Technological Revolutions in Road Transport:
Digital Freight Forwarding

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1. Digital forwarding – definition and today's meaning

1.1 Human role

A freight forwarding operator's most essential tasks involve planning and organizing the transport process. In performing their duties, the operator must exercise due care, taking into account customer needs and analyzing data incoming from a variety of sources. At the same time, this position requires consideration of all relevant risks. Therefore, on the one hand, they try to minimize costs and, on the other, mitigate risks. In organizing the transport process, the freight forwarding operator takes into account available resources, the market environment, terms of the transport offer, other customer requirements, cargo type, timeframes, all associated costs, availability of carriers and a myriad of other factors. Additional elements of the operator's work involve the preparation of transport documentation and insurance services for shipments. Sometimes, their tasks also include customs clearance or the conclusion of transport contracts. Thus, it stands to reason that freight forwarding operators act as integrators of many data sources and coordinate multiple processes with the end goal of proposing the optimal organization of transport. In other words, they are intermediaries between the customer and the carrier, seeking to optimize the transport service. Anther vital aspect of their work is the proper vetting of carriers, which includes verifying whether they have the requisite licenses and permissions, registration documents, insurance etc. The last, but by no means least, vital task of the freight forwarding operator is communication, which often requires command of several foreign languages.
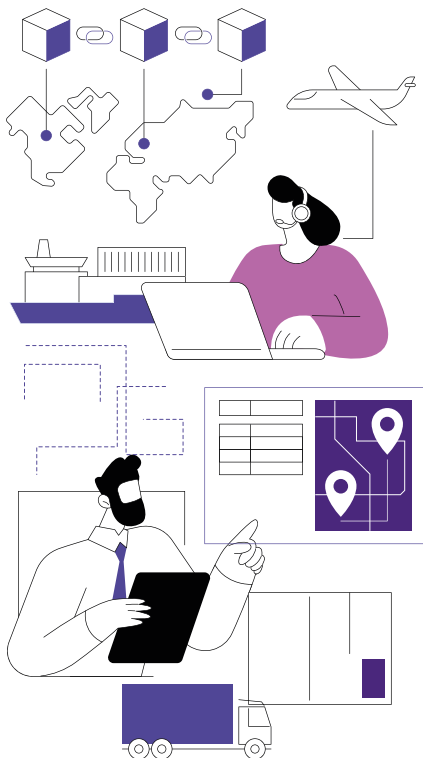
Responsibilities of freight forwarding operators

- contacting and receiving orders from customers – rate setting,
- organizing the movement of cargo,
- selecting the mode of transport,
- selecting and vetting the carrier,
- establishing terms of cooperation with the carrier/subcontractor,
- preparing detailed transport documentation,
- insurance service for shipments,
- where necessary, customs clearance,
- collecting and delivering shipments in collaboration with subcontractors,
- securing shipments for the duration of transport,
- concluding transport contracts.

> **Civil Code: Article 794.**
> **§ 1.** By a forwarding contract, the freight forwarder undertakes to send or receive a shipment or to provide other services related to its transport against remuneration within the scope of operations of its business.
> **§ 2.** The freight forwarder may act on its own behalf or on behalf of the principal.

In recent years, digital freight forwarders have been gaining prominence as companies capable of providing freight forwarding services innovatively. Sometimes, it seems that such businesses have the tools to offer a comprehensive service fully digitally, thus eliminating the need for any human involvement. This, of course, is a misconception. Humans still are and will be needed to carry out freight forwarding services. What makes digital freight forwarding stand out, however, is the advanced automation of individual tasks and optimizations made possible by modern IT solutions.

Reviewing the list of freight forwarders' tasks presented above, it is easy to identify those that can be most easily automated using off-the-shelf or proprietary ICT tools. These include automatic carrier selection, automatic rate proposal, optimal route plotting, consideration of constraints (road-related, driver working time-related, cost-related, etc.), but also further options for assigning available loads to a given vehicle, automatic verification of insurance (or selection of cargo insurance), automatic generation of relevant documentation and its fully digital workflow, and finally load monitoring, ETA calculation (which could also involve automatically booking available time slots at the place of unloading) and ongoing status monitoring, particularly in non-standard situations requiring a reaction.

Perhaps all those activities seem like they can indeed be fully automated. However, reality proves that this process simply cannot work without humans. If only because some elements are not yet ready to function on a purely digital basis. Moreover, it is yet no possible to fully integrate the myriad of tools used by individual participants in the processes. More on that further in this report. Finally, however, we cannot forget about aspects such as the experience of the freight forwarding operator, relationships with customers and subcontractors, as well as other elements that make up the so-called human factor. There is also intuition, another crucial factor. State-of-the-art solutions leveraging the most advanced AI technologies will always be only as good as the data they are being fed, reliant on comparative analysis against past events or predictions based on various mathematical models. Under certain conditions, a machine or a human must make a decision without having a full set of data, and this is where intuition comes into play. And intuition is the domain of humans, not artificial intelligence.

Thus, today, many of the processes related to providing freight forwarding services in numerous businesses are already digital. Considering that freight forwarding companies use computers and email in their daily work, with the remaining tasks handled by employees, it stands to reason that some level of freight forwarding digitization already exists in the sector. Obviously, the ranks of businesses running software to facilitate everyday work are growing, and the more processes are automated, the more digitized freight forwarding becomes. However, it all comes down to supporting the daily work of freight forwarding operators. Undeniably, given open access to various data sources, algorithms and AI technologies will find the optimal solution (or several alternative ones, but evaluated for different criteria) faster than a human being, thus supporting the freight forwarding operator in their final decision. Without such solutions, the work related to the analysis of available loads, vehicle search, quotations, and negotiations would all be very time-consuming, and, unsurprisingly, it is in these areas that digital forwarders try to build their competitive advantage.

Data openness and security

It is also worth mentioning that a certain degree of difficulty in automating individual processes comes from a lack of data standardization and the inability to integrate tools used by freight forwarders daily with those used by their customers, subcontractors or other supply chain participants, or relevant authorities in different countries, a fact not to be ignored given the international nature of freight forwarding services. The lack of standards also poses many difficulties related to communication between different systems. Security of transmitted data is another vital aspect considering that freight forwarding often involves very sensitive information, not only personal data (e.g. of the driver, freight forwarder, unloader), but also sensitive business data.

The variety of available systems also means that the number of integrations that must be performed to ensure a fully digital and automated operation is increasing. Without it, the individual participants of logistics processes will be forced to concurrently run many tools to be able to interface with their contractors. And this, in turn, instead of facilitating, begins to hinder work. Perhaps this time, European authorities will come to the rescue. Currently, the Digital Transport & Logistics Forum, an expert group of the European Commission, is finalizing work on guidelines for e-FTI platforms (slated to release in the summer of 2023), which should function in each country in accordance with the assumptions of the so-called the e-FTI Regulation, i.e. regulation on electronic freight transport information. In this report, we will focus on digital road freight forwarders, but perhaps the launch of e-FTI platforms, enabling the digital exchange of data on freight transport by any available mode of transport (road, water, air), will not only expedite but also expand the scope of digital forwarding, while essentially blocking the further development of companies that held back on digitizing their operations for too long.

Fig. 1.1 Classification of digital forwarding
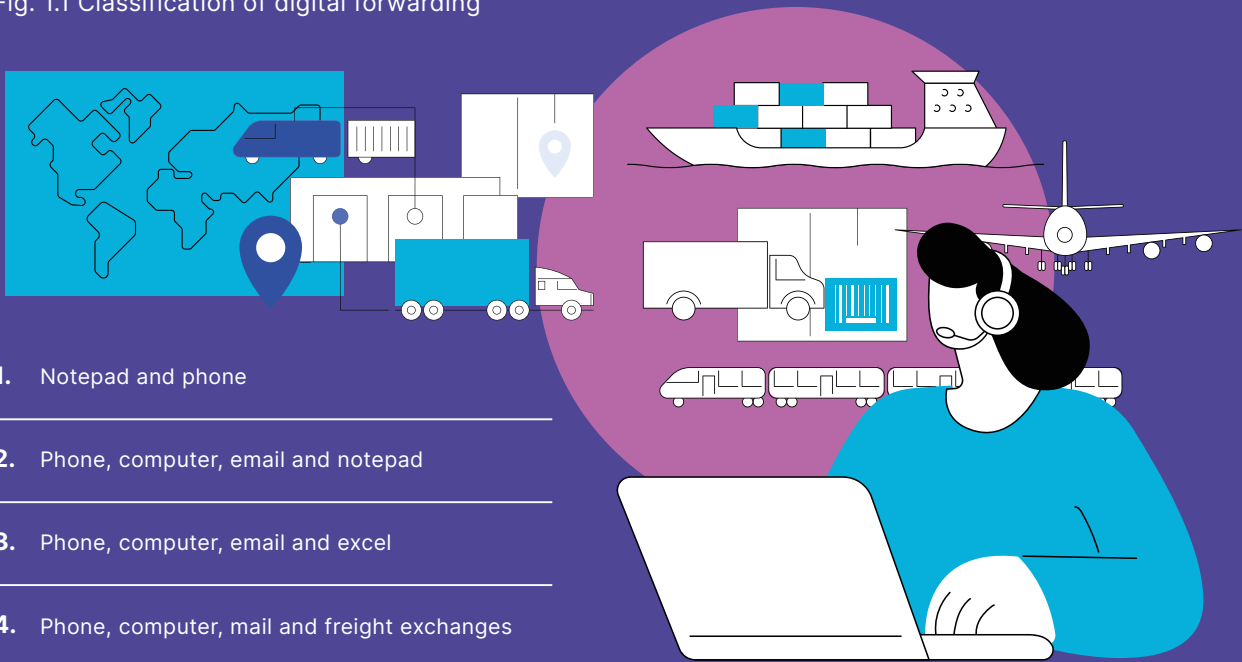
1. Notepad and phone

2. Phone, computer, email and notepad

3. Phone, computer, email and excel

4. Phone, computer, mail and freight exchanges

5. Phone, computer, mail, freight exchanges and TMS

6. Phone, computer, mail, freight exchanges, TMS and monitoring

7. Phone, computer, mail, freight exchanges, and monitoring integrated with TMS

8. Computer, email, freight exchanges and monitoring integrated with TMS with tools optimizing the selection of vehicles/carriers for loads and suggesting the possibility of taking further available freights

9. Computer, email, freight exchanges and monitoring integrated with TMS with tools optimizing the selection of vehicles/carriers for loads and suggesting the possibility of taking further available freights and a tool to propose and accept rates automatically

10. Computer, email, freight exchanges and monitoring integrated with TMS with tools optimizing the selection of vehicles/carriers for loads and suggesting the possibility of taking further available freights and a tool to propose and accept rates automatically

11. Computer, email, freight exchanges and monitoring integrated with TMS with tools optimizing the selection of vehicles/carriers for loads and suggesting the possibility of taking further available freights and a tool to propose and accept rates automatically along with full integration with carriers' and customers' systems

12. Computer, email, freight exchanges and monitoring integrated with TMS with tools optimizing the selection of vehicles/carriers for loads and suggesting the possibility of taking further available freights and a tool to propose and accept rates automatically along with full integration together with access to their data (anonymized) with carriers' and customers' systems and a fully digital workflow of documents related to digital handling

Application of artificial intelligence (AI) in logistics and digital freight forwarding

It is expected that AI-based solutions in logistics (including supply chain management and automation of the decision-making processes in TFL) will serve as powerful instruments supporting organizations in tackling these challenges. An integrated AI-supported approach can consider the capabilities and constraints of all business functions, from procurement to sales. AI's ability to analyze massive volumes of data, understand relationships between them, offer insight into operations, and support enhanced decision-making renders it a potential game-changer. [27] However, getting the most out of these solutions is not only a matter of technology, as companies must take organizational steps to fully exploit the possibilities of AI, using so-called machine learning (ML). Machine learning in the context of artificial intelligence and automation is understood differently than traditionally. The system's learning process is designed to achieve results based on fragmented knowledge, enable improvement, create new notions and reason inductively. [28] The most important applications of AI/ML in areas directly related to logistics include:

- **Planning (general)**

  Logistics requires effective planning, which involves the coordination of suppliers, customers and various units within a company. Machine learning solutions can facilitate this task as they excel at scenario analysis and numerical analytics, both elements crucial to planning. AI planning methods also include hybrid algorithms combining expert systems with discrete optimization, learning decision trees or if/then rules. [29]

- **Delivery planning**

  AI/ML help companies analyze demand in real time, allowing organizations to update supply scheduling parameters to optimize supply chain flow dynamically. Thanks to dynamic scheduling, businesses can use fewer resources as it minimizes losses.[30]

- **Demand forecasting**

  AI capabilities enable organizations to use real-time data for forecasting. Thus, AI-based demand forecasting methods offer significantly improved error rates over the traditional counterparts such as ARIMA, AutoRegressive Integrated Moving Average and exponential smoothing methods. With increased accuracy in predicting demand, manufacturers can optimize the number of vehicles dispatched to local storage facilities and reduce operating costs from improved workforce planning. In turn, local warehouses and retailers can bring down holding costs (the opportunity cost of holding an item instead of investing money elsewhere). Finally, customers are less likely to experience supply disruptions that reduce their satisfaction.

- **Automatic freight pricing**

  Dynamic pricing is real-time pricing, where the price of a product responds to changes in demand, supply, competitors' prices, and price of subsidiary products. Pricing software typically uses machine learning algorithms to analyze historical customer data in real-time, enabling it to react faster to changes in demand by adjusting prices.

