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Digital Transformation: Advantages and opportunities of E-CMR in international cargo logistics

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ABSTRACT

The aim of this article is to provide, through a review of the existing literature and the analysis of a case study, the implications of the impact of digitalization on the logistics sector. For this purpose, the forced implementation of the basic operational document in international road freight transport: the CMR (*Convention relative au contrat de transport international de Marchandise par Route*), is taken as the object of study. In the process of implementation in a typical company, the challenges that transport companies have to overcome in order to comply with the mandatory requirements of the CMR and the opportunities that arise when using the e-CMR (electronic CMR) are analyzed. It is concluded that the benefits of e-CMR implementation outweigh the constraints and obstacles: reduction of operating costs and carbon footprint, transparency, safety of dangerous goods and prevention of contagion in pandemic situations. The contribution of the paper is based on the compilation and contribution of new elements for the conceptualization of the term Digital Transformation. The contributions for management and business practice are aimed at improving processes and optimizing costs in the logistics sector.

KEYWORDS

Digital Transformation, CMR, e-CMR, International Logistics, Process Innovation, Cargo Logistics, Delivery Processes

JEL CODES

O32, O33, L92, M15

one ton over a distance of one kilometer) were transported on the roads of European countries in 2018 (**Figure 1**, UNECE, 2018). Narrowing the scope to EU member states, according to the European Commission, there are more than 350,000 companies employing around 1.5 million people and representing a business of up to €600 billion (Eurostat). In recent years, EU has made efforts to promote digitization of organizations as a means to grow more effectively and become more competitive (Clarke, M., 2014).

Figure 1. Road transport volume by country, performed in 2018, in million tonne-km

Source: UNECE Transport Statistics Database

2. BACKGROUND

It is necessary to summarize the legal evolution to which road transport has been subjected, as it shows the constant effort of the EU to regulate it, as well as the starting point of the administrative gaps that the regulations must cover. From 1956, with the CMR Convention, to the final application that will take place in 2024, it will have gone through several IRU (International Road Union) requirements, an Additional Protocol in 2008, and several regulations of the European Parliament, until reaching its mandatory application. In other words, the different stages in the history of e-CMR reveal the benefits of its implementation (Poliak *et al.*, 2019)

2.1. The CMR Convention

The Convention on the Contract for the Carriage of Goods by Road (CMR Convention) was signed in Geneva on 19 May 1956 under the auspices of the United Nations Economic Commission for Europe (Bonnet, 2016) in order to standardize legislation among countries in relation to the contract of carriage by road vehicle by adopting a standard transport document. There are currently 58 countries that have signed the CMR Convention (United Nations, 2021) and applies to any international carriage of goods by road, when at least one of the countries concerned, the country of origin or destination, has signed the CMR Convention. (Schelin, 2016). Countries that have accepted the CMR Convention have gained considerable advantages in terms of contractual and liability conditions, as well as simplifying the handling of claims. Transport information is recorded on the CMR consignment note, which accompanies the transport from loading to delivery. The CMR Convention regulates this documentation and provides the principles for establishing the carrier's liability. (Schelin, 2016).

2.2. The CMR: Paper consignment note

Despite the incipient regulation, the CMR Convention did not define a specific format for the CMR consignment note. First, in 1976, the International Road Union (IRU) defined a format following the requirements of the CMR Convention and later, in 2007, an update of this format was published with instructions for its correct completion (Bon-Garcin, 2006). This format provided basic data sets to the register, which ensured compliance with the requirements of the CMR Convention. (Figure 2, IRU, 2007). The mandatory contents, which must be included in the consignment note, are defined in Article 6/1 of the CMR Convention. Article 6/2 lists the contents applicable in particular cases, while Article 6/3 lists other optional contents.

