The Vehicle Fleet Monitoring and Personnel Management System

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Abstract. Paper discussed the problem of monitoring of motor vehicles in Poland, there is no vehicle monitoring system in Poland at the national level. The main problem of paper was formulated as follows: What should be the structure of the Vehicle Fleet Monitoring and Personnel Management System, taking into account national and international legal regulations and existing threats?

Main hypothesis has formulated: The Vehicle Fleet Monitoring System for Vehicles and Personnel Management should ensure proper, undisturbed organization of transport, monitoring of means of transport and threats, which depends mainly on the professional competences of employees, and secondly on the technical condition of infrastructure and road fleet.

While submitting the main hypothesis to the process, detailed hypotheses were formulated:

1. Professional competences of employees are a key element of the smooth functioning of the system.
2. The technical condition of the infrastructure has a significant impact on the smooth functioning of the system.
3. Standards requirements for management and devices should include modern solutions in the field of ITS (Intelligent Transport Systems).

The basic elements of such a system should be as follows: system central, telemetry modules, locating modules installed in company cars, mobile workers' mobile terminals, secure data transmission network, specialized software, call center.

The proposed monitoring system will also be an extremely useful tool when determining the company's strategy or planning its development. Thanks to it, we can analyze what kind of vehicles or machines we can resell, which ones to buy, and which ones should be upgraded. It will also allow you to determine the processing capacity and determine what will be necessary to increase it. It will also allow for an effective and positive personnel policy for the company's operations.

Keywords: vehicle fleet, monitoring, personnel management, system.

1 Introduction

In Poland, there is currently no system to monitor the fleet of vehicles at the penalty level or even the regional level. Only bus traffic control systems operate in major cities in Poland.
Domestic and EU legal acts impose obligations on administration, inspection services and carriers in the scope of monitoring road transport.
Directive 2010/40 [2] defines monitoring areas in the scope of: optimal use of road, traffic and travel data, and continuity of ITS services related to traffic management and freight transport, ITS applications related to safety and traffic protection, vehicle connection with transport infrastructure.
The Act on the Transport of Dangerous Goods [14] sets out the rules for conducting operations in the field of domestic and international road transport of dangerous goods as well as bodies and units performing tasks related to this carriage. As part of the supervision exercised, the minister responsible for transport collects information in order to monitor events involving dangerous goods and actions taken in connection with these events, monitor the scale of violations of regulations regarding the transport of dangerous goods, and monitor the training process in the transport of dangerous goods.
The Act on the road and rail transport monitoring system [15] defines the principles of the road and rail transport monitoring system, hereinafter referred to as the "transport monitoring system", responsibility for the breach of duties related to the transport of the sending entity, the receiving entity, the carrier, the means of transport. Carriage of goods - the movement of goods on or through the territory of the country by means of transport on a public or national railway network, including stopovers required during this transfer, transhipment and unloading.
The transport monitoring system includes the collection and processing of data on the transport of goods, in particular with the use of technical means for this monitoring, the use of the ICT system and control of the implementation of obligations under the Act. Data control is carried out by: Head of the National Fiscal Administration, officers of the Customs and Tax Service, Police officers, Border Guard officers, inspectors of the Road Transport Inspection.

2 Statistics of accidents and road transport goods

There is a large number of accidents and fatalities in road transport in Poland, about 3,000 people die every year, and about 40,000 are injured - Table 1.

Table 1. Road statistics in 2016 and 2017 [12]

Description	2016	2017
Road collisions	406 622	434 688
Traffic accidents	33 664	32 705
The number killed in road accidents	3026	2810
Number of injured in road accidents	40 766	39 394

Accidents are not only tragedies of many thousands of families; they are enormous costs for the economy, exceeding 3% of Polish GDP. Poland loses over PLN 49 billion a year due to road accidents. The death of one person is a loss of over PLN 2 million, a seriously injured victim of about PLN 2.4 million - Table 2.

Table 2. Forecast of annual costs of accidents and road collisions for the years 2015-2020 [7]

Year	Annual costs of road accidents	The unit cost of a fatal victim	Unit cost of a seriously injured victim	Unit cost per victim slightly injured
2015	48 222 230 040	2 052 518	2 323 299	26 860
2016	48 550 141 204	2 066 475	2 339 097	27 043
2017	48 878 052 368	2 080 432	2 354 896	27 226
2018	49 205 963 533	2 094 389	2 370 694	27 408
2019	49 533 874 697	2 108 346	2 386 492	27 591
2020	49 861 785 861	2 122 303	2 402 291	27 774

The situation in road transport is also complicated by the fact that the dominant type of transport in the carriage of goods in Poland is road transport - Table 3.