- **Route optimization**

  AI models support companies in analyzing the routes they use and propose optimizations. Route optimization mainly uses graph theory, including shortest path algorithms, to identify the most effective route for logistics trucks and dynamically recommend optimal loads for the return route. This reduces the carrier's effort in obtaining loads and brings down costs and speeds up the shipping process. [32];[31] Moreover, smart route optimizers are also effective tools for lowering companies' carbon footprints.

The ongoing Polish Digital Logistics Operator (PCOL) project embraces all of the applications mentioned above, in particular through the implementation of a system containing::

- a multi-criteria route optimization algorithm, which is a hybrid between the VRP model and the TSP model, facilitating:

- an efficient solution to the the round trip model thanks to asynchronously changing Big Data;

- an algorithm for determining optimal routes, taking into account boundary parameters such as transport slots, vehicle load capacity, and fleet heterogeneity;

- an algorithm for estimating whether orders are still valid by unsupervised clustering of historical data in terms of time classes, classification of incoming data in the context of these classes and prediction of the order validity time;

- Big Data clustering algorithm determining the characteristics of geographical areas for the purposes of anonymized visualization on a map (heat map);

- modeling the structures of transport and logistics systems, the characteristics of traffic flows loading the system and the dynamically changing information streams related to them, taking into account many variables and many actors (customers, logistics operators, suppliers, carriers, transshipment terminals, natural environment). Modeling such complex structures and optimizing the processes involved represents a multi-criteria optimization problem.

prof. Adam Gałuszka

1.2 The future of digital freight forwarding and its impact on the market

Digital freight forwarding is an emerging concept that is quickly gaining popularity. The largest initiatives pursued by well-known and established brands from the sector are making and will continue to waves in the media, especially in the context of subsequent large investment rounds. But does this mean that only a handful of players will reign supreme on the freight forwarding market once and for all and the matter is all but settled? Not necessarily, because we are seeing the continuous digital transformation of parties having years and years of experience in the industry. We are seeing more start-ups trying to offer tools that optimize or automate processes related to freight forwarders' operations. Moreover, forwarding companies also invest in their own solutions or buy off-the-shelf solutions.

Digitization is happening here and now, and this trend will only accelerate. Crucial to further development will be factors such as data openness, standardization, platformization and legislation as the they connect all actors of the TFL landscape into one network of inter-communicating systems speaking a "unified language". However, it stands to ask whether, over time, as we approach a certain breakthrough, there will truly be a sudden shift towards those who will have the best, fastest and most flexible tools and whether there will be an abrupt consolidation on the freight forwarding market. Of course,

these changes can also be driven by parties that have yet to enter the market or those that will upset the industry only in the near future. But given a hypothetical, ideal scenario, where all applications and systems used in the industry will be able to communicate with one another without restrictions (i.e. only with such restrictions as requested by the parties or the legislator), it is actually possible to imagine a situation where the freight forwarder's role will be limited to "traffic maintenance" and making decisions in situations requiring it.

Suppose the algorithms are able to match vehicles with loads in an ultra-short time, propose attractive rates/prices for everyone, prepare documentation, etc. then we will reach a point where "bots" will start competing with each other, vying to finalize the process faster and better. In this scenario, the weaker, unstable and easily overloaded ones will give up... but, for now, this remains a distant vision. Today, digital freight forwarding certainly stirs the imagination. Still, it also has a real impact on the market and accelerates digital transformation as it certainly is a strong motivator for more traditional forwarding companies to focus on digitization because whatever the digital future holds, to stay afloat even in a short, measurable time horizon, relying only on relationships, a notebook full of phone numbers to partner companies is equivalent to deliberately setting oneself up to fail.

2. Digitization of forwarding

Digitization is not a measure of innovation but a condition for the survival of freight forwarding. Digital freight forwarding companies are putting more and more pressure on the traditional freight forwarding model. Though increasingly aware of the challenge, traditional freight forwarders continue to apply an approach limited to implementing a TMS system. That simply is not enough. Standing a chance of competing in the modern marketplace requires understanding the advantages digital freight forwarding offers.

Digital freight forwarders are still ordinary forwarders, offering the same range of services as their traditional counterparts and still employing human operators. However, they are able to select and automate a certain range of their operations and ensure an end-to-end digital flow of information. This allows them to work more efficiently, generate higher margins, minimize errors and achieve greater transparency. The essential digitized areas are described below.

Automatic selection of carrier for freight
Matching algorithms can analyze thousands of cargo-carrier combinations in one second and choose the best one from the point of view of margins or utilization of available capacity. Such operations are beyond the reach of the human brain. Therefore, they have a significant impact on minimizing empty runs and thus also on reducing CO2 emissions. In the case of spot loads, a similar algorithm can independently decide which of the available loads are worth attention and which are not worth pursuing.

Automatic determination and acceptance of the freight rate
By collecting and analyzing pricing data from thousands of transactions (and from external sources), pricing algorithms equip digital freight forwarders with real-time knowledge of the optimal rate for a given freight. Optimal, i.e. one that, on the one hand, offers good margins on forwarding and capacity on the other. In certain situations, such algorithms can, to some extent, "negotiate" and accept rates based on predetermined criteria on their own. This solution not only increases the efficiency of the forwarding business but, again – saves human labor.

Digital forwarding / handling hundreds of freights at one time

Tendering	Automated matching & pricing	Acceptance
	Algorythms identify avaible trucks. — Carriers accept or bid. Algorithm analyzes bids in secons.	
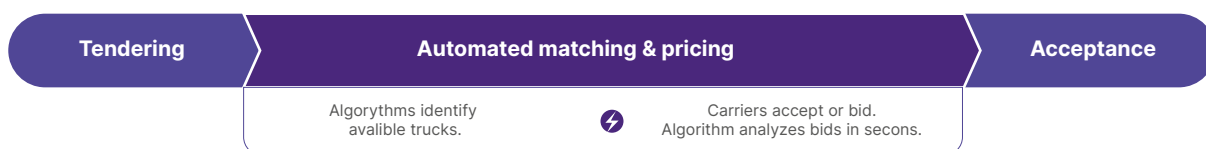
Mesured in minutes: (0 phones calls or emails)

Traditional forwarding / handling several freights at the same time

Tendering	Matching	Pricing	Acceptance
	Brokers manually Identify available truck.	Collect bids from availble carriers. Negotiate back and forth.	
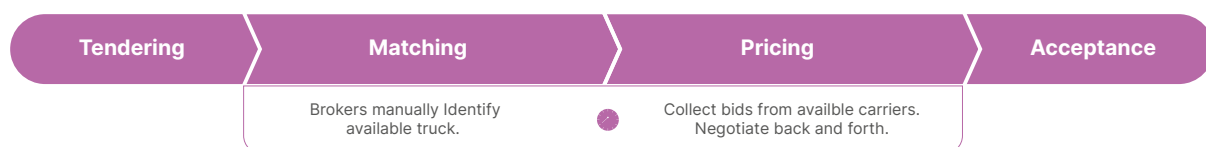
Mesured in Hours: a few hours (several emails and phone calls)

PITD

Digital workflow and integrated data flow

It eliminates a majority of the most tedious and error-prone work. In the ideal scenario, all documents (from orders through CMR , to invoices) are sent digitally thanks to system integration via API. This enhances the efficiency of the process and improves transparency and archiving, enhancing the traceability of transactions.

Cargo monitoring and ETA calculation for the shipper

A digital freight forwarder is able to digitally and continuously provide its customers with information about the status of their cargo, orders at risk of delay, and calculate the ETA for each freight without the involvement of humans. Again, it saves time, offers greater transparency and improves customer relations.

Today, digital freight forwarders' most significant challenge is building a critical mass of cooperating carriers. This is because the availability of capacity determines the effectiveness of loading matching algorithms and, in general, forwarders' ability to meet their customers' needs. Not only are digital forwarders relative newcomers and have yet to build relationships with carriers, but they also impose specific requirements on carriers regarding processes and tools for digital cooperation. This is sometimes a barrier for carriers who do not exactly have a reputation for adopting new technologies quickly. In this respect, traditional forwarders have a significant edge, especially those with an established history on the market that have formed robust relationships with transport companies that also effectively use freight exchanges. They can press this advantage further by leveraging digital tools, e.g. class 4.0 logistics platforms

However, digital forwarding usually has a strong ace up its sleeve – capital. Most big players in this market are heavily funded by investors and various funds. This positions them to attract carriers by offering, for example, very fast payments (within a few days) or... take over traditional freight forwarding companies, their relationships with transport companies included.

Saying that the mechanisms of digital forwarding will make human work redundant would, however, be an exaggeration. Transport is and will be an industry primarily based on interpersonal relations. Moreover, even the most advanced algorithms are still unable to solve many unusual problems that appear in supply chains every day. Digital forwarders face the same issues, which is why they still employ "freight forwarding operators with a pulse". However, under this model, operators are relieved of most of the repetitive tasks and can fully focus on finding new customers or resolving problematic situations, thus improving the quality of customer service, which is another significant advantage of digital forwarding.

This is a fundamental difference compared to traditional forwarding, where people's time and abilities are wasted on performing repetitive actions that algorithms could handle. However, traditional forwarding companies, especially small and medium-sized outfits, do not have such large budgets, nor do they have sufficient technical expertise to develop a solution capable of competing with digital forwarding. Furthermore, they lack access to data from a broad market area that could power these algorithms, which is crucial to load matching and pricing effectiveness.

A quick win for traditional freight forwarders might come from using off-the-shelf logistics platforms, which, for the relatively low price (compared to independent development) of subscriptions, provide ready-to-use tools based on logistics 4.0 solutions powered by data held by these platforms. Some of

these solutions also have their own carrier communities and thus expand freight forwarders' access to transport space.

A locally used forwarding TMS alone will fall short of meeting the challenges of digitizing the freight forwarding sector, though, admittedly, many forwarding companies are pursuing this direction. TMSes are disconnected data islands, which most often analyze only the internal data available to freight forwarders (if any at all), and therefore lack data from the broader market. Typically, they are not connected digitally with shippers and carriers, and usually do not feature advanced decision-making algorithms. Such systems are only an improvement over manual work, which in some small freight forwarding companies is still done using spreadsheets, for example.

However, merely buying new tools is not enough. The digitization of forwarding represents not only a technological shift but also a cultural one as well. A change that must be supported by company boards and managers at every level. It forces businesses to change some of their habits, processes and workflow so that the digital data chain is not interrupted by "analog" behaviors (e.g. additional arrangements by email), ensuring the accuracy of entered data. The better they can adapt to these changes, and the greater the trust in the recommendations of digital algorithms, the greater their effectiveness.

3. Trends in the TFL industry

In recent years, the transport and logistics industry has faced many challenges. Legal regulations, labor shortages, or wildcards such as the COVID-19 pandemic have profoundly affected global supply chains. And so, it might seem that the primary trend in the TFL industry is digitization in its broad sense. But is that really the case?

3.1 Digital transformation

The first mentions of digital transformation emerged in the closing years of the 20th century. Since then, many companies across all industries around the world have been pursuing this direction. Every business goes about changes in a slightly different way. There is no area with perfect technologies, but there are those that are tailored to the needs of a given organization. In the PwC report, in the re-search carried out among the members of the Digital Academy, five such foundations were identified (Fig. 3.2.).[1]

Fig. 3.1 The foundations of digital transformation [1]

52% customer-centricity 52

18% data

16% innovation

8% employees

6% technologies
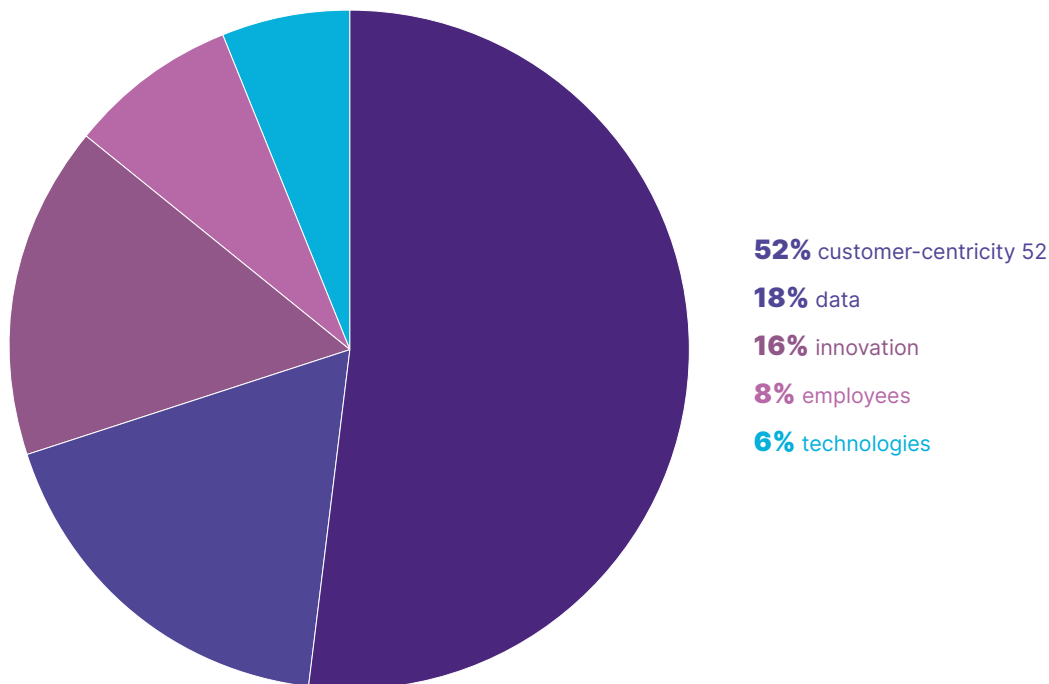
"Digital transformation involves managing the existing business and building for the future at the same time, something like changing the engine of the plane while in flight."
(Ashutosh Bisht, IDC).[1]

The research presented in the report [1] shows that the barriers to introducing digital transformation are mainly human-related. Fig. 3.2

Fig. 3.2 Barriers to digital transformation [1]

1 Lack of involvement from management

2 Improper communication

3 Reluctance to change

And here, the situation becomes somewhat deadlocked xxx, as the same respondents also indicated that it is middle managers and boards that should be the ambassadors of digital transformation.

