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Telematics in car fleet management

Telematyka w zarządzaniu flotą samochodową

Abstract. This work describes the characteristic of telematics used in car fleet management. The main aim of the work was to show the functioning of telematics systems in car fleet management. The genesis and history of telematics were presented. Issues related to the types and functionalities of telematics systems were addressed. The benefits and risks of using the telematics system in fleet management are listed. The benefits are lower fuel costs, lower operating costs, faster delivery. Threats include concerns about employee privacy, costly system implementation, and difficulties in familiarizing employees with the new system. The above-mentioned benefits and threats show whether it is worth introducing telematics solutions in a given enterprise and what to pay attention to when choosing a telematics system. The difference in the use of telematics in the world as a result of uneven economic development of selected countries was shown. The value of the telematics market in car fleet management, which is growing every year, is presented. The study of the global vehicle telematics market penetration rate and GDP per capita showed differences in the development of the telematics market in selected countries due to uneven economic development. Most countries with higher GDP *per capita* had higher automotive telematics market penetration.

Key words: telematics, fleet management, transport

Synopsis. W artykule przedstawiono charakterystykę telematyki wykorzystywanej w zarządzaniu flotą samochodową. Głównym celem pracy było rozpoznanie funkcjonowania systemów telematycznych w zarządzaniu flotą samochodową. Przedstawiono genezę oraz historię telematyki oraz zagadnienia związane z rodzajami i funkcjonalnościami systemów telematycznych. Wymieniono korzyści i zagrożenia wynikające z korzystania z systemów telematycznych w zarządzaniu flotą samochodową, do których należą: mniejsze koszty paliwa, mniejsze koszty eksploatacji, szybsza dostawa. Zagrożenia obejmują obawy o prywatność pracowników, kosztowne wdrożenie systemu, trudności w zapoznaniu pracowników z nowym systemem. Wymienione korzyści i zagrożenia pokazują, czy warto wprowadzać rozwiązania telematyczne w danym przedsiębiorstwie i na co zwracać uwagę przy wyborze systemu telematycznego. Wskazano różnicę w zastosowaniu telematyki na świecie w wyniku nierównomiernego rozwoju gospodarczego wybranych państw. Przedstawiono wartość rynku telematyki w zarządzaniu flotą samochodową, która z roku na rok się zwiększa. Badanie wskaźnika penetracji globalnego rynku telematyki pojazdów oraz PKB *per capita* wykazało różnice w rozwoju rynku telematyki w wybranych krajach spowodowane nierównomiernym rozwojem gospodarczym. W większości kraje o wyższej wartości PKB na mieszkańca miały wyższy wskaźnik penetracji rynku telematyki samochodowej.

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Słowa kluczowe: telematyka, zarządzanie flotą, transport

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Introduction

The term “telematics” is a translation of the French word *télématique*. The term began to appear in the literature in the early 1970s. Telematics is a combination of two French words: telecommunications (fr. *télécommunications*) and informatics (fr. *informatique*). In Europe, the widespread use of the term telematics began only after the start of EU programs for the development of telematics in various fields [Rosiński 2014].

Telematics is usually defined as IT, telecommunication, information, and automatic control solutions. This term is mainly applied to electronic communication and electronic information acquisition and processing. Often the term is applied to technical solutions that use information and telecommunication systems in an integrated way [Wydro 2008].