The waybill is issued by the carrier in three different colored originals. The red copy is for the sender, the green copy for the carrier and the blue copy for the consignee. Other copies may be issued to other interested parties, such as insurance companies, banks or customs. (Poliak & Tomitová, 2020). These copies signed by the shipper and the carrier have an evidentiary function, acting as proof that the contract between these two parties has been made. It is also used as proof that the carrier keeps the goods in good condition during transportation, unless the carrier includes any reservations in the reservation clause. Thus, the CMR constitutes evidence to resolve possible disputes or claims between the carrier and the shipper. (Ferrer, 2006).

2.3. E-CMR (electronic consignment note)

With the growing volume of trade, road freight transport is expected to increase considerably in the coming decades, which will have a significant impact on the environment (De Pretto, 2019). In addition, increasingly complex supply chain procedures pose a challenge to ensure the efficient movement of goods between countries. Consequently, the implementa-

Figure 2. CMR model issued in 2007

The form is titled 'LETTRE DE VOTURE INTERNATIONALE' and 'INTERNATIONAL CONSIGNMENT NOTE'. It includes fields for 'Expéditeur' (Sender), 'Destinataire' (Consignee), 'Prise en charge de la marchandise' (Loading of goods), 'Livraison de la marchandise' (Delivery of goods), 'Nature de la marchandise' (Nature of goods), 'Poids brut' (Gross weight), 'Volume net' (Net volume), 'Signature de l'expéditeur' (Sender's signature), and 'Signature du transporteur' (Carrier's signature). It also includes a section for 'Réserve de dommages' (Reservation of damages) and a section for 'Partie non contractuelle' (Non-contractual part).

Source: IRU <https://www.iru.org>

tion of electronic consignment notes in international road transport becomes crucial; especially considering that both the rise of new digital technologies and the popularization of Internet access create the perfect conditions for the digitization of the consignment note (Dzemydienė *et al.* 2020). Thus,

an Additional Protocol to the CMR Convention was adopted to store the data in a digital format called e-CMR (electronic consignment note) and enable its use. The legal basis for this digital transformation was established with this Additional Protocol to the CMR Convention issued on February 20, 2008 (UN, 2020).

However, there are some important countries that have not yet signed the protocol, such as Germany, Austria and Italy. This makes the adoption of e-CMR considerably more difficult, especially considering Germany's strategic situation. In fact, when crossing the territory of a country that does not recognize the e-CMR, the driver cannot manage with the electronic consignment note alone. It is therefore necessary to carry a paper waybill in the vehicle as well, which discourages the use of the e-CMR and ruins the advantages of using a digital format. (Poliak & Tomitová, 2020).

2.4. EU legislation on e-CMR

The entry into force of the 2008 Protocol represents an opportunity to enhance and unlock the potential of transport to contribute to growth, as well as to address environmental challenges and working conditions (Tomicová *et al.*, 2021). Therefore, the EU is pushing for the use of e-CMR, with the understanding that all Member States should adopt the electronic consignment note to reap the benefits of this digital transformation (Poliak *et al.*, 2020). Accordingly, Regulation (EU) 2020/1056 of the European Parliament and of the Council of 15 July 2020 on electronic freight transport information states in Article 2 that by 21 August 2021, all Member States shall notify the Commission of the provisions of national legislation for the acceptance of eFTI (electronic freight transport information). Furthermore, Article 18 sets 21 August 2024 as the date of entry into force and implementation of these national laws. (EU, 2020).

3. METHODOLOGY

To review the evolution and current state of CMR, it has been necessary to review academic literature, as well as legal and economic documents issued by international institutions such as the European Commission or the United Nations. Then, following Verina and Titko's (2019) framework for estimating the impact of digital transformation, a reflection has been carried out on three groups: technologies, people and processes. This reflection has been complemented by discussions and data analysis from other current academic sources and international institutions, which has allowed outlining various benefits derived from the implementation of digital CMR. Finally, a real case study has served to deepen the opportunities offered by the digitization of CMR.

3.1. Digital transformation

The transition to electronic consignment note in Europe is a digitization forced by the European Commission that has a significant impact on the road freight transport business. Following the framework for analyzing the impact of digital transformation on business and society proposed by Verina and Titko (2019), this review also groups the affected factors into three categories: technologies, people and processes identified by these authors.