What about the benefits of digital transformation? Basically, by definition, it is supposed to accelerate and optimize processes. Another important element is the effective acquisition and, above all, processing of data. Raw data without proper analysis is worthless.[1]

> 52% of Polish companies use real-time analytics
> (Dell Technologies Digital Transformation Index, 2018)
> Low-quality data cost organizations $11.8 million a year in 2018
> (Gartner, 2019).

Fig. 3.3 Three elements of optimizing digital transformation [1]

1 Technology

2 Data

3 New ways of working and operating of organizations

Implementing technology and automation is a recipe for unburdening employees and accelerating business processes. However, we cannot forget about innovative technologies that translate to increased efficiency. Nevertheless, data remains the essential element. The ability to track customer behavior and processes or collect data over time generate new opportunities. However, their most important benefit comes from their analysis and effective use. Respondents in the PwC report indicate that digital transformation had the greatest impact on process optimization.

Fig. 3.4 Benefits of digital transformation [1]

34% process optimization

19% cost reductions

19% quicker operation

17% increased revenues

11% change of business model
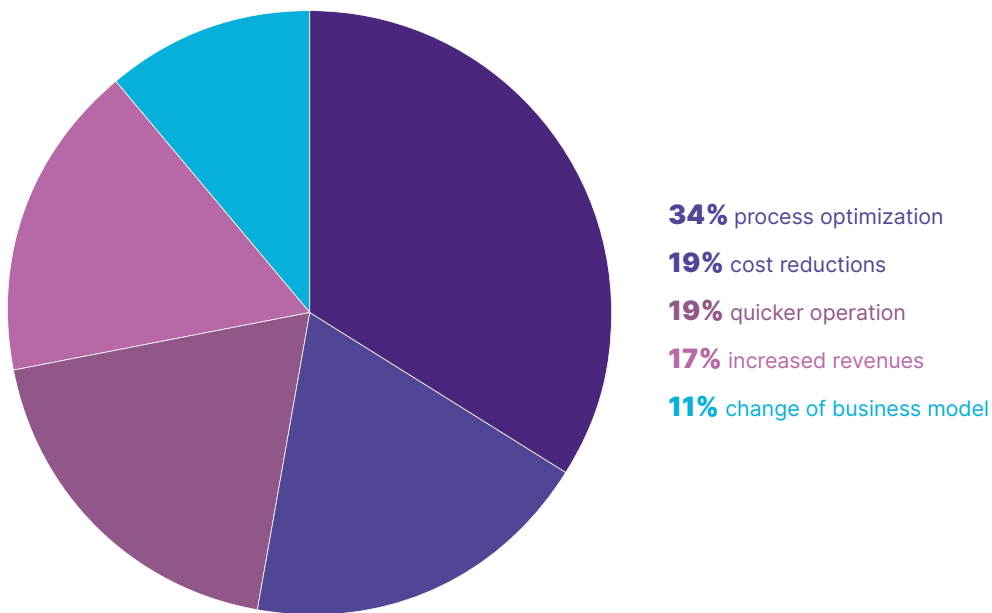
> By 2023, data literacy will become essential in driving business value (Gartner, 2020).
> 63% of Polish workers believe that automation creates more opportunities than threats. (PwC, Upskilling Hopes & Fears, 2019).

3.2 Cloud as the next stage of digital transformation

The cloud accelerates digital transformation as it facilitates the transformation of economies or entire industries, i.e. commerce (Allegro, Booksy), transport (Uber, Bolt), food services (Uber Eats, Glovo) and entertainment (Spotify, Deezer). The cloud marks the next stage of information technology development. Cloud solutions help modernize IT infrastructures and accelerate the adoption of digital innovations. According to McKinsey analyses, the rate in Poland is 14 times lower than in the most digitally advanced European economies (i.e. in Belgium, Finland, the Netherlands, Norway, Sweden or Ireland). [2]

Cloud solutions offer two benefits. The first is the modernization of IT and the acceleration of digital innovation in developing technologies used in the future. The second is crucial for businesses and institutions, as the cloud is considered an accelerator of innovation and the development of new technologies. This is possible thanks to advanced tools, such as e.g. the Internet of Things (IoT), artificial intelligence (AI) or machine learning (ML). The cloud offers much more than merely supporting databases and their safe storage. It presents new opportunities in managing large data sets, harnessing enormous computing power by implementing cutting-edge technologies and thanks to its global infrastructure.[2]

> 90% of organizations say that their cloud usage is higher than they had initially planned, due to the pandemic. McKinsey.

Examples of using the cloud in transport and logistics around the world

Poland

The national postal operator streamlined and automated its back office by migrating its accounting system to the cloud. With 1.1 thousand users and 10 thousand operations per month, it can process 100 thousand transactions per hour, resulting in increased accuracy and time savings.

Denmark

One of the container operators used the cloud in its own infrastructure to introduce new tools and processes for half the cost of their development. The migration of 26 core applications reduced the cost of operations by 10%.

USA

A logistics giant used cloud computing and AI/ML tools to optimize the routes of its couriers. They have 120 destinations every day. The algorithm saves about 40 million liters of fuel and 400 million dollars annually.

Retail

Poland

A clothing company that was struggling with surging online sales experienced issues with its website, especially during peak traffic periods. Within six weeks, it moved one of its flagship brands to the cloud. As a result, availability increased, translating to higher sales.

Australia

An online department store leveraged the cloud to overhaul its recommendation engine for its portfolio of 10 thousand products. Initial A/B tests showed double-digit revenue growth per user session.

Switzerland

A retail chain leveraged cloud-based data lakes and BI engines to obtain a 360-degree view of customer online and offline behavior. This effort resulted in a 60% reduction in BI and CRM costs and enabled the analysis of 4 TB of customer data per month.

Own study based on [2]

PITD

McKinsey identified seven factors that will allow the Polish economy to take full advantage of the digital transformation and increase its productivity (Fig. 3.5)

Fig. 3.5 Factors supporting digital transformation in Poland [2]

Soft infrastructure

☑ Increase in the adoption of digital tools by Poland's small, medium, and large enterprises

☑ Increase in the adoption of digital skills and take-up of internet services by Poland's general population

☑ Implementation, development and promotion of e-government solutions in Poland's public sectors

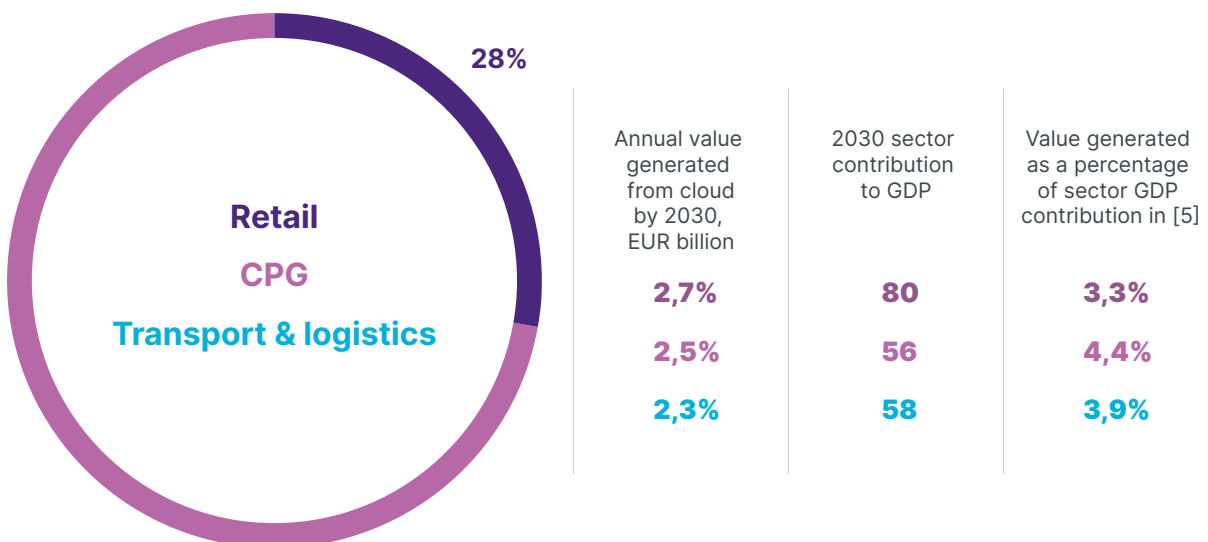☑ Fostering entrepreneurship in Poland to stimulate the start-up ecosystem

Accelerating cloud adoption

☑ Leveraging Poland's IT specialist labor pool and grow their numbers in the coming years

☑ Increase the availability of training to develop digital skills of Polish employees

☑ Foreign investors expect the regulatory environment supporting the attractiveness of the IT sector

McKinsey's analyses show that the spread of cloud technologies in public institutions and Polish enterprises could generate an added value of EUR 27 billion by 2030, which corresponds to 4% of Poland's GDP. The Consumer Packaged Goods (CPG), retail and transport & logistics sectors stand to benefit the most (Fig. 3.6) from this transition.

Fig. 3.6 Share of retail, CPG and transport and logistics from cloud implementation by 2030 [2]

	Annual value generated from cloud by 2030, EUR billion	2030 sector contribution to GDP	Value generated as a percentage of sector GDP contribution in [5]
Retail	2,7%	80	3,3%
CPG	2,5%	56	4,4%
Transport & logistics	2,3%	58	3,9%

28%

In retail alone, €2.7 billion can be generated from dynamic pricing, smart promotions, and inventory optimization accelerated by cloud technology. In turn, the CPG sector can generate a further €2.5 billion through, for example, manufacturing automation and the optimization of yield, energy, and throughput.

According to further studies run by the Central Statistical Office (GUS) and PMR, there are five barriers (Fig. 3.7) that slow the adoption of cloud solutions. [2]
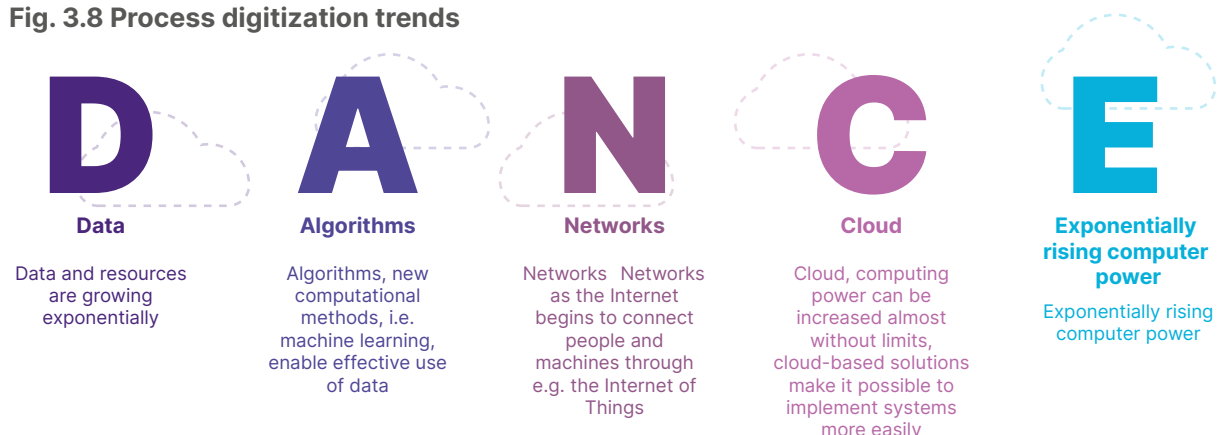
Fig. 3.7 Barriers to cloud solutions [2]

| Lack of awareness | Regulatory ambiguity | Security concerns | Lack of required capabilities | Financial burden |

The "Public Cloud in Poland 2019" report ("Chmura publiczna w Polsce 2019") presents the results of surveyed Polish companies (Fig. 3.7). Unfortunately, many businesses admit that they do not have suffi-cient expertise in cloud solutions. However, every fourth company representative believes that the most important indicator for using these types of solutions is cost reduction. Three in ten are concerned that they may no longer comply with regulatory requirements after migrating to the cloud (no physical loca-tion of data). The same number of representatives are concerned about the security of cloud services. In 2019, as many as 44% of companies reported problems with hiring for IT-related positions. Enterpri-ses pointed to the high costs involved with migrating to the cloud as the main disincentive for the move.

3.3 Major trends in digitization

Researchers from the Massachusetts Institute of Technology identified five main trends in the digitiza-tion of processes whose first letters form the acronym DANCE..