The term telematics is usually used together with adjectives that define the field of application. Thus, we can distinguish certain areas such as urban, financial, operational, library, home, postal, medical telematics [Wydro 2008]. Telematics has developed at a very fast pace. Its origins date back to 1960. During the Cold War, the US Navy, using six satellites, managed to develop the Global Positioning System (GPS). The system was created to track submarines containing nuclear weapons. With the development of telematics, the world's first GPS satellite was launched into orbit in 1978. In the following ten years, a large number of such satellites were created and activated. In 1978, the term ‘telematics’ also appeared for the first time in a report created for the French government [The History...]. The year 1984 was a landmark in the early history of telematics. At that time, the European Parliament adopted a resolution to promote road safety. It was very important because it launched a large number of scientific studies relating to telematics [The History...]. In 1985, the world's first car navigation program was introduced to customers in the United States of America. The idea for this system came from Stanley Honey, CEO of Etak. It was a landmark achievement and marked the beginning of the large-scale use of GPS. In the 1990s, two significant trends emerged in the field of telematics. The first concerned the drive to improve the pieces of equipment that were responsible for securing vehicles. The second trend concerned the growing interest in developments in communications, electronics, mobile technology, and GPS. At the beginning of the decade, in 1990, Pioneer Electronics released the first navigation car system for consumer use. These systems used GPS satellites and CD-ROM maps to determine location [Palenchar 2014].

After some time, a directive was signed by President Clinton in 1996, which dealt with GPS and its international significance. The detente included information that citizens and companies would be able to use GPS free of charge [Antich 2017]. At the end of the 1990s, the first systems for vehicle location began to be developed. At the end of the decade, the company Data factory initiated in-vehicle, leading-edge web-based telematics interfaces. The development of telematics accelerated in the first decade of the 21st century. At that time, web-based fleet management systems were hosted on the web, and data could be seen in real-time. However, there was the disadvantage of map updates, which without broadband took half a day, while pages loaded very slowly [Antich 2013].

In 2004, TomTom introduced the world's first GPS receiver for satellite navigation. It changed the way people moved around the world. A year later, the innovative satellite began transmitting another signal to civilians. Towards the end of the decade, as a result of the global recession and subsequent financial crisis, there was an highted focus on increasing driver safety and reducing fuel consumption. In addition, a large number of different tools were developed and marketed, leading to increased efficiency and capability of fleet management systems, as well as increased driver safety. These tools included unified navigation linked to the vehicle's electronic systems, enhanced GPS navigations incorporating voice recognition, and GPS phones with Bluetooth headsets [The History...].

In 2010, smartphone applications linked to telematics were launched on the market. With these applications, fleet managers can remotely monitor vehicles and support drivers in daily administrative tasks. After 2010, telematics platforms started to offer cloud-based services with high-speed access to information. With the help of cooperation between different systems and API protocols, further opportunities were created in the telematics sector in 2014. These included, among others, the proliferation of systems connecting different devices, increasing companies' productivity, and connecting offices with the driver and the vehicle. Since 2015, companies have increasingly opted to use telematics. As a result, the telematics market value is growing at a rate of around 20–25% per year [Kilcarr 2015]. As of 2017, a large number of cars leaving factories are equipped with more than 100 sensors creating a regular stream of data [Richter 2017].

Telematics in transport offers the ability to analyze and monitor every detail of the logistics process. It helps to make proactive decisions that reduce operational costs, increase service levels, and maximize cargo and driver safety [Sharpe 2019]. The extent of the use and application of ICT (Information and Communication Technologies) in the management of transport systems applies equally to all modes of transport. Telematics solutions enable easier integration of these transport branches, influencing the creation of intermodal structures [Mikulski 2007]. Customer requirements are increasing as a result of continuous access to data via devices. More and more dynamic details are monitored, which concern every load in the truck fleet. In telematics, digitization is being pursued to make efficient use of the telematics data collected [Sharpe 2019].

The main aim of this paper was to show the functioning of telematics systems in car fleet management. The paper has the following specific objectives: to present the origins and history of telematics, to describe the types and services of telematics, to identify the benefits and risks of using telematics, to show the relationship between the degree of telematics development and the economic development of the country.

The paper sets out the following research hypothesis, according to which the use of telematics in the states studied depended on the country's level of economic development.

Materials and Methods

The area related to the use of telematics for car fleet management was selected for the study using of the purposive selection method. Sources of materials include domestic and foreign literature, articles, reports, specialist blogs, and websites. Descriptive and graphical methods were used to analyze and present the materials.