The "technologies" category includes all digital technologies that act as disruptors of the transformation process (Kleedorfer & Huemer, 2017). In the "processes" category, both internal and external processes are considered, and how their modification influences the organizational structure, strategies, operations and even the business model. As for the "people" category, it integrates customers, employees, executives and any stakeholder affected by the digital transformation. Applying this framework, a deductive reflection has been carried out to assess how the forced digitization of CMR would affect the road transport

sector, the obstacles it would have to overcome, as well as the benefits to be leveraged.

3.2. Technologies involved

The technologies involved in the digitization of CMR are Big Data, cloud computing, software development and mobile devices (Zhu *et al.*, 2018). All of them are already well established in the market and do not pose any stress in the transition process. Especially, if we consider that Big Data and cloud computing are provided by a digital platform, being a mandatory requirement the presence of an independent third party to ensure the proper custody of the data (Ghofrani *et al.*, 2018). The accessibility of these technologies, understood as the combination of acquisition cost and usability, is very high. Big Data, cloud computing and software provided by a digital platform has a low acquisition cost, usually offered as a cheap service with fast scalability. Mobile devices used in the operational process are widely established in the market and users are familiar with them.

3.3. Process transformation

To further analyze the digital transformation impact of e-CMR implementation on the trucking business, it is necessary to

define the current process of using the paper waybill, as well as the future process of using digital capabilities, and with it the beginning and end of the transformation path. By comparing the two situations, a compelling list of inefficiencies in the current process and arguments for how they would be mitigated by digital transformation will be developed.

3.3.1. Paper process

It can be divided into three consecutive stages with an end-to-end relationship, with the previous stage to be delivered before starting the next one: contracting, transportation and administrative management (**Figure 3**).

In the first phase of contracting, loads are assigned by phone, e-mail or spreadsheet. Operators at a call center distribute the loads, check truck availability and wait for confirmation of acceptance. This is followed by the transportation phase, where smaller carriers are usually subcontracted by those who have accepted the shipment. At the end of this stage, the cargo is delivered. After delivery, the next stage is administrative management, where the paper waybill (paper CMR) is sent to the offices, where the information is loaded into different systems in order to proceed to generate the invoice and close the deal.

Figure 3. Diagram and location of the CMR in the logistics process

3.3.2. Out-of-paper process

Digitizing this process from start to finish means eliminating paper completely. The solution to implement this new process is none other than a digital platform in the cloud where all the necessary information is uploaded, and each participant in the process has access to the data needed for its operations.

In the contracting phase, the transport is still negotiated in the same way; however, the data is stored on a platform that will automatically generate the e-CMR. From this point on, the e-CMR is available in digital format to all interested parties. The carrier can register different events of a transport service on the platform, using an application that allows access to the platform via a cell phone. In addition, real-time transport stage information is accessible to all stakeholders through different devices.

After the transport stage, all the data will be immediately available to the administrative management staff. At this last stage, the e-CMR platform can be integrated with the company's IT systems via an API (Application Programming Interface). Thus, in this last stage, workers would have the information directly in their corporate management systems.

3.3.3. Paper vs. non-paper process

The digitization of the current process contributes to mitigate, even eliminate, many of its inefficiencies. The mere eradication of paper and its replacement by a digital medium contributes to the reduction of errors in data handling, avoids inconsistencies and allows access to data in real time throughout the process, significantly improving transparency.

The following list shows the main objectives pursued by the process and the efficiency achieved in both scenarios: paper consignment note and electronic consignment note.