Fig. 3.8 Process digitization trends

Data

Data and resources are growing exponentially

Algorithms

Algorithms, new computational methods, i.e. machine learning, enable effective use of data

Networks

Networks Networks as the Internet begins to connect people and machines through e.g. the Internet of Things

Cloud

Cloud, computing power can be increased almost without limits, cloud-based solutions make it possible to implement systems more easily

Exponentially rising computer power

Exponentially rising computer power

Source – own materials of GS1 Poland

As demand and e-commerce grow, so does the volume of transport. Without the digitization and automation of processes, the volume of orders will exceed our capacity to process them. Also, staff shortages in the logistics and transport industry mean that digitization will become an essential element of every enterprise. The IT solutions used in the logistics market are presented below (Fig. 3.9).

Fig. 3.9 IT solutions in the TFL industry

Support area	System type
☑ Integrated enterprise management	☑ **ERP** (Enterprise Resource Planning)
☑ Supply chain planning and optimization	☑ **SCM** (Supply Chain Management)
☑ Productio	☑ • **MES** (Manufacturing Execution System) • **APS** (Advanced Planning and Scheduling)
☑ Storage	☑ **WMS** (Warehouse Management Systems)
☑ Quality management	☑ **QMS** (Quality Management System)
☑ Spare parts mangement	☑ **CMMS** (Computerised Maintenance Managment Systems)
☑ Transport	☑ • **TMS (**Transport Management System) • **Digital finance management platforms** • **Freight exchanges** • **Transport platforms** (supporting eCMR implementations)
☑ E-commerce	☑ **E-commerce platforms**
☑ Tools to digitize product data	☑ **PIM** (Product Management System)

Source: Study based on GS1 Poland
and the Polish Road Transport Institute

In this report, we focus mainly on solutions related to transport, which will be the central part of the chapters below.

3.4 Transport Management System (TMS)

TMS is an IT system that supports everyday transport operations, i.e. planning, monitoring, management of means of transport and settlements. It can be part of an ERP system. The system provides insight into daily transport operations, data and documentation. TMS optimizes the process of shipping goods, making it easier for companies to manage and streamline transport operations, regardless of the mode of transport, i.e. whether by land, air or sea.

Transport management systems can be installed from a file on a computer or a company server. They also come in web versions that are accessible via a web browser and can be integrated with other systems. [GS1 Polska]; [3]

Functions of TMS systems [3; 4]:

- transport cost calculation
- transportation planning
- customer service
- vehicle schedule
- drivers schedule
- driver travel assignments
- easy communication with drivers
- account of vehicle logs
- route planning and optimization
- vehicle fleet management
- monitoring and handling of transport orders
- option to integrate with other systems, e.g. telematic, ERP-class
- load location monitoring using GPS
- organization during loading and unloading
- access to reports (fleet cost analysis, empty mileage analysis)
- payment settlements
- mobile app for drivers
- SMS communication with drivers
- CRM email communication with business partners

For more information, read the Report:

3.5 Digital finance management platforms

In general, the transport industry is plagued by liquidity issues. Long payment terms, even up to 90 days, or late payments cause many disruptions with cascading consequences. However, there are solutions on the market that can support transport companies. One such example is Transcash.eu, a company that boasts digitization of processes and has a strong paperless policy. [3]

Product offering:
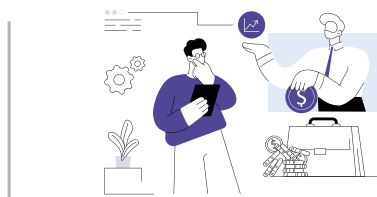
Factoring   **debt collection**   **debt exchange**
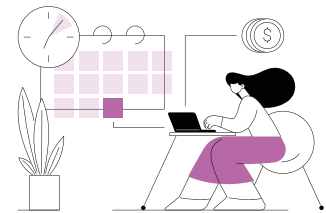
Factoring improves the financial liquidity of transport companies as it allows them to receive money for transport services on the same day they issue the invoice. This has a significant impact on their operations. In turn, debt collection helps recover money from past-due invoices. The Debt Exchange, on the other hand, is a unique solution that allows for purchasing or selling past-due receivables. It publishes available-for-sale debts of transport and forwarding companies from Poland and abroad. Every month, 25 thousand companies from all over Europe use information on past due receivables of companies from the TFL sector.[3]

How does factoring work?

STEP 1
The carrier carries out the transport service and issues an invoice to the counterparty with a deferred payment date (e.g. 60 days).

STEP 2
The carrier sends a scan of the invoice to the factor (Transcash).

STEP 3
Transcash transfers 100% of the gross amount to the carrier's account (in 30 minutes).

STEP 4
The counterparty repays the invoice to Transcash within the due date.

The digitization of the customer service process guarantees extremely fast and "contactless" service. At the same time, it offers a vastly reduced environmental footprint. A paperless policy and companies' mass drive to eliminate paper documents from the workflow make digital platforms indispensable in supporting the financial management of transport enterprises.
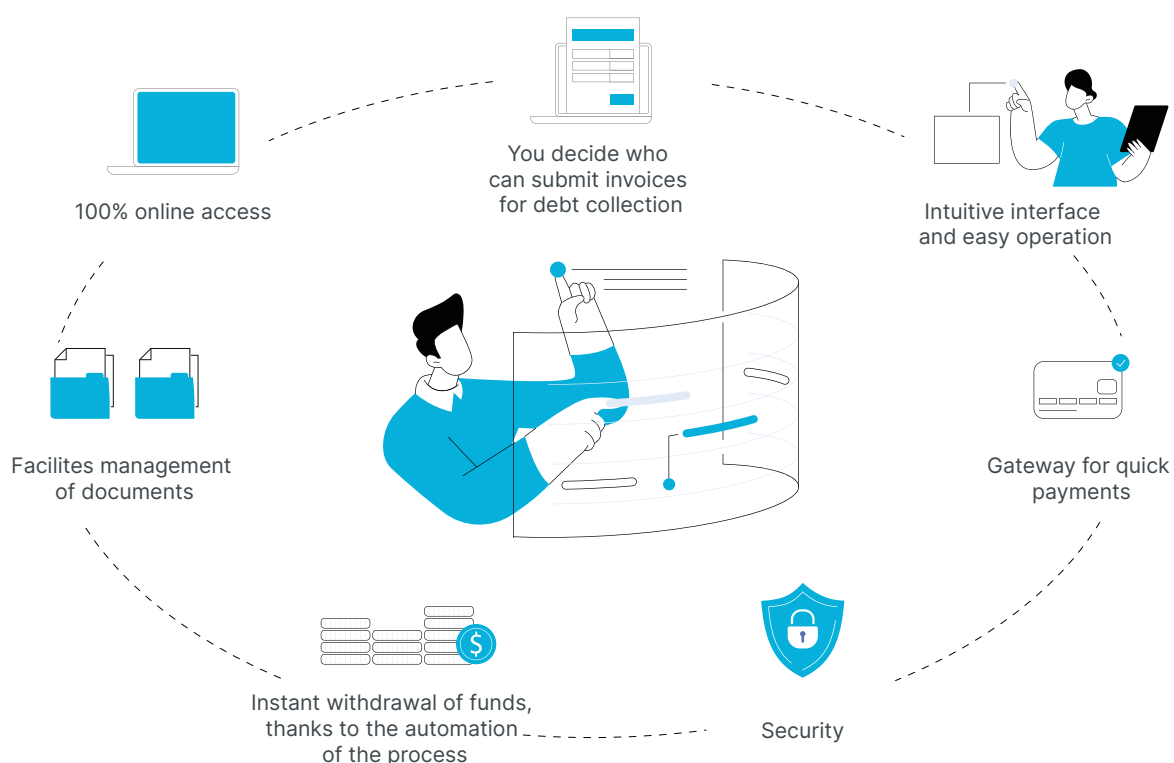
Digitalization of the customer service process [3]

Who is it for? – For transport companies of any size

100% online access

You decide who can submit invoices for debt collection

Intuitive interface and easy operation

Facilites management of documents

Gateway for quick payments

Instant withdrawal of funds, thanks to the automation of the process

Security

3.6 Digital eSkonto service

The growing popularity of digital forwarding is driving up demand for specialized financial products available online. Financial liquidity is crucial to the smooth functioning of companies in this sector and is supported by such services as eSkonto, which allows for paying invoices to carriers' on the day they are issued. This solution expedites the process as currently invoices for transport services are paid within 60 to 90 days on average.

Products created with digital freight forwarders in mind should be convenient to use and guarantee a fast flow of data and funds. eSkonto is a tool that streamlines financial settlements. It requires minimal involvement on the part of the freight forwarding operator and guarantees quick payment to carriers who do not have to utilize their own funds.

eSkonto – benefits of digitization

eSkonto's operating principles are rooted in factoring mechanisms, meaning that users do not have to allocate their own funds to withdraw money as the service provider does it for them. Such a service is offered by Transcash, among other companies. The first step in the service involves setting the financing limit, the commission for carriers of a given forwarding company and the date on which the payer (freight forwarding company) will pay the invoices to the service provider. At this stage, the payer decides whether financing should be available to all carriers or only to selected partners. Also, at this stage, the service provider and the payer confirm whether they want to approve each invoice submitted for financing before the payment of funds or just want to be notified about it. The process is fully online.

100% online financing and service

Using eSkonto for forwarding is free of charge, and the tool can be managed fully digitally. The entire financing process under eSkonto is designed to minimize the involvement required from freight forwarders. From the Payer Service Panel level, the freight forwarder can review, accept or reject invoices, generate reports or change the previously agreed payment date. The forwarding company decides the extent of its involvement in the entire financing process. From the carrier's point of view, the financing process is extremely simple. The carrier submits the invoice online and receives the money in its account within 15 minutes.

Benefits of eSkonto for freight forwarders

- no financing costs: eSkonto is free of charge, with the service provider financing the invoices;

- increased competitiveness thanks to fast payment and low commission for factoring for carriers;

- clear rules of cooperation: the financing limit and the invoice repayment date are aligned to needs;

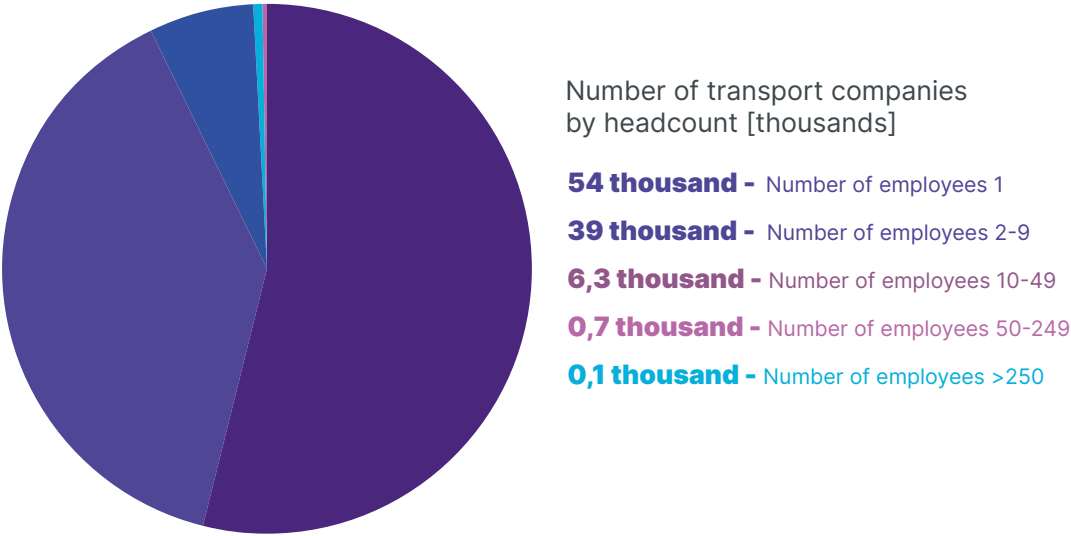- transparency in documents: all invoices handled within eSkonto are accessible in the system.

QuickPay – express payment for Trans.eu users

Forwarders using the Trans.eu platform can finance their carriers registered in the platform conveniently and at no cost by enabling the QuickPay express payment service. Then, each added freight will be marked with an appropriate designation on the list of freights so that carriers know upfront which orders are eligible for an express payment after transport.

3.7 Freight exchanges – cutting down on empty runs

In Poland, there are approximately 125 thousand companies active in the road transport of cargo. In 2020, Polish companies traveled 355 billion tonne-kilometers, which gives Polish companies a 21% share among all EU countries. The Polish market is very fragmented as, according to the report [5], in 2018, there were 54 thousand transport businesses employing one person and 39 thousand with up to ten employees. The share of large players in the transport market is marginal (Fig. 3.10).

