource challenges refer to the difficulties associated with securing funding for the implementation and maintenance of the eFTI system. The implementation of eFTI requires a significant investment, which can be a challenge for organizations and governments. Additionally, ongoing maintenance of the eFTI system requires resources such as staff, hardware and software. These resources need to ensure the efficient and effective operation of the system over time. Organizations must carefully assess their budget and allocate adequate resources to ensure the success of the eFTI implementation. The availability of expertise and technical skills is also critical for successful implementation, as the eFTI system is complex and requires a high level of technical knowledge. Organizations must ensure that they have access to the necessary technical skills and expertise to effectively implement and maintain the eFTI system.

7.8. User adoption challenges

User adoption challenges are an important aspect of the implementation of the eFTI system, as the success of the system depends on the willingness and ability of stakeholders to use it (Van Vuuren, 2013). Ensuring user adoption requires addressing several factors, including:

- Training: It is important to provide training to stakeholders on how to use the eFTI system, so that they are able to make the most of its features and functions. This may involve creating training materials, such as videos, tutorials, or user manuals, or providing hands-on training sessions.
- Awareness of benefits: Stakeholders need to understand the benefits of the eFTI system, so that they are motivated to use it. This may involve providing information on the benefits of the system, such as increased efficiency, improved data accuracy and increased transparency, or highlighting the consequences of not using the system, such as the increased risk of errors or increased costs.
- Motivation to use the system: It is important to ensure that stakeholders are motivated to use the eFTI system, rather than relying on traditional methods. This may involve providing incentives for using the system, such as bonuses or rewards, or ensuring that using the system is made as easy and convenient as possible.

User adoption is a key factor in the success of the eFTI system, and addressing these challenges will help ensure that the system is used effectively and efficiently by all stakeholders.

8. eFTI benefits

eFTI is a critical solution for the logistics industry, as it enables the real-time visibility, automation, and standardization of freight transport information. The implementation of eFTI can bring many benefits to the logistics industry and its stakeholders, such as improved efficiency and cost savings, enhanced visibility and traceability, and increased security and compliance. In this section, we will discuss the main benefits of eFTI, and how it can help to overcome the challenges in freight transport information management. Specifically, we will explore how eFTI can help to improve the efficiency and cost-effectiveness of the





freight transport process, provide real-time visibility into the location, status, and condition of cargo, increase compliance with regulations, improve customer service, increase automation and standardization, lead to better decision-making and operational intelligence and achieve increased flexibility and scalability.

8.1. Improved efficiency and cost savings

eFTI can bring improved efficiency and cost savings to the logistics industry. eFTI enables the automation and standardization of information exchange between various stakeholders, such as shippers, carriers, logistics providers and government agencies, thus reducing the reliance on manual processes and paperbased documents. For example, eFTI can automate the collection, management and sharing of data, such as bills of lading, customs declarations and shipment tracking forms, thus reducing the need for manual data entry and reconciliation. This can lead to faster processing times, fewer errors and lower costs. In addition, eFTI can also help to optimize the freight transport process by providing real-time visibility into the location, status and condition of cargo, as well as the performance of logistics providers. This can enable shippers and logistics providers to proactively manage supply chain disruptions, optimize routes and reduce transit times, which can lead to significant savings in terms of time and costs. Furthermore, eFTI can also help to reduce the cost of compliance, by automating and standardizing the exchange of information with government agencies and simplifying the clearance process.

8.2. Enhanced visibility and traceability

Enhanced visibility and traceability throughout the freight transport process refers to the ability to access real-time information on the location, status and condition of cargo, as well as the performance of logistics providers (Dasaklis et al., 2019). This can enable shippers and logistics providers to proactively manage supply chain disruptions, optimize routes and reduce transit times. For example, eFTI can provide real-time visibility into the location and status of cargo, through the use of tracking and monitoring technologies, such as GPS, RFID and IoT sensors. This can enable shippers and logistics providers to track and trace cargo in real-time and quickly respond to any disruptions or delays that may occur. In addition, eFTI can also enable the traceability of cargo throughout the supply chain, by providing a complete and accurate record of the movement, handling and condition of cargo, at every step of the transportation process. This can help to ensure the integrity and security of cargo, and also helps to comply with regulations and standards (Hastig and Sodhi, 2020). Furthermore, eFTI can also provide real-time performance metrics on logistics providers, such as transit times, delivery times and compliance with service-level agreements, which can enable shippers to select the most efficient and reliable providers, and negotiate better rates.