Table 3. Cargo transportation in Poland [10]

Specification	2010	2015	2016	2017
In millions of tons	1795,6	1803,8	1837,6	2053,3
Road transport	1491,3	1505,7	1546,6	1747,2
Railway transport	234,6	224,3	222,5	239,5
Pipeline transport	56,2	54,9	54,1	52,4
Maritime transport	8,4	7,0	7,3	8,3
Inland water transport	5,1	11,9	6,2	5,8
Air Transport	0,04	0,04	0,04	0,05

A similar situation concerns the transport of dangerous goods, as evidenced by statistics, which make us realize that the risks that may occur in transport are a very important element of regional, national and international policy. This is because 88-90% of dangerous goods are transported by road and only 10-12% by rail transport.
In 2017, around 175 million tonnes [10] (around 479 thousand tonnes per day) of dangerous goods were transported in Poland, which quite often constitute a deadly threat. To transport by means of transport, which has a load capacity of 18 tons, 26 611 trucks are needed daily.
Transportation of dangerous goods causes a large number of local hazards annually [3, 11, 13]: chemical (263) and ecological (725). Among the factors causing the largest number of incidents involving dangerous goods are non-compliance with road safety rules: 104 (40%) for chemical hazards and 446 (62%) for ecological ones. Threats resulting from the way of storage and transport of dangerous goods are also dominant. Statistics on the technical condition of vehicles and tanks used for transport

indicate that the number of transport defects is 37 (14%) for chemical hazards and 78 (11%) for ecological ones.
In Poland, there are on average up to 70 road accidents in the transport of dangerous goods a year, in 2010-2015 there were a total of 456 accidents. As a result of the analysis, it should be noted that the majority of accidents are related to transport in tanks. Accidents involving tanks constitute on average about 75% of all accidents per year. This trend remains stable.
During the last 6 years 255 serious technical failures took place in road transport, including 154 failures in transport of dangerous goods, which constitutes as much as 59% of all breakdowns.
It is need to implement vehicle monitoring system, to control the work of drivers, buyers, traders, security services, etc. It is also the ability to quickly respond to changing market demands, planning and increased sense of safety.

3 Characteristics of proposed system

3.1. General requirements

The lack of a vehicle fleet monitoring system in Poland results in the creation and implementation of the system, using GPS and GSM technology, supported by a specialized software package, gives the possibility of locating vehicles and personnel in Poland and throughout Europe. Such a solution not only gives the opportunity to accurately locate the vehicle, but also allows:

- vehicle monitoring, which has a fundamental impact on road safety of these vehicles and other users,
- more efficient management of this fleet in transport companies, which has a direct impact on reducing transport costs,
- remote immobilisation of the vehicle, e.g. theft,
- acquisition of vehicle operational data,
- acquisition of metrological data prevailing on the route of vehicle movement,
- maintaining constant communication between the vehicle and the base as well as sending messages,
- in the event of a breakdown or disaster, automatic notification of the relevant crisis management centre and emergency services,
- selection of optimal routes (defining routes and the maximum deviation from them for safety reasons, i.e. traffic intensity, weather conditions and surface condition) with particular consideration of time-cost criteria.

The proposed model of the system is to be assumed as a platform for handling business and IT processes in a company or any other organization (e.g. offering communal services to communes) with a fleet of vehicles. Its functionality will include: vehicle monitoring and location, communication management, employee work control, job accounting, document management, infrastructure records, etc. It is designed to manage both mobile as well as stationary company resources and field staff. First and foremost, it will allow broadening the knowledge about the company's