Fig. 3.10 Structure of the transport market in Poland in 2018 [5]

Number of transport companies
by headcount [thousands]

54 thousand - Number of employees 1

39 thousand - Number of employees 2-9

6,3 thousand - Number of employees 10-49

0,7 thousand - Number of employees 50-249

0,1 thousand - Number of employees >250

According to Eurostat data, in 2020 empty runs represented nearly a fifth of all road kilometers in road transport in the European Union. They account for 22.6% of all road transport activities in Poland, slightly exceeding the EU average. There are more empty runs in domestic transport than in international transport. This is mainly because more transport runs are carried out over shorter distances. Several platforms are available on the market, facilitating direct connections between carriers and shippers. These tools are called freight exchanges. Europe's four largest freight exchanges are TimoCom, Trans. eu, wtransnet and Teleroute. Freight exchanges are also sometimes referred to as transport platforms. [3]

Benefits of using a freight exchange [3]:

reduction of empty runs

access to thousands of orders according to individual matching algorithms

calculation of optimal routes

protection against unpaid invoices

maximizing cargo space utilization

Modern telematic solutions

Telematics covers systems for sending, receiving and analyzing data from vehicles. This technology makes it possible for e.g. dispatchers in transport companies to communicate with the driver and vehicle. Today, telematics goes beyond merely monitoring vehicles, semi-trailers or loads themselves in real-time. It is a tool for optimizing routes and reacting to "exceptions" (i.e. potential delays). It also relieves drivers of administrative tasks and increases their safety. Of course, telematics also optimizes order and electronic document handling and helps improve drivers' driving style or registering and accounting for their working time.[6]

Advantages of telematics[3]

- ☑ Location data
- ☑ Load condition data
- ☑ Load temperature data
- ☑ Data on completed trips
- ☑ Professional navigation and route optimization
- ☑ Driver identification
- ☑ Determining accurate ETAs
- ☑ Telematics data aggregation
- ☑ Data on transport conditions (jarring etc.)
- ☑ Cargo security data
- ☑ Driving style
- ☑ Tachograph data
- ☑ Vehicle service data
- ☑ Fuel consumption control
- ☑ Real-time tire condition
- ☑ Communication with the driver
- ☑ Document handling
- ☑ Video recording
- ☑ Driver safety
- ☑ Road safety
- ☑ Automatic management of trip-related claims
- ☑ Integration with other systems

Telematics facilitates many things, from planning and efficiency, through control of transported loads and order handling, to automating some processes and reducing costs. The adopted priorities define the scope of the necessary data and the list of functionalities and types of required devices. For example, if a company wants to focus on bringing down fuel costs, it should look for a solution that will not only provide current data on consumption but also streamline its analysis (option to generate automatic reports) and facilitate taking remedial action (improvement of drivers' driving style – assessment of drivers and active coaching while driving, e.g. Webfleet OptiDrive 360 function), route optimization (mileage reduction), order management and TPMS.

The systems can lead to up to 15-20% savings in fuel consumption, with an average return on investment period of 6-9 months. Nearly 90% of customers finance telematics in equipment rental, thus keeping entry costs low by incurring only monthly subscription fees.

3.8 Digital transport management system

The transport industry has faced various challenges in recent times, particularly in the last two years. Starting with the COVID-19 pandemic, throught the war in Ukraine and the Mobility Package, and ending with the shortage of professional drivers. For this reason, parts of fleets remain idle, and the rapidly changing situation on production lines or in warehouses significantly extends the wait time for unloading and loading. To address this issue, Trans.eu launched CargoON, a flexible and fully automated road transport management system that allows manufacturers (shippers) to increase their transport capacity. The system also allows for a more effective combination of offering loads on the spot and contract markets.

Logistics 4.0 and access to capacity in one place

The CargoON platform offers numerous solutions and services to digitize, optimize and automate processes, communication and documentation related to road transport management.

The **CargoON Freights** module allows for intuitive end-to-end digitization of the transport management process – from planning, through ongoing cooperation with carriers, to settlement. The process of allocating loads can also be configured as automatic. This module allows for placing and controlling orders not only with regular suppliers but also on the spot market on a fully automated basis.

In turn, the **Simple Tenders** service facilitates the tendering process for carriage, making it possible to establish reliable partnerships with new carriers in a very short time. The connection with the Trans.eu platform makes CargoON the only system in its class to guarantee access to a pan-European network of tens of thousands of proven carriers and freight forwarders

End-to-end digitization

Dock Scheduler, , also available as a standalone product, allows users to optimize the management of the availability of loading bays and ramps by defining their handling capacity in the system. Because the carrier can independently issue arrival notices, the manufacturer's labor costs are reduced, the risk of mistakes is minimized and drivers' wait time is shortened while throughput and work efficiency at the shipper's end are increased.

Leveraging IT solutions to determine dates of loading and unloading also allows users to maintain a high service level, improve customer satisfaction and avoid costly downtime. For example, thanks to Dock Scheduler, MFO S.A. was able to raise its warehouse throughput by approx. 23-24% without increasing the number of shifts, FTEs, additional equipment or machinery.

The products comprising the CargoON suite ensure end-to-end digitization of the supply chain, translating into tangible savings and greater transparency in relations with all supply chain participants, be it manufacturers, forwarders, carriers or drivers. Digital solutions also reduce the number of empty runs and thus support the environment through tangible reduction of CO_2 emissions.

"Through the continuous development of the Platform and by launching a product dedicated purely to manufacturing companies, we strengthen our efforts towards full digitization and automation of the road transport management process," says Klaudia Cozac, Customer Experience Officer at CargoON

"Digitization paves the way to process optimization, improved indicators and, importantly, cost reductions. This is especially important today, in the face of persistent supply chain issues," she adds.

CargoON is a product dedicated purely to manufacturing companies, which also helps with the "first and last mile" in road transport.

Fast implementation ON.

CargoON is a system and cloud solution that can easily integrate with SAP and ERP systems or other TMS software. Compared to competing solutions, deployment is not time or resource intensive, as it only takes a few weeks. For manufacturers who are not yet members of the community, transitioning to the system is simple and competitively priced.
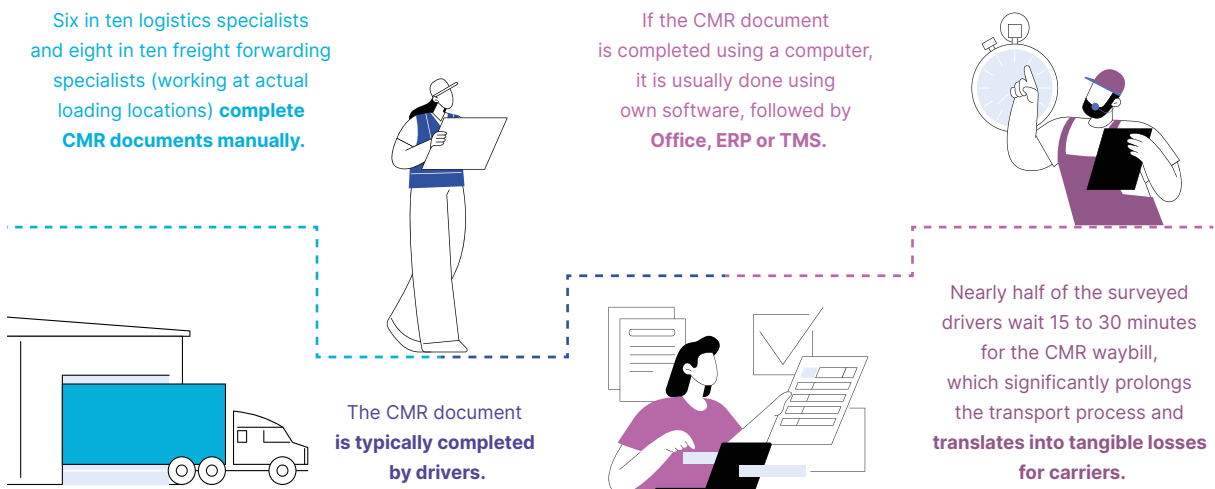
For more information in:

3.9 Platforms for generating e-CMR

The waybill is the most important commercial document. It serves as proof of handing over cargo to the carrier and thus of entrusting him with responsibility for the load. Primarily, it contains essential information about the parties to the transport transaction (sender, carrier, recipient), cargo characteristics and details of the transport (information function). It facilitates the identification of the cargo, particularly special loads, e.g. frozen products. The waybill also serves as proof that the cargo was accepted for carriage, thus enabling the pursuit of potential claims (evidence function). Sometimes this document is required to release the goods to the recipient at the port of destination (legitimacy function). International transport uses the CMR waybill. This document is typically issued in up to five copies. [7]

The Polish Road Transport Institute prepared a report on e-CMR waybills [8] to determine whether companies in Poland are ready to introduce this document and also to identify whether waybills contain correct data. Drivers said they usually have to wait quite a long time for documents, mostly on account of queues, lack of time or excessive bureaucracy. Research shows that filling out a CMR document takes up to half an hour. In turn, only 15% of waybills are error-free, and only 22% contain up-to-date data. The most important conclusions are presented in Fig. 3.11.

Fig. 3.11 Major lessons for the industry[8]

Six in ten logistics specialists and eight in ten freight forwarding specialists (working at actual loading locations) **complete CMR documents manually.**

If the CMR document is completed using a computer, it is usually done using own software, followed by **Office, ERP or TMS.**

The CMR document **is typically completed by drivers.**

Nearly half of the surveyed drivers wait 15 to 30 minutes for the CMR waybill, which significantly prolongs the transport process and **translates into tangible losses for carriers.**

According to the drivers:

- ☑ Only a fourth of drivers believe that CMR documents are legible
- ☑ Only a fifth of drivers believe that CMR documents contain up-to-date data
- ☑ Nearly half of drivers believe that one-two out of ten CMR documents contain errors
- ☑ Over half of drivers believe that one-two out of ten CMR documents contain outdated data

After analyzing the data in Fig. 3.11, it is evident that there is much to be done in this area. So what is this e-CMR? E-CMR is nothing more than an electronic version of the waybill. However, it should be noted that an electronic waybill is much more than merely a digital version of a paper document, e.g. in pdf format. Through certified platforms where authorized persons enter data, all supply chain participants will have access to them at all stages of the freight journey. Moreover, they can update them where necessary. In addition to the B2B data exchange between business entities, the relevant public institutions will have parallel access to the system for inspection purposes throughout the European Union.

According to the International Transport Union (IRU) estimates, using electronic documents entails savings of 25-30%. E-CMR will be mandatory throughout the European Union starting August 2024, but many companies are choosing to implement it now. In Poland, in September 2019, an additional protocol to the Convention on the Contract for the International Carriage of Goods by Road (CMR) entered into force, which concerns using an electronic waybill. However, e-CMR documents account for only 1% of all shipping documents used in the European Union. Why? In Poland, it is because of inconsistencies in legislation. The Polish Road Transport Act stipulates "the obligation to use paper documentation for roadside inspection and compliance with the provisions of the Road Transport Act".[9]

Using digital documents offers a number of benefits for the TFL industry. It helps reduce the time needed for administrative activities for one waybill from about 23 minutes to 9 minutes, which brings down man-hour costs from PLN 14.01 to PLN 5.48. [9] The most important advantages of the electronic waybill includes access to electronic documentation for all participants in the supply chain and administration authorities. This allows for quick and secure access to data with the option to update them on an ongoing basis. In turn, this eliminates the risk of errors, reducing the risk of penalties and fines for defects or errors in documentation. Safely storing saved data in an encrypted cloud removes the need to rent premises to archive hard copies.

One of the biggest problems marring the transport industry is the relatively long wait times for payments for services rendered. This is because before an invoice can be issued after delivering cargo to its destination, the entire set of signed documents must be sent to the payer first. Of course, assuming that all the documentation was filled out correctly along the way. Some companies indicated that the paper worflow of documents extended the payment up to 111 days. Thanks to saving all data in the system, the electronic waybill allows the process to start almost immediately after the transport.

In Poland, there are several platforms that support electronic waybills. Although under Polish legislation using an electronic waybill is not allowed (as of November 2022) and may cause issues during inspections, the adoption of such platforms among companies is on a consistent rise. This applies to both pilotage and the use of an electronic waybill in a hybrid form, with one hard copy available in case of an inspection by the relevant services. Among the platforms available on the market, the most notable service providers include Green Transit, Trans Assist, Trans.eu Group, Trimble Transportation, Logmap or Snarto. The report "e-CMR. Are you ready?" ("e-CMR. Czy jesteś gotowy?") contains an in-depth comparison of their functionality. The number of users of e-CMR platforms is constantly growing. For example, in 2021, the Trans Assist platform was used to generate over four thousand electronic e-CMR. Suppliers anticipate that in 2022 this number will quadruple. Obviously, the pandemic contributed to the acceleration of the digitization process. The benefits of using the potential of the platforms are presented in Fig. 3.12.

Fig. 3.12 Major lessons for the industry

e-CMR platforms

Possibilities

Generating **Sharing** **Signing** **Storage**

Advantages

☑ Simplicity

☑ Intuitiveness

☑ User convenience

☑ Accessible via various devices (phone, tablet, computer)

☑ Savings

☑ Data safety

☑ Eco-friendliness

NOWY RAPORT

e-CMR

Czy jesteś gotowy?

Pobierz ↓

POLSKI INSTYTUT TRANSPORTU DROGOWEGO

GS1 Polska

4. Fleet electrification

Electromobility is currently the hottest trend in the automotive sector, extending not only to passenger cars but to vans and trucks as well.