8.3. Increased security and compliance





The use of digital technologies in eFTI enables the secure and standardized exchange of information between various stakeholders, such as shippers, carriers, logistics providers and government agencies, thus reducing the risk of data breaches, fraud and other security threats. For example, eFTI can provide a secure and standardized platform for the exchange of information, such as bills of lading, customs declarations and shipment tracking forms, which can help to ensure the integrity and security of data. eFTI can be integrated with other security solutions, such as encryption, authentication and access controls, to further enhance the security of data and communications. In addition, eFTI can also help to increase compliance with regulations and standards, by automating and standardizing the exchange of information of cargo, throughout the freight transport process. This can enable shippers and logistics providers to quickly respond to any regulatory requirements, and reduce the risk of fines, penalties and other compliance-related issues. Furthermore, eFTI can also enable the integration of other solutions, such as digital twin, smart logistics, and predictive maintenance, which can support the digitalization of the logistics industry and enable new business models and service offerings, as well as enhance the security and compliance of the freight transport process.

8.4. Improved customer service

By providing real-time visibility into the freight transport process, eFTI systems can help logistics providers improve the customer experience by providing more accurate and up-to-date information on the status of shipments. This information can be shared with customers in real-time, enabling them to stay informed about the location and expected delivery time of their cargo. By providing customers with better visibility into the logistics process, eFTI systems can help logistics providers to enhance customer satisfaction and increase customer loyalty. Additionally, eFTI can help logistics providers to quickly respond to customer inquiries and address any issues that arise during the transport of goods, further improving the customer experience. This can ultimately help to build trust between the logistics provider and its customers and foster long-term customer relationships.

8.5. Increased automation and standardization

Automation refers to the use of technology to automate manual processes, such as data entry and document preparation, and to standardize the format of information exchange between stakeholders. Standardization ensures that all parties involved in the transportation of goods use a common set of data formats, communication protocols and information exchange methods. This can lead to a reduction in errors and improve the accuracy of data. Improved automation and standardization can have several benefits for logistics operations. For example, it can reduce the time and resources required to complete manual tasks and ensure that all parties involved have access to the same information in a timely and accurate manner. This can help improve the overall efficiency and effectiveness of logistics operations and support compliance with regulations and standards. In addition, standardization can facilitate the exchange of data between different systems and organizations, enabling better collaboration and





information sharing. Ultimately, this can lead to better decision-making, improved customer service and increased competitiveness in the logistics industry.

8.6. Better decision-making and operational intelligence

The availability of real-time data and analytics through eFTI can provide organizations with greater insights into their logistics operations. This information can be used to identify areas for improvement, track performance metrics and optimize processes. For example, organizations can analyze data on cargo movements, shipment times and transport costs to identify bottlenecks and inefficiencies, and to make more informed decisions about resource allocation and routing. The use of eFTI can also provide organizations with real-time visibility into the performance of their supply chain partners, which can help to build stronger relationships and identify opportunities for collaboration. The improved decision-making and operational intelligence provided by eFTI can lead to improved operational efficiency, increased cost savings and enhanced customer satisfaction.

8.7. Increased flexibility and scalability

An eFTI system that is based on cloud computing can offer increased flexibility and scalability to organizations. The use of cloud computing allows organizations to access the system from any device and location, which provides them with the ability to respond quickly to changing business requirements and regulations. With cloud computing, organizations can also scale up or down their use of the eFTI system based on their changing needs, without having to worry about investing in additional hardware or infrastructure. This can help organizations to be more agile and respond to changes in the market or regulatory environment and to keep up with the growing demands of the logistics industry. Additionally, by using cloud computing, organizations can also reduce their capital and operational costs, as they do not need to invest in, maintain and upgrade their own IT infrastructure.

9. eFTI and Industry 4.0 technologies

eFTI and Industry 4.0 technologies are revolutionizing the logistics and supply chain industry. These technologies are enabling real-time tracking and monitoring of cargo, as well as providing insights into the entire supply chain process. This is allowing companies to improve efficiency, reduce costs and increase transparency (Dasaklis et al. 2022).

One of the key technologies driving this transformation is the Internet of Things (IoT). IoT devices, such as sensors and RFID tags, can be placed on cargo to provide real-time information on critical parameters such as location, temperature, humidity, etc. This allows companies to track their cargo in real-time, reducing the risk of loss or damage. Additionally, IoT devices can also provide insights into the efficiency





of the supply chain process, allowing companies to identify bottlenecks and optimize their logistics operations.

Another important technology is the use of big data and analytics. With the vast amount of data generated by IoT devices, companies can use big data and analytics to gain insights into their supply chain operations. This includes identifying patterns and trends in cargo movement, predicting potential issues and optimizing logistics routes. By leveraging big data and analytics, companies can improve their logistics operations and make more informed decisions.

Blockchain technology is also gaining popularity in the logistics and supply chain industry. Blockchain provides a secure and transparent way to track and verify transactions. In the logistics industry, this can be used to track the movement of cargo, as well as verify the authenticity of goods. By using blockchain, companies can increase transparency and reduce the risk of fraud. Rachaniotis et al. (2021) proposed a suitability assessment framework for implementing blockchain technology in EFTI (Figure 6).