1. **Legal certainty:** The CMR must provide legal certainty to all participants in the process.
 - a. **CMR:** The paper consignment note is recognized by several countries and is widely used throughout the EU, providing legal certainty to all parties involved.
 - b. **eCMR:** The digital consignment note is recognized in some European countries, but there are still some important countries, such as Germany and Italy, that do not recognize it. However, the EU regulation of July 15, 2020 sets August 2021 as the deadline for its acceptance in all member states.
2. **Data integrity:** It must not be possible to alter or damage the recorded data.
 - a. **CMR:** Several copies are generated for each interested party, so that if any modification were to occur in one of them, it could be detected by comparison with the other copies. However, this situation makes it necessary to re-share the different copies, since there is no reliable trust pattern for all parties. Hard copies can be damaged or lost.
 - b. **E-CMR:** The data is stored and guarded by a third party outside the operational process, who is responsible for its inalterability. Storing data on a digital medium allows the use of other technologies, such as Blockchain, which fully guarantee the inalterability of the data. Digital storage also helps to avoid physical deterioration.
3. **Consistency of information:** The data that exists for a given event must match across all copies.
 - a. **CMR:** Several copies of the information are made, one for each stakeholder. Since carbon paper is used, the information on all copies is the same. Even if there are several copies, additional information can be added to some of them.
 - b. **E-CMR:** There is a single data repository, thus ensuring consistency of information.

4. **Accessibility of information:** The data must be accessible to the participants in the process for consultation and their ability to perform the operations assigned to them.
 - a. **CMR:** The data available to each interested party are those on their copy of the paper waybill and, therefore, are only accessible to the person who has the paper.
 - b. **E-CMR:** Data is stored on a digital medium so that it can be made available to all stakeholders on different types of devices with Internet access. It also allows simultaneous access for several devices.
5. **Error-proofing:** The process design should help to avoid errors.
 - a. **CMR:** The information that is recorded is handwritten by the carrier at the beginning of the transport stage. Some of this information may be received by different means, such as telephone, when accepting the cargo. There are several possibilities for errors.
 - b. **E-CMR:** The information is entered by the data handler, it is not communicated to others. It does not eliminate the possibility of error, but it mitigates the risk; the person who handles the data is the one who records it, thus avoiding communication errors.
6. **Lean:** The reduction of waste, understood as any activity that requires more resources (human, financial or time) than necessary.
 - a. **CMR:** Some copies of the paper waybill have to physically travel between the different participants in the process. Issuing the CMR papers at the end of the transport stage to the administrative staff for invoicing creates an inefficient delay. The administrative staff will also have to enter all the information into their corporate billing systems.
 - b. **E-CMR:** The information is available in digital format from any terminal with Internet access, with the existence of a single master copy. Thus, all physical

travel is eliminated and no time is consumed in this concept. Using the eCMR platform's API, data can be automatically uploaded to the companies' billing systems, reducing the time wasted manually entering data and avoiding human error.

3.3.4. *Players affected*

In any change process, the people affected are always the key factor, as they act as accelerators or brakes, depending on the alteration of their individual interests. In order to overcome resistance to change, change is often shown as the only plausible option and the current situation as unsustainable, thus accentuating the need for change. Sometimes, if there is a benefit to the general interest, the legislator takes action and overcomes the final resistance, thus accelerating the change.

For the analysis of how different stakeholders are affected by the digitization of the consignment note, those affected have been divided into two groups: operational process actors, who perform the process activities in practice, and other stakeholders whose interests are affected by the results of the digitization, although they are not involved in the execution of the process directly. To understand how they are affected by this digital transformation, the rubber band model has been followed. (Krogerus & Tschäppeler, 2017) The rubber band model was used. This model estimates the resistance of the different stakeholders to the digitization of CMRs, comparing what holds them back in the current situation with what drives them to embrace the digital transformation.

According to Krogerus & Tschäppeler (2017) the rubber band model appears to be similar to the conventional questions "What are the pros and cons?". However, it is a question with positive and negative response bias, whereas the questions "What holds

me back?" and "What drags me down?" are neutral and do not highlight one situation as more attractive than the other.