According to the electromobility counter of the Polish Alternative Fuels Association (PSPA), in September 2022, there were approx. 57 thousand electric cars registered in Poland. Over the first nine months of 2022, their number expanded by nearly 19 thousand, i.e. was 44% higher than in the corresponding period of 2021.
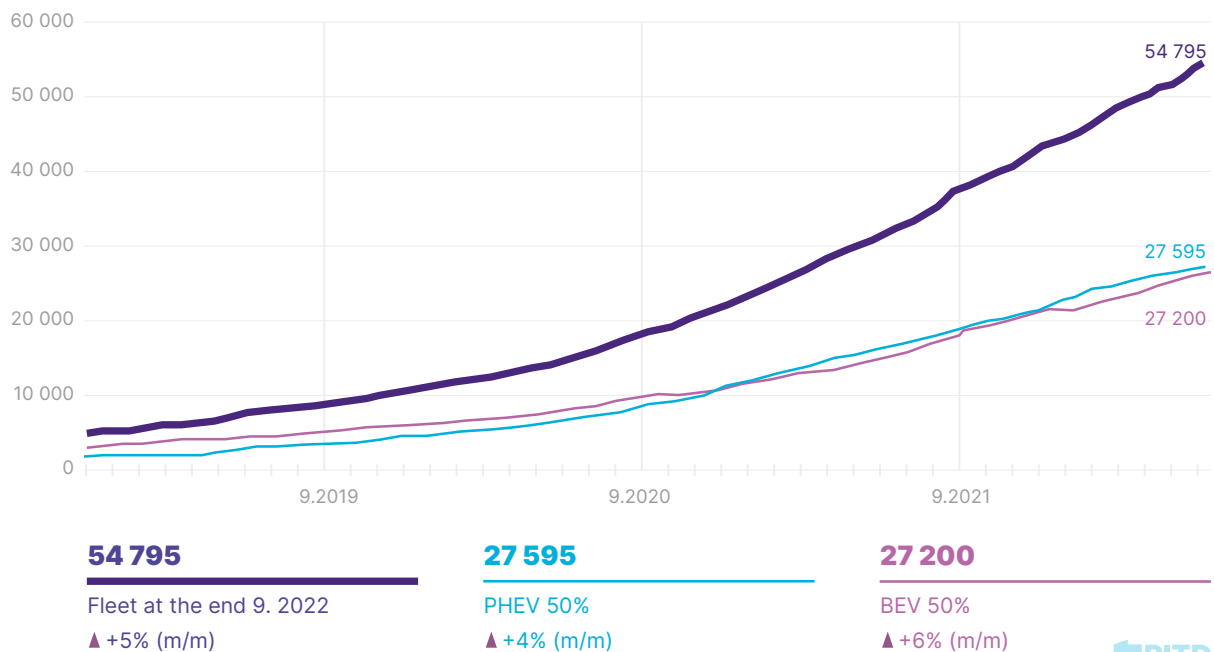
While the electric truck market is booming, it is only starting its electrification journey. PSPA data shows that the majority of electric vehicles on Polish roads (almost 55 thousand) are passenger cars, compared with 2,461 vans and trucks. This figure is growing rapidly as the number of registered delivery vehicles, both new and used, soared 134% relative to the corresponding period of 2021.

The charging infrastructure is growing hand in hand with electric fleets, and the pace of its expansion will make or break the electrification of this segment.
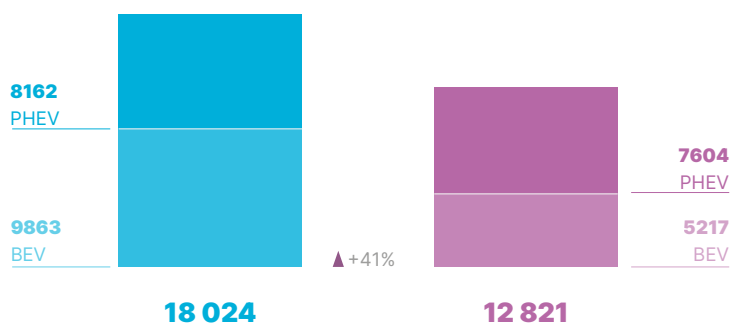
Fig. 4.1 Electromobility counter - as of September 2022

The size of the fleet of electric cars, vans and trucks

57 256 ▲+74% (r/r)

54 795	**27 595**	**27 200**
Fleet at the end 9. 2022	PHEV 50%	BEV 50%
▲ +5% (m/m)	▲ +4% (m/m)	▲ +6% (m/m)

Polish Alternative Fuels Association, Polish Automotive Industry Association

Number of newly registered electric cars, passenger cars (new and used)

8162 PHEV

9863 BEV

▲ +41%

18 024

7604 PHEV

5217 BEV

12 821

park		Number of registrations (new and used)		
electric cars, vans and trucks	2461	1 -9. 2022 **970**	▲ +134%	1 -9. 2021 **414**
electric buses dmc>3.5 t	788	1 -9. 2022 **138**	▼ -26%	1 -9. 2021 **187**
electric motorcycles and mopeds	15 765	1 -9. 2022 **3601**	▲ +27%	1 -9. 2021 **2830**
electric vehicles micro and others	555	1 -9. 2022 **121**	▲ +53%	1 -9. 2021 **79**
hydrogen passenger cars (fcev)	124	1 -9. 2022 **45**	▼ -31%	1 -9. 2021 **65**
hybrid cars and vans	439 160	1 -9. 2022 **112 452**	▲ +6%	1 -9. 2021 **106 500**

PITD

Source: PSPA

4.1 Emission regulations

The main driver of changes in the automotive sector is the policy of the European Union, which is strongly focused on the reduction of GHG emissions from road transport. On 14 August 2019, the European Parliament and the EU Council introduced new regulations containing specific emission targets for heavy road transport. According to their assumptions, from 2025 all manufacturers of trucks sold on Community markets will have to reduce the average CO_2 emissions generated by new vehicles by 15% (compared to the level from 1 July 2019 to 30 June 2020), and from 2030 by another 30%. Reducing the level of emissions from heavy road transport sector poses a serious challenge in Poland as 98% of trucks in the country are equipped with diesel engines. [14] It is worth noting that Poland boasts the EU's largest truck fleet, accounting for close to one-fifth of the entire EU fleet.
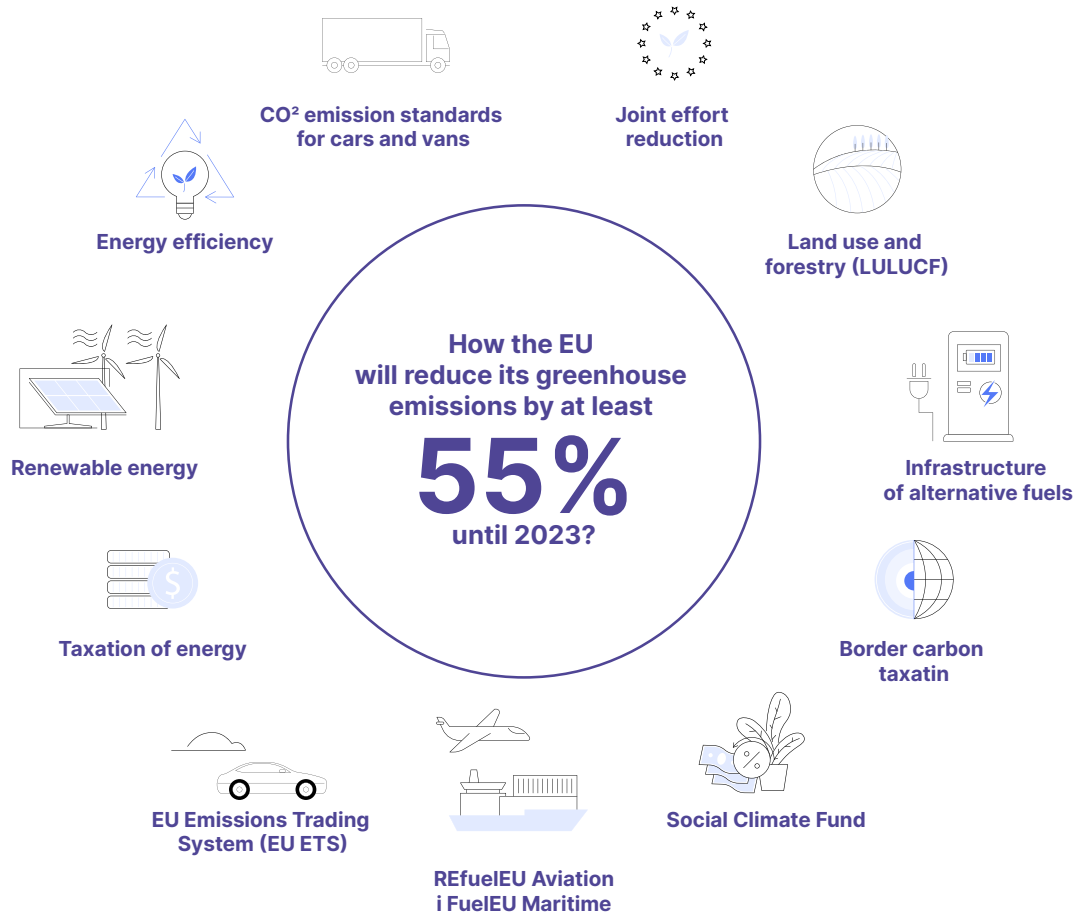
4.2 Sustainable development strategy

In December 2020, the European Commission presented a strategy for sustainable and smart mobility, which lays the foundation for the further transformation of the transport sector. The document assumes, among other things, that in 2030 there will be at least 30 million zero-emission vehicles in operation on European roads and high-speed rail traffic will double. In 2050, nearly all vehicles will be zero-emission, and high-speed rail traffic will triple. Achieving these objectives will require the progressive tightening of exhaust emission standards and, ultimately, the introduction of a ban on selling combustion engine vehicles.

4.3 Fit for 55

On 14 July 2021, the European Commission announced a package of legislative proposals called "Fit for 55" with the overarching idea of reducing CO2 emissions by at least 55% by 2030. The EC's proposals provide several instruments supporting the decarbonization of the transport sector, including accelerating the expansion of the charging infrastructure for electric trucks.

Fig. 4.2 Components of the "Fit for 55" package[10]

CO² emission standards
for cars and vans

Joint effort
reduction

Energy efficiency

Land use and
forestry (LULUCF)

Renewable energy

**How the EU
will reduce its greenhouse
emissions by at least**
55%
until 2023?

Infrastructure
of alternative fuels

Taxation of energy

Border carbon
taxatin

EU Emissions Trading
System (EU ETS)

REfuelEU Aviation
i FuelEU Maritime

Social Climate Fund

PITD

4.4 Euro 6 and Euro 7 standards

From 1 January 2021, a new exhaust emission standard, Euro 6D ISC-FCM, has been in force in the EU obliging manufacturers to monitor emission values during vehicle operation. As of 2022, the new standard also applies to heavy goods vehicles.

According to European Commission's plan, the Euro 7 emission standard is scheduled to come into force in 2025. It will introduce new, tighter restrictions on emissions of carbon oxides, PM 10 and PM 2.5 particulate matter, and NOx. The standard will also impose tighter requirements for cleaning equipment such as particulate filters and catalytic converters used in cars.

4.5 Advantages of electric trucks

Electric trucks are one of the hallmark achievements of urban logistics in recent years. They offer many advantages, including reducing pollutant and greenhouse gas emissions, lowering noise levels, no operating fluid leaks, and more comfortable working conditions for drivers. What is more, in the face of rising gas and diesel prices, replacing combustion vehicles with electric ones can save costs. Even if the price of electricity increases, electric trucks will remain more economical than vehicles relying on fossil fuels. In addition, electric vehicles do not require as frequent maintenance as their combustion engine counterparts, which need changes of oil, coolant fluid or the oil filter. Proper care for the technical condition of electric vehicles requires only an inspection of the battery and other elements installed in all vehicles, such as brakes or tires

4.6 Charging infrastructure

Currently, public high-power charging stations, whether due to their location or technical conditions, cannot be freely used by heavy-duty vehicles. Nevertheless, the charging infrastructure is expanding. In late September 2022, there were 2,460 public charging stations for electric vehicles (4,738 points) in operation in Poland. 28% of them were fast (DC) charging stations, and 72% slow (AC) chargers with a power less than or equal to 22 kW. In September alone, 33 new public charging stations (79 points) were launched.

Fig. 4.3 Infrastructure for charging electric vehicles in Poland

Number of charging stations in Poland (pcs.) **4738** ▲+2% (m/m)
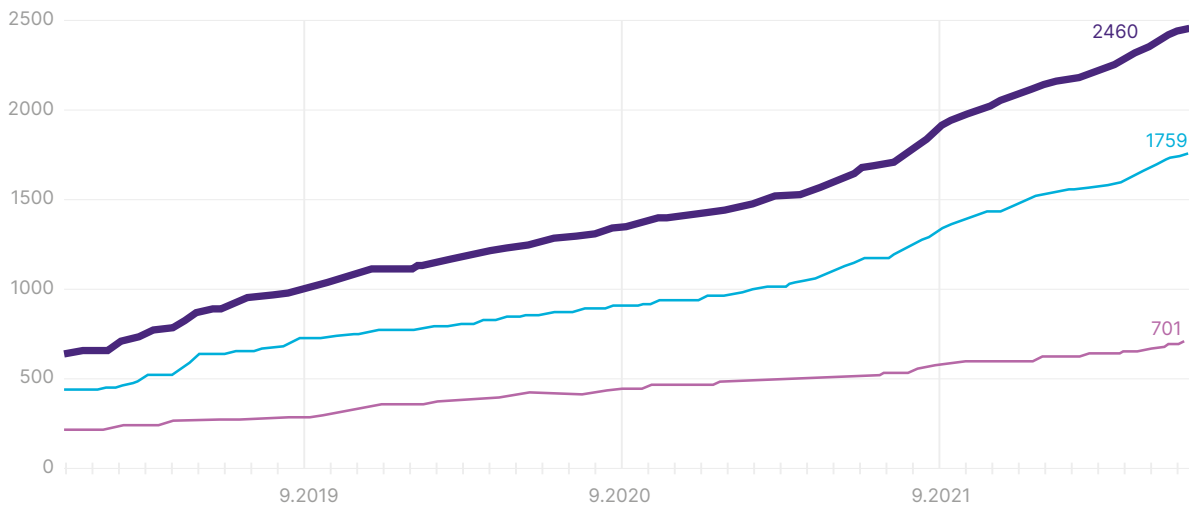
2460
status at the end 9. 2022
▲ +1% (m/m)

1759 | 72%
AC charging stations
▲ +1% (m/m)

701 | 28%
DC charging stations
▲ +3% (m/m)

Structure of publicly available charging points
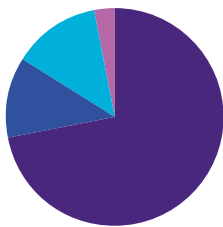
72% typ 1 i 2

12% chademo

13% ccs / combo 2

3% tesla

Cities with the highest number of charging stations
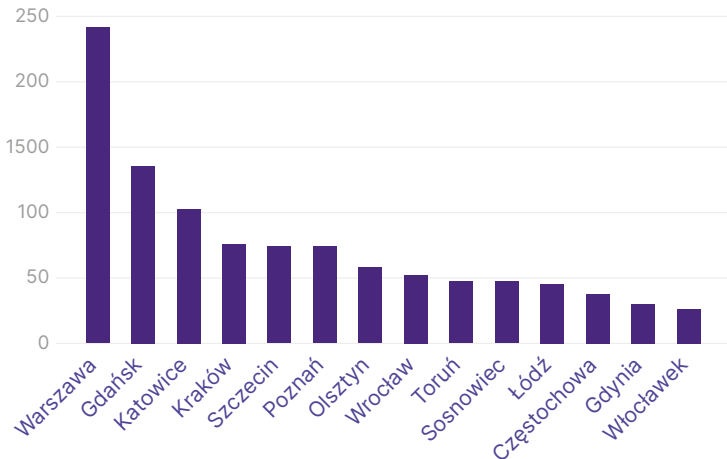
Source: Polish Alternative Fuels Association, Polish Automotive Industry Association

4.7 Barriers to electromobility

The main barrier hindering the widespread adoption of electromobility is the high prices of electric cars relative to their combustion equivalents. Consequently, many countries introduced a system to support potential EV buyers to stimulate the market. In addition, the charging infrastructure is not yet developed enough to handle all-electric vehicles on the road.