own resources so as to implement the maximum effectiveness of using the owned cars, machines or devices in connection with the human resources and tasks. It will enable responding to crisis situations - and this can significantly decide about business.
Thanks to the proposed solution, the consortium will fulfil the obligation to apply European standards and national regulations, will be able to optimize business processes and reduce operating costs. The latest technology will provide increased safety, which is important especially in the transport of dangerous goods. The constant pressure of time, punctuality, the need to select optimal routes, control of efficiency and cost-effectiveness - all this makes companies constantly seek new solutions to meet growing expectations. A good solution is a monitoring system that gives you the opportunity to view the location of a given car and the status of the order. The main task that vehicle monitoring has to fulfil is the location of the fleet. But its advantages can be much greater - depending on its extension with additional functions. Additional benefits that result from the use of monitoring are: optimization of the efficiency of a given car, sealing of fuel management and prevention of abuse, control of the working time of a given vehicle and the route travelled along with stopping places. In the case of providing services to, for example, a city, such information is necessary, as each municipality allocates a certain amount to municipal services, which must be well used and, above all, settled. Without a well-functioning monitoring system, this can be very difficult.
Fuel saving is an important benefit. And it is not about such extreme cases as fuel theft. Having a monitoring system, you can first and foremost determine the most optimal route, so that the transport does not get stuck in traffic jams that are notorious on Polish roads, and control the driver's driving style.
Economical driving (eco-driving) means how to drive a car that is both eco-friendly and economical. Ecological - because it reduces the negative impact of the car on the natural environment, economical - because it allows real fuel savings. It is assumed that the savings resulting from economical driving range from 5% to even 25%. The new solution will provide the "Eco-Driving" function, which will monitor the driving style and notify you about excessive accelerations, sudden braking and excessive car speed in curves. Thanks to it, it will be possible to remotely control whether the driver has too "hard leg", i.e. for example whether the car does not burn too much fuel and if it drives safely.
An important advantage of the proposed system will therefore be an increase in safety – a monitored car is less likely to exceed the speed by the driver. If this happens, the employer could take the consequences of the employee's direction. The use of monitoring will also allow capturing inappropriate driver behaviour and recommending a proper driving style.

3.2. Professional competences of employees

The professional competence of the staff definitely affects efficient and effective management and efficiency in road transport. Competences include: knowledge, skills, experience, attitudes and behaviors as well as personal characteristics [4, 9]. Bearing in mind the issues under consideration, professional competences are a set of

abilities enabling effective work performance, achieving goals and adherence to operating standards. Competences imply the ability to transfer what people know and understand to different contexts, i.e. different aspects of work [1]. In other words, competencies can be defined as the ability to integrate knowledge, skills, and personality traits in order to achieve a successful implementation of a complex mission of the organization. Professional personnel management requires a systemic approach and should give the expected results, which is why it must be harmonized with each other.

Bearing in mind the management of road transport, it should be taken into account operators and system administrators (subsystems), entities managing these systems, stakeholders and predicted ITS users - the so-called ITS entities, including representatives: Ministry of Transport, General Directorate for National Roads and Motorways, Road Transport Inspection, Government Security Centre, Provincial Centres of Crisis Management, Police, State Fire Service, Border Guard, Customs Service, Institutions subordinate to the Voivodship, Mayors, Road Managers, (commune head, mayor, city president, provincial board), Transport companies.

The purpose of implementing a modern personnel management system is mainly to reduce costs, increase productivity and improve employee service. The system is to be a platform for handling all business and IT processes in companies. Its functionality should include: communication management, field staff work control, job accounting, inspections, warranty claims, document management, infrastructure records, device locations, etc.

A modern personnel management system should: improve the personnel and task management process, including planning, maintenance and development of employees, give the possibility of flexible changes during operation, have a modular structure, provide mobile access for all employees via, for example, an internet browser, be integrated with other IT systems used in the enterprise, ensure the security of personal data and monitor and remind about expiring dates, give a lot of freedom in defining the selection filters, fully automate the planning and settlement of working time and employee tasks.

Thanks to mobile solutions, technical staff has constant access to important information to manage service and company assets. The company's headquarters can monitor production loads, record expenses incurred and work done, as well as report on the progress of works on an ongoing basis, enabling optimization of the company's human resources utilization and directing them where they are needed.

Facilities to be serviced or visited by employees are often located in different parts of the city or even the country. Considering the high transport costs, it is important to plan the employee on the optimal route for the day. With a modern platform, these activities will be much simpler and will optimize the cost of moving employees between objects. Direct communication with employees in the field through a mobile application, visualizing the current implementation of the plan, will allow for its quick adjustments. Collecting information in the field will be facilitated by taking photos, dictating voice notes and filling in forms.