3.4. Operational process resources

The operational resources that are affected in the CMR digitization process are: The shipper (the sender of a shipment), the carrier (who transports the cargo), the consignee (the receiver of the shipment) and the controller (who closes the process by generating the billing). The results of the analysis with the rubber band model can be seen in the following **Table 1**:

Table 1. What holds and what pulls the operational actors-rubber band model

CMR	PLAYERS	eCMR
<ul style="list-style-type: none">• Job retention: Switching to eCMR may result in some layoffs, the same amount of work can be done with fewer resources.• Fear of using new digital tools.	Consignee	<ul style="list-style-type: none">• Simplification of work: No need to call, check the availability of drivers and wait for the acceptance time. The systems take care of all this.• Reduced claims due to less likelihood of human error.
<ul style="list-style-type: none">• Fear of using new digital tools.	Carrier	<ul style="list-style-type: none">• The issuance of a paper waybill is no longer necessary.• There is no deterioration of physical documentation.• No transfer is necessary.• Reduced claims due to less likelihood of human error.
	Consignee	<ul style="list-style-type: none">• Better and easier planning through availability and transparency of data
<ul style="list-style-type: none">• Job retention: Switching to eCMR may result in some layoffs, the same amount of work can be done with fewer resources.	Administrative	<ul style="list-style-type: none">• Simplification of administrative work.• The manual insertion of CMR data in computerized billing systems is eliminated.• Reduced claims due to less likelihood of human error.

The main resistance to CMR's digital transformation is the fear of some stakeholders of losing their current job due to improved productivity; those fewer resources are needed to perform the same amount of work. Another constraint is the lack of digital skills in the workforce. However, this can be solved with training.

However, the executive resources of the process do not have the decision-making power to proceed with digitization. Therefore, those whose individual interests are harmed will fundamentally affect the process by delaying it and resisting the implementation of the new operation. However, they lack the ability to stop or trigger it.

3.5. Other stakeholders

In addition to the people executing the process, there are other groups whose interests are also affected by the digitization of the CMR: road transport entrepreneurs, industry associations and legislators (Ferrer, 2006; Verheyen, 2016). It is within the latter group that the DM (decision-maker) of the digitization process is found. In a first term, a decision-maker could be the entrepreneur who intends to increase the productivity of the company by introducing e-CMR, reducing costs, saving time and reducing the risk of error. However, due to the legal implications of this transformation, the last word lies with the legislator, who can force the digitization of the entire sector by making it mandatory.

The following **Table 2** provides a summary of the analysis of other stakeholders:

There are several reasons that prevent entrepreneurs from undertaking the digitization of the consignment note on their own. The road transport sector is a traditional sector with a low level of digitization, so the implementation of e-CMR involves a significant effort in terms of human resources. To

Table 2. What retains and what pulls other stakeholders-rubber band model (own elaboration)

CMR	PLAYERS	eCMR
<ul style="list-style-type: none"> • The cost of transformation: uncertainty as to whether the benefits justify the costs and effort. • Lack of digital capabilities in this sector. • Information and industry contacts acquired over years of experience. • No need to be an early adopter. 	Entrepreneur	<ul style="list-style-type: none"> • Increased productivity.
<ul style="list-style-type: none"> • Don't bother the customer with a project that may be an implementation headache if customers are not asking for it. 	Associations	<ul style="list-style-type: none"> • To drive the digitalization of the sector, providing benefits for its customers and selling them.
<ul style="list-style-type: none"> • Not on the political agenda or a low priority 	Legislator	<ul style="list-style-type: none"> • Increase the productivity of a strategic sector.

be effective, the digital transformation must cover the entire sector, which is highly unlikely if the legislator does not force the change.

3.6. New player

The e-CMR scenario needs a new player to provide the e-CMR digital platform that has the critical function of storing and managing the data. There is a legal requirement that the information must be managed by a third party that is not involved in the business in any way, thus ensuring independence in the delicate task of data management (EU, 2020). To foster the confidence of competent authorities and business operators, the EU, in its Regulation (EU) 2020/1056, encourages Member States to establish a certification system for e-FTI (electronic freight transport information) platforms.