5. Last mile optimization

It would seem that the last mile means "only" the final stage of the delivery of goods. Nothing could be further from the truth. In the case of online purchases, this final stage turns out to be the most important, costly and complicated in the entire logistics process. Accounting for 50% of the total operating cost of package distribution, the last mile greatly determines customers' shopping experience. Items not delivered on time or damaged in transit are probably the most serious issue, one which the seller has no direct control over.

There are many ways to optimize the last mile. Courier companies are investing in drones, mobile apps and even AI. The more innovations, the greater the possibilities for consumers. Self-service parcel lockers, both those installed in dedicated facilities or standalone ones open 24/7 play an increasingly prominent role. To remain competitive in the modern marketplace, companies must keep up with the times and improve the effectiveness and quality of the last-mile process on an ongoing basis to meet the growing demands of e-commerce customers. To streamline the last stage of delivery, logistics companies, distribution centers, courier companies, postal operators, and retail chains increasingly turn towards modern technological solutions. These include, for example, artificial intelligence (AI), the cloud, blockchain or the Internet of Things (IoT). Modern enterprises are also strongly focusing on optimization systems. From production planning, through streamlining warehouse processes, to effective and fast deliveries, optimization seems to be tailored to address the existing last-mile challenges and more and more companies seem to recognize its potential. [11]

5.1 Modern warehouse solutions

The "Last Mile for E-commerce" report ("Ostatnia mila dla e-commerce") [11] shows that 55% of the total operating costs in warehouses are related to order picking, where the individual items in a shipment are collected from different locations in the warehouse so that they can be packed and sent to their destination. Even small improvements in order picking can bring substantial financial benefits. Warehouse managers should also pay attention to task planning, taking into account potential disruptions or downtime.

The authors of the report [11] draw attention to the so-called Job-Shop Scheduling Problem (JSP). In their opinion, a suitably advanced optimizer handling JSP enables more effective utilization of resources (machinery, vehicles, skilled and unskilled staff, service points and premises), but also allows for shipment within a specific time window and quick response to failures and minimizes downtime. As a result, it ensures more effective planning and management of the supply chain. Optimization of order picking and JSP can be implemented in various ways, but typically it is done as part of or integrated with WMS-class (Warehouse Management System) software. WMS systems can locate goods with pinpoint accuracy and control warehouse turnover. Moreover, they enable quantitative and stock control of goods received in the warehouse, e.g. in terms of consistency of the delivery with the underlying order. The implementation of these elements is the most important challenge currently faced by logistics center operators in Poland and globally. Proper deployment of Warehouse 4.0 solution not only allows for a significant increase in efficiency, elimination of errors and minimization of customer wait time but also reduces risks associated with employee turnover, a frequent issue in this sector.

5.2 Supply optimization

Another aspect of last-mile optimization is freight transport. Optimization of transport is inextricably linked to travel cost reduction. Primarily of fuel costs, which, according to the American Transportation Research Institute, together with vehicle repairs and driver salaries, account for more than 72% of total operating costs per kilometer in the industry. [11] Since costly repairs are involved, the fleet should be regularly re-placed . The "Mobility 2032. Are you ready?" report ("Mobility 2032. Czy jesteś gotowy?") [12] shows that "modern cars consume much less fuel, with the difference sometimes reaching as much as 8 liters per 100 km." [12] Additionally, there is also the element of route planning. Done manually, it is time-consuming, inef-ficient and error-prone. Route optimization software can reduce the distance traveled by up to a dozen per-cent or so. A large number of business partners, subcontractors and shipping companies involved in order fulfillment means that it is necessary to manage vast amounts of information. This is where TMS (Transport Management System) software comes into play as it greatly facilitates data collection and aggregation. From a business standpoint, TMS tools improve the turnover of goods through improved collection planning, real-time tracking, and more effective planning (shortening supply chains) and ensuring that goods will be available for sale as soon as possible, on time. It is a set of functionalities that improve work, reduce costs and greatly enhance the effectiveness of transport management.[13]

For more information, read the "Last mile for e-commerce" report)

6. Cybersecurity

Threats to cyber security are typically associated with the financial sector, and in particular with banking. Meanwhile, in recent years, hackers seem to have set their sights on the TFL sector. Since 2018, the transport and logistics industry has become the second most attractive target for hackers, moving up from 10th place, where it ranked the year prior. [15]

According to "The Cybersecurity Handbook", Poland is in the top twenty countries most vulnerable to cyberattacks. For the TFL industry, it should be alarming that when it comes to the logistics sectors, cybercriminals steal sensitive and valuable data, often paralyzing the work of even the largest enterprises and exposing them to huge financial losses. One of the most notorious incidents was the attack of the Petya virus carried out in 2017 on Maersk, the world's largest maritime container shipping operator. The company's IT systems were paralyzed for several days by ransomware, forcing it to disable some of its fleet management and new order acceptance systems. Fortunately, no data was stolen. Nevertheless, the attack brought down Maersk's operations to its knees, inflicting significant financial losses (the operator's quarterly profit was down by USD 300 million) and provoking significant disruptions in the global supply chain. The consequences of an attack, even after it is dealt with, can linger for months, which is why the TFL industry is very serious about preventing and quickly detecting cybersecurity incidents.

6.1 Cybersecurity and modern technologies

The transport and logistics industry is one of the most important branches of the modern economy and thanks to advanced technologies, it became more efficient and safer. Nevertheless, there is a great disparity in technological development and cybersecurity between the individual players in this market. Considering that only 20% of companies require their suppliers and subcontractors to apply certain cybersecurity standards [16], in all likelihood, some of them may be a potential source of risks to the entire network of links in the supply chain. It is also important to note that the industry often operates on very slim margins, which effectively demotivates owners and management boards from investing in costly security, specialist training for employees and purchasing IT services from reputable companies guaranteeing high quality. The key to success in this regard is a well-configured Supply Chain Risk Management setup. Innovative technologies can help achieve greater transparency, enabling businesses to leverage optimization potentials and, consequently, effectively maintain their supply chains.

6.2 Key security risks

The "Technological revolution. Directions in the development of the Transport-Forwarding-Logistics sector" report identifies key security risks. According to the report, companies should prioritize preparedness for [15]:

- System unavailability (WMS, TMS, EDI) or data loss;

- Ransom extortion (ransomware);

- Violation of data integrity (unauthorized changes to data, e.g. regarding payments, directions of delivery, routing);

- Disclosure of confidential information, customer or personal data;

- Cargo theft;

- Destruction of resources (e.g. as a result of interference in the operation of equipment, systems);

- Loss of reputation (e.g. as a result of exposing customers or business partners to risk in situations where a company is the source of infection).

6.3 Actions that reduce the risk of a cybersecurity breach

In addition to professional software or third-party services, there are a number of free methods that an ordinary user should use on a daily basis. First of all, users should regularly change account passwords and use strong passwords, which can be generated by an external password manager. At the same time, using browser-based password managers may not be the best idea. Moreover, users should not trust everything they click. Another good idea is using payment cards equipped with a chargeback mechanism for purchases. In addition, it is essential to update antivirus software and Windows regularly. Experts at the "Cyberattacks. How to protect yourself from them?" debate, organized by the Polish Road Transport Institute [17] admitted that "as much as 98% of successful attacks in cyberspace were carried by exploiting system vulnerabilities more than one year old".

6.4 NIS Directive

It is worth following changes in law which puts more and more emphasis on cybersecurity issues. Some regulations, such as the EU NIS Directive and the associated Act on the National Cybersecurity System, already classify the transport sector as an essential services sector, for which they define very specific requirements regarding the security of IT/OT systems and networks. The scope of such regulations will undoubtedly be expanded, and the requirements for operators of essential services will gradually increase.

7. Autonomous transport – current situation and legal conditions

The revolution ushered in by the spread of autonomous transport will open up new opportunities for the TFL industry. These include savings related to fuel and energy consumption and lower CO2 emissions, as well as eliminating shortages of specialized drivers. However, technological development also raises many doubts, especially of a legal nature.

Progress in autonomous transport depends not only on engineers and programmers responsible for preparing such machines for everyday work but also on legislators. The latter are responsible for drafting the appropriate regulations, thanks to which vehicles driven by AI will be able to coexist with vehicles controlled by human drivers

7.1 Autonomous transport – current state

Many transport companies already employ technologically innovative solutions that accelerate, improve and automate transport and deliveries. However, this autonomy is only partial or conditional. Vehicles move "autonomously" only in certain situations, and the driver relies on driving assistance systems like lane assist.

However, the pursuit of fully autonomous transport is becoming the next big thing. According to SAE International's six-level vehicle autonomy scale (Fig. 7.1), this concerns self-driving vehicles levels 4 and 5 that monitor and react to changing road conditions, even without being equipped with such elements as a steering wheel. The only "human" intervention required during such journeys involves setting the destination. Of course, this type of revolution would apply not only to small cars transporting food or helping the disabled and passenger cars, but also to trucks or rail vehicles. Current examples of autonomous vehicles from the highest levels of the SAE International scale are local, driverless taxis and Tesla's and General Motors' prototypes.

The remaining levels of the SAE International scale relate to partial or conditional autonomy. Leading automotive companies are already launching models certified at level 3 of the SAE International scale. One example is the start-up Einride, which, in collaboration with leading companies from many different industries, enables intelligent transport of goods with the assistance of an electric and autonomous fleet of trucks, freight mobility and its own charging and communication networks

Fig. 7.1 Autonomy Scale - SAE International

Current day	Steering accelerating deceleration	Monitored environments driving	Monitorowane środowiska prowadzenie	
0. No automation	👤	👤	👤	with full control drivers
1. Driver assistance	👤 🚚	👤	👤	with full control drivers
2. Partial automation	🚚	👤	👤	with full control drivers
2020				
3. Conditional automation	🚚	🚚	👤	temporarily without driver's control
4. High-level automation	🚚	🚚	🚚	temporarily without driver control
2030				
5. Full automation	🚚	🚚	🚚	out of control drivers

PITD

Source: European Commission

7.2 Is the revolution already here?

Are we ready for fully autonomous transport today? As it turns out, on account of lacking sufficient infrastructure and legal regulations, not yet entirely. Nevertheless, to keep up with the technological revolution, legislators are constantly amending legal regulations applicable to autonomous transport. One example is the amendment introduced this summer by the European Union to Regulation No. 2019/2144, which allows the automation of vehicles up to level 3, thus green lighting systems replacing the driver's control over the vehicle. These systems include signaling, steering, acceleration and braking systems to provide the vehicle with real-time information on the state of the vehicle and the surrounding area, as well as driver availability monitoring systems. The Regulation also covers event data recorders for automated vehicles, a harmonized format for the exchange of data for multi-brand vehicle platooning, and systems to provide safety information to other road users. In turn, France introduced a decree, published on 7 August in the Official Journal, implementing the new Article R. 3152-3 to the transport code, defining "remote operator rights in the context of automated road transport systems". The document defines the role and method of training persons supervising autonomous vehicles. Under the decree, control over this type of machinery will be left only to qualified staff, contributing to safe operating conditions.

Similar trials were also conducted in the United States, China and Australia, where tests of autonomous vehicles without a steering wheel and pedals have been approved on national roads. This spells excellent news for automotive companies working on level 5 autonomous technologies. These include Tesla, Mercedes, Ford, VW, BMW, Cadillac, and even tech giants Sony and Apple. In Sweden, the E4 motorway between Södertälje and Jönköping saw the first European tests of Scania's Level 4 autonomous trucks, their cargo consisting of components for the production of Scania vehicles.