Results and discussion

Telematics functions in vehicle fleet management

An essential element of a telematics system is the placement of a monitoring device in the vehicle. The device allows, receiving, storing, and sending telematic data. When using a GPS receiver, important data is collected about the status of the vehicle and the current location of the vehicle in real-time. In-vehicle telematics also includes a trailer and asset monitoring, which is used to protect cargo under conditions of transit, condition, and location or storage. Drivers can tag the GPS location when unhitching a trailer. The coordinates are then passed on allowing this direct navigation of the selected trailer [Bazylak 2020].

The optimization of routes and tasks also helps with telematics systems. As a result of combining the experience of logistics specialists in a transport company and telematics systems, drivers can drive the fastest routes, avoiding traffic jams and obstructions. Control and efficient transport management do not require sitting in an office. The entire command center can be located on a company laptop or smartphone [Optymalizacja procesów...].

Another functionality of telematics is to ensure the safety of traffic and the car. One example is checking the driving time of a vehicle so that, based on the GPS reading, it is possible to react immediately if the driver exceeds the maximum limit of hours on the road. As a result, regulations are complied with, and the risk of overtired drivers and subsequent accidents is reduced. With the help of cooperating control devices, we can obtain such data as driving with flat tires, approaching other cars, reaching the upper limits of engine speed, sudden slowing down and acceleration, dangerous cornering, etc. As a result of cooperation with speed cameras or traffic cameras, it is possible to detect offences such as failing to stop before a "stop" sign or driving through a red light. Telematics is also helpful in checking the technical condition of the vehicle. The assessment of the technical condition of the vehicle is influenced by the analyzed data on failures and defects. An increase in the frequency of faults and breakdowns is a message to replace the parts concerned or carry out a comprehensive inspection. One of the factors indicating irregular operation of a vehicle is an irrational increase in fuel consumption. Telematics systems provide information about the operational parameters of the vehicle and remind and register mandatory periodic inspections [W jaki sposób...].

Telematics makes it possible to create a fair, legal, and motivating driver accounting system. Telematics data, combined with the experience of company logisticians, makes it possible to determine the average efficiency of the fleet. By setting a certain range of kilometers and freight, it is possible to establish a base salary for the driver. There is also the option of adding bonuses for meeting selected criteria or achieving high results in comparison with other drivers [Telematyka jako narzędzie].

The control of refueling is also one of the telematics solutions. Telematics makes it possible to indicate the specific place of refueling and automatically integrates it with the invoice. The refuelings can be verified together with the value of the respective invoice. In addition, effective fuel measurement from a fuel probe, an algorithm, and also analytics are also used. This is a guarantee of no refueling discrepancies and a small fuel discount during refueling. A fuel filler safety device is also used to protect against driver abuse [Gospodarka paliwowa].

Benefits and risks of telematics systems in fleet management

One of the benefits of telematics is the reduction in fuel costs. Fuel consumption for a selected route depends on several factors. The most important parameters influencing fuel consumption are mainly the length and number of stops, consumption while driving, and route choice. The driver's driving style also affects fuel consumption. Telematics systems can detect wasteful driving and effectively eliminate it.

Telematics solutions make it possible to effectively reduce the overuse of vehicles by continuously monitoring all parameters that are important to the fleet manager. With the implementation of telematics, maintenance and repair costs can be reduced as the driver is aware that his behavior is being recorded and therefore drives more carefully. As a result, the risk of a collision or accident and the wear and tear on the car is reduced. In addition, telematics systems send diagnostic information to the selected vehicle and signal, for example, the approaching inspection time. As a result, the fleet manager can plan the shutdown of the vehicle.

Telematics enables effective management of drivers' working time. This is crucial when it comes to scheduling the delivery of loads to their destination. The arrival time of a vehicle can be predicted concretely and irrefutably. This results in a significant reduction in delivery delays.