The core business of these companies is precisely the offer of electronic waybills and their value proposition is based on time and cost savings. They offer both an API (Application Programming Interface) to integrate with the corporate applications currently used in transport companies and apps to ensure access by different users from their cell phones. Clearly, this player is an apostle of CMR digitization, as it is only present in the digital

environment, developing any service that materializes savings and facilitates the transition.

4. RESULTS

Despite the reluctance of some employers to adopt e-CMR, and despite the efforts that authorities in different countries have had to make in implementing new policies and procedures, the benefits far outweigh the drawbacks. The most salient benefits are described in the following sections.

4.1. Reduction of operating costs

The implementation of eCMR makes it possible to achieve cost savings ratios in operations of between 45% and 55%. These savings derive primarily from two concepts: the simplification of the entire administrative process and the elimination of costs due to loss or deterioration of paper documentation. (Syrjänen, 2017)

The working time consumed in a paper waybill is more than 20 minutes, while in the electronic waybill this time is reduced to 5 and a half minutes. The cost savings are also significant, the total cost associated with a paper waybill is more than 6 euros, while the electronic version is less than 2 euros. (Table 3, Vrio, 2020).

Table 3. Time and cost per item according to Vrio (2020).

ACTIVITY	TIME (In min)			COSTS (In €)		
	CMR	ECMR	Saving ECMR	CMR	ECMR	Saving ECMR
Printing	1	0	1	€0,31	€0,00	€0,31
Distribution	3	0,5	2,5	€0,93	€0,15	€0,78
Signing	5	5	0	€1,54	€1,54	€0,00
Retreival (1%)	0,15	0	0,15	€0,05	€0,00	€0,05
Status update	3	0	3	€0,93	€0,00	€0,93
Archive	3	0	3	€0,93	€0,00	€0,93
Sent Port of Discharge	5	0	5	€1,54	€0,00	€1,54
TOTAL	20,15	5,5	14,65	€6,23	€1,69	€4,54

Comparison of the costs and unit times of working with a CMR and an e-CMR.

Source of data: <https://vrio-europe.com> (own elaboration)

By issuing the waybill digitally, printing is avoided, although distribution to interested parties is still necessary. However, doing it digitally is significantly cheaper and faster than distributing it physically on paper. The retrieval of the waybill is an additional cause for savings.

Upon final delivery, the completed e-CMR is instantly available to all parties, which will allow companies to start their invoicing processes for goods received. Not having to wait for the driver to return with the original CMR can speed up the invoicing process by weeks, which will help companies improve their invoicing processes and ultimately cash flow.

4.2. Carbon footprint reduction

Currently, in the EU, the road freight transport business issues around 377 million CMRs, with corresponding copies to stakeholders. (Vrio, 2020) with their corresponding copies to stakeholders. With the adoption of the electronic consignment note, paper would be completely eliminated, lead-

ing to a significant reduction in the carbon footprint of the business.

The environmental impact of this digitization can be calculated by estimating that a standard pine tree produces about 10,000 sheets of paper. Taking into account that at least three copies of CMR waybills are needed, it could be concluded that one standard pine tree is equivalent to 3,333 CMRs. Therefore, for the total amount of 377 million CMRs, more than 113 million trees have to be cut down. (RIBBLE, 2021)

4.3. Increasing transparency

One of the clear advantages of implementing e-CMR is that information is always available in real time, on any device, anywhere, to all parties. The status of the United Nations Economic Commission for Europe (UNECE) results in greater transparency throughout the process, as it allows all parties to know at all times how the transport is developing, if everything is going according to plan or if any inconvenience arises. In the latter

situation, this transparency facilitates the application of the necessary corrective measures.

Working with the electronic consignment note, we also have the possibility to track and record more data, one example being that captured by IoT (Internet of Things) sensors or photos taken by the driver when the goods are damaged. This additional value-added information contributes to transparency by providing better information on all transportation events and helping to resolve unforeseen problems along the way. Such will be the transparency that a published report on benefits, barriers and recommendations, "Towards paperless transport", reveals concerns about ensuring trust, confidentiality and data security within and outside Europe. (Digital Transport & Logistics Forum, 2018).