Another advantage is the ability to control the work of employees in the field. Thanks to the installed mobile application, the management staff can track the position of their vehicles and employees on an ongoing basis. The system should present points between which employees move and compare them with tasks to be performed on a given day. All tasks should be added to the system on an ongoing basis and automatically settled. Based on such information, the manager can optimally plan the work of his team. For the user of modern mobile management, there should be basically two types of applications available:

- planner / manager application,
- field employee application on a smartphone or tablet.

Manager using the available tools can manage tasks and monitor the progress of work. The current position of the employee and the status of the task will be visualized on the map with the appropriate icon and color. Support for the work of the planner/manager will enable, among others: adding tasks, setting deadlines for their implementation, tracking the progress of work. Assignment of tasks to employees should take place in manual or automatic mode. Optimization of task assignment should take parameters as: availability of resources, location of tasks and deadlines.

3.3. The technical condition of the infrastructure (TCI)

Technical condition of the infrastructure is based on the CarSpy application, developed by OM Poland. It is used to locate and monitor vehicles in order to improve the management of the car fleet, increase safety and make information available to customers of transport companies. It allows full control over the monitored vehicle. At any time from any computer you can check where the vehicle is located, how fast it travels, what route it traveled, whether the driver took the required breaks in work and what is the driving technique, or what is the level of fuel, etc. Monitoring takes place in real time , it is also possible to check the history of the vehicle. The system allows you to optimize the fleet maintenance costs.
The CarSpy application offers the presentation of information on the status and location of vehicles and the generation of reports that can be passed on to users via websites, e-mail and SMS. The devices also work like a tachograph - they count and record the course of the vehicle on an ongoing basis.
The CarSpy application enables:

- access to data from any computer and from anywhere in the world (even during holidays, being on the other hemisphere, you can control vehicles, because the solution does not require installation of any specialized software, is based on the website),
- access to basic data from a smartphone (CarSpy mobile),
- on-line monitoring of vehicles in the EU (where vehicles are currently known, real-time observation, integration with Google Street View allows virtual viewing of vehicle locations in panoramic images),
- location outside the EU on demand and control of routes traveled (in the case of traveling outside the EU, the vehicle can be located on demand, and after its return, read the travel history),

- speed control (often too fast driving means additional operating costs, but also the risk of accident and possible refusal of compensation by the insurer),
- generating reports from routes traveled (the system archives data and presents eg in the form of routes, marking stops), there is no need to create extensive daily reports, you can generate a report on a given car or all vehicles in the fleet,
- generating other reports (eg vehicle stops, daily and monthly runs, status of digital and analogue inputs, temperature, driver identification, driver's driving style)
- access to archival data,
- the ability to set your own points and user zones (you can set the coordinates of the location of our clients, stores, warehouses, etc.),
- notification about zone violations or departures from the zone (e-mail and / or SMS notification, you can control vehicles on an ongoing basis without having to "look" into the application),
- monitoring of additional vehicle circuits (using additional inputs in the device can be controlled when the alarm was activated, the door was opened, the platform was started, the aggregate was switched on, what is the temperature in the cold room, this data is available in the system, but also informed on-line by SMS / email).

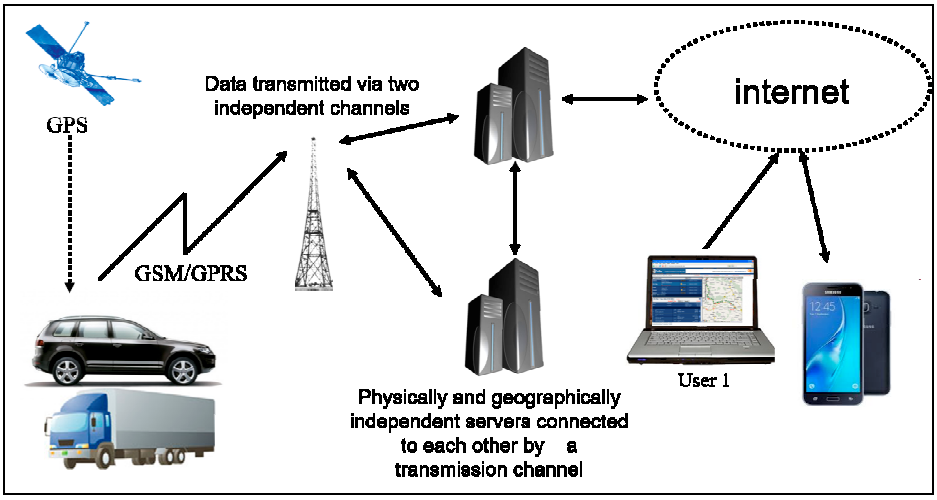

Fig. 1. Architecture of CarSpy [own study]

The "Vehicles Online" page of the CarSpy application is the main window that you enter directly after properly logging into the system. It is divided into three frames and a function selection bar – figure 2.