The use of telematics makes it possible to speed up deliveries. Very often, information about existing traffic obstructions reaches the driver too late to change the route. The data provided by telematics systems enables both the planning of optimal routes and the adaptation of the current route to the situation.

The implementation of telematics reduces administrative costs. It is possible to reduce the amount of work connected, for example, with tachographs or driver's working time accounting. Automation of such processes using telematics systems not only shortens the time in which they are performed but also affects their flawless and timely execution. Monitoring the exact time of the start and end of a journey enables better payroll management. This helps in verifying proper remuneration for hours worked and eliminates time spent on calculations and manual sheet checking.

Another advantage of implementing telematics is the improvement in driver safety. When driving, all mileage and vehicle use is recorded, resulting in drivers driving less aggressively and more carefully.

Telematics makes it possible to check driver abuse. Fuel theft and the use of company cars for private purposes are fairly common problems. Such incidents can be prevented with well-thought-out telematics solutions. Telematics systems monitor the level of fuel in the tank, the place of refueling, the frequency, and situations when the tank has been opened beyond refueling. In more advanced systems it is possible to introduce two driving modes: private driving and business driving. As a result, the fleet manager obtains information on how often the car assigned to a given employee is used for business purposes and how much time is used exclusively for private purposes.

The above-mentioned benefits will be achieved only if a telematics system is implemented that is equipped with all the necessary functions. Such a system should be comfortable and intuitive to use [Telematyka w transporcie...]. Telematics devices raise concerns about employee privacy. Constant monitoring raises concerns. Some employees may feel that their privacy is being invaded. The company should address any privacy concerns by explaining for what purpose the tracking device is being installed and how the information captured will be used [Saribardak 2019].

It can be difficult for employees to familiarise themselves with new software. Familiarisation with an unknown system can be complicated. If an employee has not used a telematics system before, it can take a long time to get used to it. A significant problem is also the implementation of the systems, which is costly. The initial cost of setting up telematics equipment can consume a significant amount of cash. Buying and installing telematics systems is an expensive undertaking. The total investment cost depends on the type of telematics system purchased [Insurancehotline.com 2013].

Telematics devices record what the vehicle does and what the driver does. There are times when drivers are forced to make decisions to avoid accidents. In these situations, there may be a need to act less safely. The device registers these actions against the driver as unsafe behavior. Telematics has many advantages, but also some disadvantages. Overall, the advantages of telematics devices outweigh the disadvantages [Insure TAXI 2016].

Automotive telematics market

The global automotive telematics market is driven by increasing demand for transportation and logistics. Figure 1 shows the global automotive telematics market penetration rate and GDP per capita in 2016.

In the United States, the penetration rate of automotive telematics in 2016 was 20%, in Italy 17%, and in Singapore 9%. In Poland, the ratio was 1% in a slow-growing market. The market in the countries with the highest penetration rate was mature. Analyzing the data presented in Figure 1, we see differences in the use of telematics in selected countries in 2016. Typically, countries with a higher per capita GDP had a higher penetration rate of automotive telematics. The exceptions to the norm were China, which had a low value of GDP per capita, and Switzerland, which had a high value of GDP *per capita*.