4.4. Health problems

The current situation of the COVID-19 pandemic has accelerated the digitization of society and business. In fact, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), whose mission is to coordinate humanitarian action in collaboration with national and international actors to ensure a coherent response to emergencies, has urged countries to accelerate the implementation of e-CMR, as this digital technology limits physical controls in transit, physical contact at borders and protects the health of workers.

The e-CMR will also prevent the unnecessary and systematic detention of trucks at all borders, at a time when the health of transporters is at risk (OCHA, 2021). In fact, the e-CMR would remove from the process all physical carriers that could contribute to the spread of the virus, as could be the case of document slings, where Covid-19 can survive longer than on porous surfaces. (Chatterjee, Murallidharan, Agrawal, & Bhardwaj, 2021). With the use of the electronic consignment note, the risk of

contamination by passing document folders from one person to another would simply disappear.

4.5. Safety: accident management

There are many different types of dangerous goods ranging from infected animal material to dangerous chemicals. In case of an accident in a dangerous goods transport, managing it with the CMR, only the driver has the cargo information on paper. Therefore, if he suffers any kind of injury during the accident, the authorities will have to deal with the accident with a lack of information. Police, firefighters and other authorities will have to deal with the problem without really knowing what they have on their hands. According to Eurostat, in just 28 EU countries, the annual transport of dangerous goods by road was 775 million tonnes per kilometer (TKM) in 2019 (Eurostat, 2021).

Transport management with e-CMR is a totally different situation. The digital platform offering the service will provide a link to the transport e-CMR with all the information available: quantities, nature of the cargo, etc. The aforementioned authorities will be able to plan their intervention before arriving at the accident site, equipping their forces with the appropriate equipment and materials to deal with the situation. The EU Commission, in its regulation (EU) 2020/1056, clearly states that digital platform companies have to guarantee access to this information to all competent authorities.

4.6. Other opportunities for the digitalization of the CMR

The forced digitization of the CMR consignment note generates additional opportunities for improvement in the road freight business, based on the use of new technologies and the availability of digital data. A real use case has been described to explore the additional opportunities mentioned.

4.6.1. WanaTruck real-life case study

This case was provided by the company WanaTruck, which offers CMR digitization services through a digital platform under a SaS (Software as a Service) business model. (WanaTruck, 2021)

The transport load was shipped from Almeria (Spain) to several delivery locations in England and the whole process was developed on the WanaTruck digital platform. The shipper uses a Dashboard on the digital platform to assign loads and receive acceptances, so he does not have to communicate with the carrier by phone or pass the data to him. The carrier has access to the cargo information through his cell phone using the app and can update the information using this device during the transport stage, so there is no need to create the paper waybill by hand. The consignee can also confirm the correct receipt of the cargo on the digital platform, while this information being instantly available to all parties. Finally, as soon as the cargo has been

received, the administrative staff will have the e-CMR data in the corporate IT applications, ready for invoicing.

Part of the data recorded in the e-CMR can be collected automatically using IoT technologies (Babar & Arif 2019). In the example under study, the fruit load must be transported at low temperature for proper preservation, ensuring the maintenance of the cold chain. The temperature control is performed by IoT sensors that take records every minute, thus obtaining a history of the temperature at which the load is kept during the entire transport. In addition, the truck door opening sensors record the time the doors are opened and the GPS records geolocate the transport every minute. In addition, the use of Blockchain technology guarantees the unalterability of the recorded information, providing added security. The following **Figure 4** illustrates an example of used case data.

Figure 4. WanaTruck Use Case Data

The map shows the transport route, indicating when the doors have been opened: in the Almeria area for various loading processes, on arrival in Madrid for an inspection, shortly after entering France for another inspection, in France before crossing the channel, on entering England, and several times during the various deliveries of the goods. In the graph on the right, door openings are recorded as pulses of width proportional to the time they remain open, noting the date and time of opening on the horizontal axis scale. Also, as it is shown there is a line indicating the variations in cargo temperature during transport, and two horizontal lines marking the limits between which cargo temperatures must be maintained. It can be seen how the temperature increases when the doors are opened.