Artificial intelligence (AI) and machine learning are also being used in the logistics industry. AI and machine learning algorithms can be used to predict and optimize logistics routes, as well as identify patterns and trends in cargo movement. This can help companies to improve efficiency and reduce costs. For example, an AI-based logistics platform can predict the best route for a shipment based on factors such as traffic, weather and cargo volume.

The combination of these technologies is commonly referred to as Industry 4.0, which is the fourth industrial revolution. Industry 4.0 is characterized by the integration of advanced technologies, such as IoT, big data, and AI, into manufacturing and logistics operations. By implementing Industry 4.0 technologies, companies can improve efficiency, reduce costs, and increase transparency across the entire supply chain.



Figure 6: Blockchain implementation in EFTi - suitability assessment framework Source: Rachaniotis et al. (2021)

However, the implementation of these technologies is not without challenges. One of the biggest challenges is the cost of implementation. The cost of IoT devices, big data and analytics tools, and other Industry 4.0 technologies can be high, making it difficult for small and medium-sized companies to adopt





them. Additionally, there is a lack of standardization and interoperability among different technologies, making it difficult for companies to integrate them into their existing systems.

There is also a lack of trained professionals to operate and maintain these technologies. With the rapid pace of technological change, it can be difficult for companies to find and retain employees with the necessary skills and expertise. This is particularly true in developing countries where the logistics industry is still in its early stages of development.

Another challenge is data security and privacy. As more and more data is generated and shared through IoT devices and other technologies, the risk of data breaches and cyber attacks increases. This can have severe consequences for companies, including the loss of sensitive information and the loss of customer trust.

Despite these challenges, the benefits of eFTI and Industry 4.0 technologies are too significant to ignore. By leveraging these technologies, companies can improve efficiency, reduce costs and increase transparency across the entire supply chain. This will enable them to better compete in the global marketplace and adapt to the ever-changing business environment.

10. Conclusions

The eFTI system is a critical solution for the logistics industry, as it enables real-time visibility, automation and standardization of freight transport information. It is composed of several key components, such as data collection and management, communication and collaboration tools and analytics and reporting capabilities, that work together to provide the desired functionality and benefits. The implementation of an eFTI system requires careful planning, coordination and execution, involving the integration of multiple components and different stakeholders. However, organizations can overcome the challenges of implementation by identifying the right technology solution, migrating and integrating existing data and providing training and support for stakeholders.

The future of eFTI and its potential impact on the logistics industry is very promising. As technology continues to advance, eFTI systems will become more sophisticated and capable of providing even more benefits to the logistics industry. One area where eFTI systems can benefit from technology advancements is IoT (Internet of Things). IoT devices and sensors can be used to collect data on the location, status and condition of cargo in real-time, which can then be analyzed and used to predict and prevent supply chain disruptions, optimize routes and reduce transit times. This allows for more efficient and cost-effective logistics operations and enables new business models such as predictive maintenance, digital twin and smart logistics. Another area where eFTI systems can benefit from technological advancements is AI (Artificial Intelligence) and machine learning. With the ability to analyze large amounts of data, AI and machine learning can be used to detect patterns, predict outcomes and make recommendations for logistics operations. This can help logistics providers to improve their performance, reduce costs and increase customer satisfaction. Additionally, Blockchain technology can be used to secure and validate data and to ensure compliance with regulations and standards. Blockchain-based eFTI systems can





provide secure and tamper-proof records of freight transport information, which can be used to improve transparency, trust and accountability in the logistics industry.

However, the successful implementation of eFTI systems requires industry-wide collaboration and standardization. The logistics industry is composed of multiple stakeholders, such as shippers, carriers, logistics providers and government agencies, each with its own needs and requirements. Each stakeholder has its own systems, processes and data formats, which can make data exchange and integration challenging. To achieve the full potential of eFTI, it's necessary to establish a common standard for data exchange and integration. This can be done by creating a standard data model, which defines the structure, format and content of data that is exchanged between different systems. This standard can also include a set of protocols and rules for data exchange, which ensures that data is transmitted and received correctly and securely. In addition, industry-wide collaboration and standardization can also be achieved by creating a common platform, which enables different stakeholders to share data and collaborate in real time. This can be done by creating a central hub, which connects different systems and enables data exchange and integration in a secure and standardized manner. Furthermore, industry-wide collaboration and standardization can also be achieved by creating a common governance framework, which defines the rules, policies and procedures for data management, security and compliance. This can be done by creating a set of standards and best practices, which are adopted by all stakeholders, and ensuring that data is managed and used in a consistent and secure manner.

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