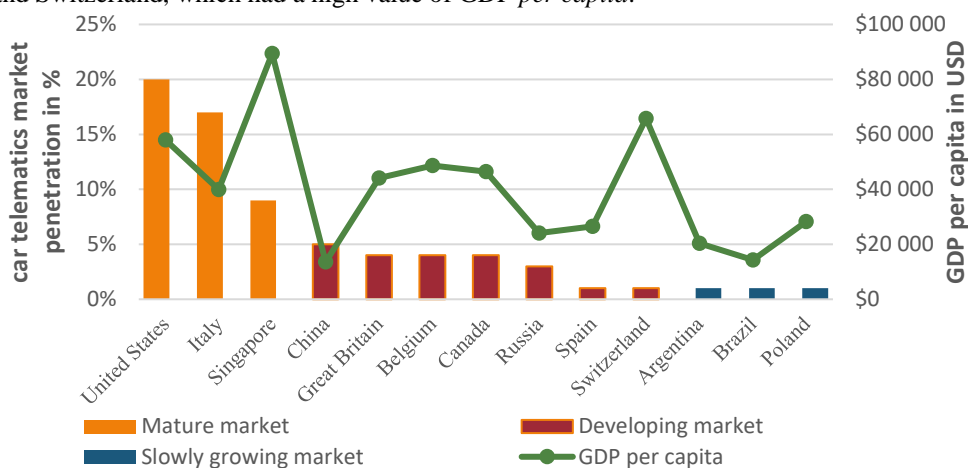


Figure 1. Global car telematics market penetration and GDP *per capita*

Rysunek 1. Współczynnik penetracji rynku telematiki samochodowej na świecie oraz PKB *per capita* na jednego mieszkańca

Source: [Dharani et al. 2018].

The global vehicle telematics market was valued at USD 115.49 billion in 2019, according to a report by Fortune Business Insights. The fleet management segment accounted for

the largest share in this market [Vehicle telematics...]. North America accounted for the largest share of the global fleet management industry in 2019. This was mainly attributed to the large-scale implementation of supportive government regulations. The Asia Pacific also occupied a significant share of the market [Business Wire 2020]. In 2018, the Indian government made it mandatory for all commercial vehicles to be equipped with tracking devices. Europe also witnessed growth in the fleet management telematics market. This was attributed to the mandatory equipping of commercial vehicles with eCall telematics systems imposed by the European Commission at the beginning of 2018 [Vehicle telematics...]. In the UK, one in three fleets used telematics in 2018, which was a good result [UK is the number...].

Increasing sales of networked vehicles, implementation of supportive government measures and regulations, and the growing popularity of telematics solutions were the major reasons behind the growth of the automotive telematics market. Difficult economic conditions, poor technological infrastructure, and low internet availability in certain regions play a key role in limiting the adoption of telematics. Most African countries have faced various economic and infrastructural challenges, which makes the use of telematics less prevalent [Telematic market...].

One trend evident in the automotive telematics market is the increasing number of collaborations and partnerships between various telematics solution providers. The global automotive telematics market is projected to be worth USD 144.47 billion by 2027 [Vehicle Telematic...]. The Asia-Pacific region is expected to account for the largest market share. The major countries expected to witness the highest growth in the market were China, Japan, and South Korea [Telematics Solutions...].

Conclusions

The aim of the study was to present the possibilities offered by the use of telematics in car fleet management. The paper presents the history of car telematics. It also defines the importance of telematics in transport. Areas of application, user needs, and possibilities of telematic transport systems are presented. Individual functions of telematics in car fleet management are covered. The functions of telematics have been discussed in detail. The benefits and risks of using telematics in car fleet management have been shown. The benefits include lower fuel costs, reduced operating costs, faster delivery. Threats include fears for employee privacy, costly system implementation, difficulties in familiarising employees with the new system. The benefits and threats listed above show whether it is worth introducing telematics solutions in a given enterprise and what to pay attention to when choosing a telematics system. However, the decision requires detailed analysis in each enterprise.

The value of the telematics market in car fleet management, which has been growing year on year, is presented. The study of the global vehicle telematics market penetration rate and GDP *per capita* has shown differences in the development of the telematics market in selected countries due to uneven economic development. For the most part, countries with a higher value of GDP per capita had a higher car telematics market penetration rate. The research hypothesis set out in the study was confirmed.

Further research may concern the application of telematics in specific enterprises. Then you can get to know the specific advantages and disadvantages of these solutions. Companies

themselves see the need for telematics, so no additional incentives are needed in this regard. Competition and the market force the use of this type of solutions.

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