All this information, in addition to being recorded and available in real time, is added to the e-CMR, making this document capable of providing much more information than the equivalent paper document. In addition to all the benefits of moving from the waybill to a digital medium, this transformation also generates many opportunities when combined with other digital technologies such as Blockchain, IoT or AI (Artificial Intelligence).

4.6.2. *IoT integration*

It should not be forgotten that the original objective of the CMR was to provide legal certainty to all parties involved in the transport of goods by road, delimiting the responsibilities of these parties in the event of any problem in the transport, whether it is damage or theft of cargo, delay or other. When it comes to delimiting responsibilities, all kinds of data that provide us with valuable information on transport conditions and events are very useful, and IoT technologies allow us to capture a large amount of data in real time, through its sensors connected to the Internet.

A clear example of application can be the use of case presented in this article. The recording of the truck door openings, which together with the GPS (Global Positioning System) positioning data, makes it possible to know when and where the truck doors have been opened and therefore the cargo has been accessed. Or the temperature sensors in the cargo container that ensure that the cold chain has not been broken and that the transport has been carried out under the required temperature conditions. All this information can be added to the electronic consignment note, making it accessible to all interested parties.

In addition, data collected in real time can be used to prevent some risks and trigger appropriate mitigation actions to prevent them from occurring. The data can always show strange behavior. Even if it is within the defined limits, a warning is generated alerting us of a possible failure to occur. That could be the example of our use case: when the cargo temperature registers a progressive increase or decrease with the truck door closed in a small period of time, it would be an unmistakable sign of a failure to occur. The possibilities are many and diverse, depending on the nature and conditions of the load.

4.6.3. *Use of Blockchain*

The use of Blockchain to store data provides the highest level of security over data integrity. The architecture of this technology, being a set of distributed databases with the highest security encryption algorithms, guarantees the inability to change the stored data, making it impossible for any of the interested parties to modify it fraudulently.

In addition, the use of Blockchain technologies creates the opportunity to use smart contracts, an agreement whose conditions are expressed in digital form and can be automatically executed when certain events occur. For example, when the driver delivers the cargo, payment can be triggered automatically

considering all the conditions of the contract. If the contract provides for a late penalty, the associated amount can be reduced from the total amount of the payment. The delay time would be calculated automatically when the delivery takes place, so everything would be executed immediately without the need for intervention by any of the parties involved.

5. CONCLUSIONS

Road transport is a strategic infrastructure and an important business for the whole of Europe, the efficiency of its management constitutes a competitive advantage for the different states. The basic documentation for the management of road transport is the CMR paper consignment note, currently adopted throughout Europe.

The digitization of such documentation, the electronic CMR, will generate abundant improvements in the business, not only by eliminating paper but also by improving the efficiency of processes. Even so, there are some countries that have not yet accepted the e-CMR, such as Italy and Germany, which in practice means a considerable restriction, since any driver who has to cross one of these countries will not be able to manage with the e-CMR alone, but will also need to issue a paper CMR.

The EU has legislated on this issue to promote the digitization of the CMR, mandating its acceptance in all Member States by August 2021, by which date all Member States must notify the Commission of national law provisions for the acceptance of the

e-CMR. From that moment on, no paper would be necessary to issue for the transport of goods by road across Europe, as it can be managed with an e-CMR that would be accepted, even if the country has not yet developed national laws. August 21, 2024 is the planned date for its entry into force and the implementation of national laws.

Technology is not an obstacle to the migration to e-CMR, but the atomization and low digital level of the sector is a major constraint to overcome. The fear of some employees of losing their current job due to the automation of processes and the lack of digital skills of the workforce seem to be the big problems of this transformation.

However, the benefits of this forced transformation are many and significant: cost and time savings of more than 50%, reduced CO2 emissions, increased transparency and security. The availability of e-CMR data in digital format, combined with some new technologies, opens up a range of opportunities to improve efficiency, safety and security.

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