In the case of Poland, although all provisions contained in Article 65k of the Road Traffic Act refer to machines that the driver can control at any time, the same article also mentions the possibility of conducting research related to testing. This, in turn, green lights trials in a safe environment, particularly when the vehicles would be used for public transport and public tasks. For this reason, several tests were also carried out in Poland: autonomous buses in 2019 and 2021 in Gdańsk, an autonomous tram in Kraków and a level 4 Renault EZ-GO passenger car in Warsaw.

7.3 Who bears responsibility?

The introduction of automatic vehicles will eliminate many hazards, such as speeding, driving under the influence of prohibited substances or ignoring road signs. However, as some tests of the first autonomous machines demonstrated, this does not mean that collisions will become a thing of the past.

There are no legal regulations on criminal and civil liability in the event of road accidents involving autonomous vehicles. It is still not known who will bear responsibility in the event of a collision: the vehicle operator, the software or GPS navigation developer, or perhaps the manufacturer. There are simply too many factors that can affect the scope of responsibility of a given party, which, in the opinion of many experts, poses an additional obstacle to the introduction of proper regulations. One example of this is the aspect of quick securing of evidence to determine criminal or civil liability, which involves downloading all data from a given autonomous vehicle, i.e. reports on the operation of the software, camera recordings or vehicle location data. Thus, in the event of a collision, technical assistance from representatives of the company which owns the given vehicle will be required, which may also hinder or delay criminal proceedings.

7.4 Autonomous vehicles and semi-trailers – technical conditions

All manufacturers appreciate the benefits of digitization. Initially, though, automotive companies focused their attention on using electronics in individual car systems. They changed their attitude once they discovered that, when integrated, information and communication technologies integrated can offer better results. This may be, for example, an increase in the technical performance of manufactured vehicles or lower fuel consumption. Other examples include solutions that increase the surface area of the driver's cabin. [15]

The systems used in the latest vehicle models are focused mainly on increasing the safety of the driver and other road users. Manufacturers introduce new solutions to help reduce fuel consumption and wear of vehicle components, extend the lifetime of a vehicle or increase the capacity of the cargo space.

Technical solutions	Electronic and IT solutions
Cameras instead of mirrors	Cameras, radars, video system – the computer connects to the steering system (facilitating maneuvering)
Drive (electric motors, hydrogen-electric motors, LNG, methyl alcohol)	Autonomous cruise control (change of gear shifting strategy based on topography)
Use of alerts	Safe distance warning (warning about obstacles in the form of a flashing light and a sound signal)
Revamped, upgraded and larger cabin area	Active headlights (selected LED high beam segments are automatically turned off when the truck approaches other vehicles)
Dashboard with digital display (Volvo FH)	Downhill cruise control (sets the maximum speed to help prevent unwanted acceleration)
Reshaping the exterior headlights and re-locating the indicators (better aerodynamics)	Adaptive Cruise Control (ACC) works across the entire speed range down to 0 km/h.
Modernization of systems	The Electronic Braking System (EBS) is required for other functions to work, i.e. the Collision Warning System with Emergency Braking and Electronic Stability Program. As an option, Active Steering is available with safety systems such as Lane Keeping Assist and Stability Assist.
Traffic sign recognition	A traffic sign recognition system that is able to detect traffic signs, such as overtaking limits, road type and speed limits.

Dipped beam	Active dipped beam – automatically turns off selected LED high beam segments. The lights are adjusted when the truck approaches other road users. The high beam is adjusted when the camera and radar detect other vehicles or when the camera detects changes in the amount of light around the truck

Own study based on [18;19]

In addition to the technological and electronic solutions of the tractors themselves, the technological revolution also extends to semi-trailers, which are becoming increasingly intelligent elements of sets.

Semi-trailer solutions	Solution description
BSIS Blind Spot Information System	By eliminating the blind spot, collisions with smaller road users are becoming easier to avoid.
Cameras monitoring cargo movement	They comprehensively monitor the interior of the semi-trailer, with particular emphasis on the movement of the load, closing the door and the presence of people inside the semi-trailer.
Cameras monitoring the movement of cargo linked to on-board telematics	Information from the cameras is transferred to the fleet management systems, enabling the traffic manager to respond and react quickly to improve safety.
Electrified semi-trailer axle	It allows for recuperating energy during braking.
Semi-trailer traction support	This function helps to accelerate the entire set in motion, as well as maintain its desired speed.

Semi-trailer ABS	Controls the skidding of a vehicle or the entire set. This improves the braking of the entire set through better grip. Eliminates semi-trailer wheel locking, offering better control of the semi-trailer and preventing jack-knifing.
RSS stabilization	A system that prevents semi-trailers from tipping over and stabilizes them in critical situations. It monitors the speed and lateral acceleration of the trailer as well as the load on the cargo to detect dangerous situations and apply the brakes automatically. [20]
Tilt alarm	It monitors the tilt of the tipper suspension and warns the driver if the ground is not level and the raised tipper could tip over.[21]
Trailer spoilers	They improve semi-trailer grip while driving. They reduce air turbulence, close automatically after slowing down to the appropriate speed (e.g. 60 km/h) and bring down fuel consumption.
Photovoltaic panels used on semi--trailers	They can power refrigeration units during the day or support engine alternators.
Electrically operated retractable roof	Electrically opened and closed, remote controlled. It improves the processes of loading and unloading a semi--trailer. [23]
Geofence ABAX technology	It allows for defining the exact boundaries of the area on the map that a given semi-trailer or equipment cannot leave. The system automatically sends notifications of the unauthorized crossing of the designated border. The transport organizer can react and control its fleet. [22]

8. Fleet and cargo security

Safety is one of the critical factors underlying the success and survival of every transport company.

According to EU estimates, fatigue is the root cause of some 10-25% of all road accidents, with one in ten professional drivers admitting that they happened to fall asleep at the wheel in other studies! Although many factors can lead to road accidents, human error underlies more than 90% of them. According to a study [24], 42% of commercial fleets are involved in an average of one to five collisions per year. For Poland, this ratio is higher at 51%, which is attributable to generally higher accident and mortality rates on Polish roads. Poland is the notorious leader when it comes to the number of fatalities in road accidents at 77 per million inhabitants, compared to Norway and the United Kingdom at 20 and 28 per million inhabitants, respectively.

Fleet managers unanimously admit (over 84% of responses) that the inappropriate driving style of drivers hurts their company, with one in two saying that they are not sure whether their drivers drive safely. Among risky driving behaviors, fleet managers are most concerned about:

Risky driving behaviors [24]

77% **phone use**

75% **fatigue**

74% **speeding and failing to obey stop signs**

73% **wearing seat belts incorrectly or not using them at all**

or smoking/eating/drinking.

Fleet companies are trying to tackle the issue of fleet driver collision in various ways, and one of the most effective methods involves using video telematics. One example of such a solution is the Webfleet Video system, which combines recordings from car cameras with telematics data about the vehicle and the driver, offering a full context of traffic events. The solution uses artificial intelligence to automatically identify risky behaviors such as driver distraction and mobile phone use, then notifies the driver with visual and audio warnings, helping them avoid dangerous situations and take corrective action.

The recordings can also be used as evidence in insurance claim proceedings, which is essential to combat fraudulent insurance claims and determine the cause of incidents quickly and accurately. The report [24] indicates that cases of fraudulent claims and false accusations are a serious problem for transport companies. As many as 65% of fleet managers are concerned that other drivers are making false claims against their vehicles, with 38% of them believing that their vehicles/employees are actually responsible for no more than 20% of reported collisions. The fight against false claims, and fast and efficient processing of claim proceedings are therefore crucial and represent a significant cost item.

8.1 Video telematics

Video telematics enables fleets to meet privacy requirements. Users can e.g. enable or disable the driver-facing camera or enable privacy mode so that event records cannot be downloaded from the device.

Investments in video telematics can lead to lower insurance costs. It is worth noting that half of the respondents in the study [24] claim that their insurance company offers lower premiums if they use telematics solutions.
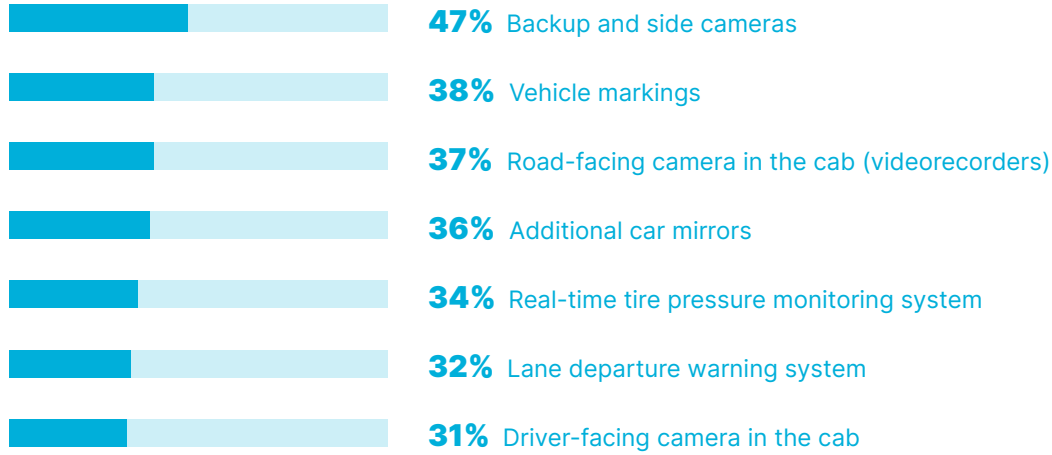
Benefits of using video telematics [25]:

- ☑ **Full insight into critical traffic incidents**

- ☑ **Improved safety – fewer accidents and dangerous incidents**

- ☑ **OProtecting drivers from false claims**

- ☑ **Lower insurance premiums and claims costs**

- ☑ **Efficient processing of compensation proceedings thanks to reliable evidence**

- ☑ **Less downtime and less driver stress in case of traffic incidents**

- ☑ **More effective training of drivers and improvements in their driving style**

Human behavior is not the only factor determining road safety. Equally important is the condition of vehicles (maintenance planning), early detection of potential failures, e.g. those related to tires (TPMS systems), professional navigation and traffic information (e.g. specially adapted for trucks), or rational planning of routes and service orders (ETA, order optimization). All these functions are available through telematics solutions and reduce stress and enhance the work of drivers, help avoid unforeseen situations and, consequently, improve safety.

In one of the surveys conducted by a telematics company, companies were asked what solutions they use most often, i.e. [25]:

47% Backup and side cameras

38% Vehicle markings

37% Road-facing camera in the cab (videorecorders)

36% Additional car mirrors

34% Real-time tire pressure monitoring system

32% Lane departure warning system

31% Driver-facing camera in the cab

Fleet safety is one thing, and cargo safety is another. Some transported loads require special conditions that must be observed throughout the duration of transport and, potentially, storage. Where the cargo requires a controlled temperature, it should be equipped with additional devices. 24-hour monitoring and controlling the temperature in the cargo hold is possible with trackers and digital thermometers. The driver sees everything on the display in the cabin, while the freight forwarding operator has a direct view of the current position of the vehicle on the map and the temperature of the transported goods. If undesirable changes or fluctuations are observed, the system can generate an alarm, and the driver and operator will receive a special notification. [26]

Summary

- **There will be no turning back from digital forwarding**
- **Cyber security will be one of the priorities**
- **63% of Polish workers believe that automation creates more opportunities than threats**
- **The forwarding profession will always be needed**
- **The freight forwarder will be relieved of repetitive tasks**
- **The future is integration and interoperability of all tools to help the forwarder:**
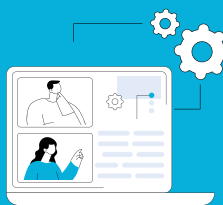
From the 12th level of tool integration we are dealing with digital forwarding
Computer, email, freight exchanges and monitoring integrated with TMS with tools optimizing the selection of vehicles/carriers for loads and suggesting the possibility of taking further available freights and a tool to propose and accept rates automatically along with full integration with carriers' and customers' systems

Digital forwarding allows:

- **automatic carrier selection**
- **automatic rate proposal**
- **determination of the most optimal route**
- **assignment of available loads to a given vehicle**
- **automatic verification of insurance**
- **automatic generation of necessary documentation**
- **digital circulation - paperless**
- **acceleration of the transport payment process**
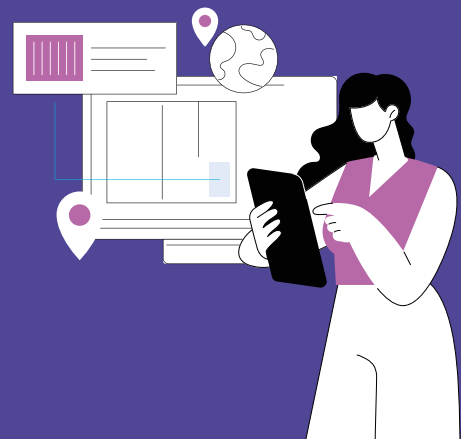
Digital shipping motivates:
One in 4 company representatives believes, that the most important indicator to the use of data cloud solutions is a cost reduction

The main factor discouraging companies:
The high cost of migrating to the data cloud

Trends in the TSL industry

- data cloud
- automation
- autonomization
- telematics
- artificial intelligence (AI)
- machine learning (ML)
- freight platforms
- system integration
- electromobility
- Digital platforms for managing finances
- E-CMR

Popular telematics solutions
- ☑ Video Telematics
- ☑ TPMS
- ☑ Ecodriving
- ☑ Lane departure warning system

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POLSKI INSTYTUT TRANSPORTU DROGOWEGO

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