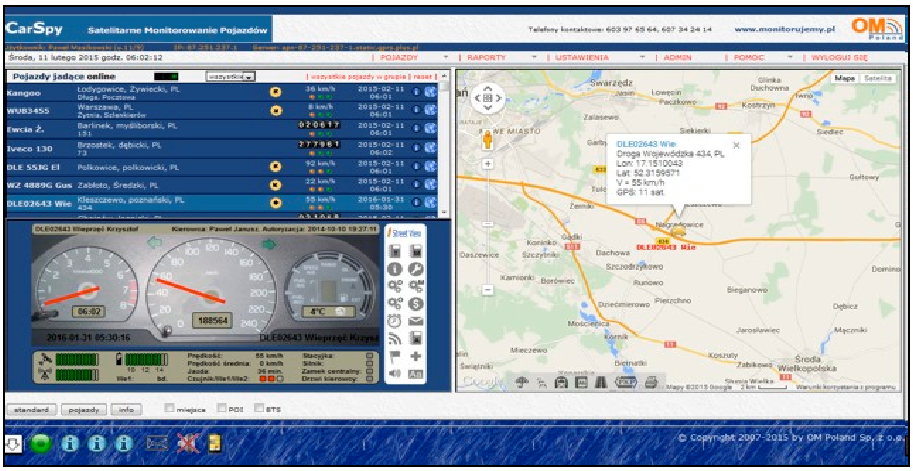

Fig. 2. Current vehicle positions - in the form of a table and visualization [own study]

The top left frame - "vehicles" - contains a list of all vehicles available for a given user. There is the date of the last report, the direction and speed of the ride, the meter's status and a description of the current location. The location information is given in the following scope: country, state, district, city, nearest streets, altitude, speed, direction of travel, nearest landmarks such as gas stations, shops, etc.
The bottom left frame - "info" - presents information about the vehicle selected in the frame "vehicles".
Right frame - "map" - always presents the current location of all user vehicles and additional information, e.g. vehicle routes, selected by clicking the icon in the "info" frame.

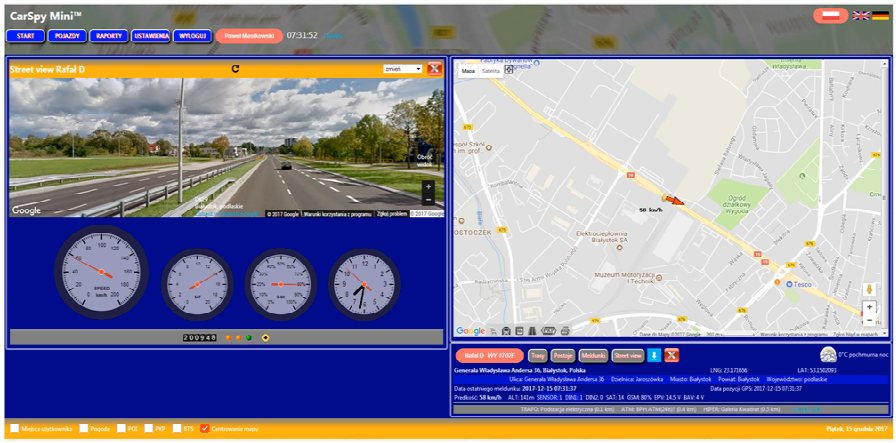

Fig. 3. Online vehicle monitoring using Google Street View [own study]

The CarSpy application is integrated with the Google Street View service. Thanks to this, you can virtually watch the location of vehicles on panoramic photos.

CarSpy gives Google Street View the geographical coordinates of the vehicle's location and the direction (angle) of the traffic, which allows the user on the website to view a view analogous to what the driver actually sees in front of the windshield.
In addition, simulation of the dashboard in the lower left window provides information about the speed, engine speed and other parameters of the monitored vehicle.

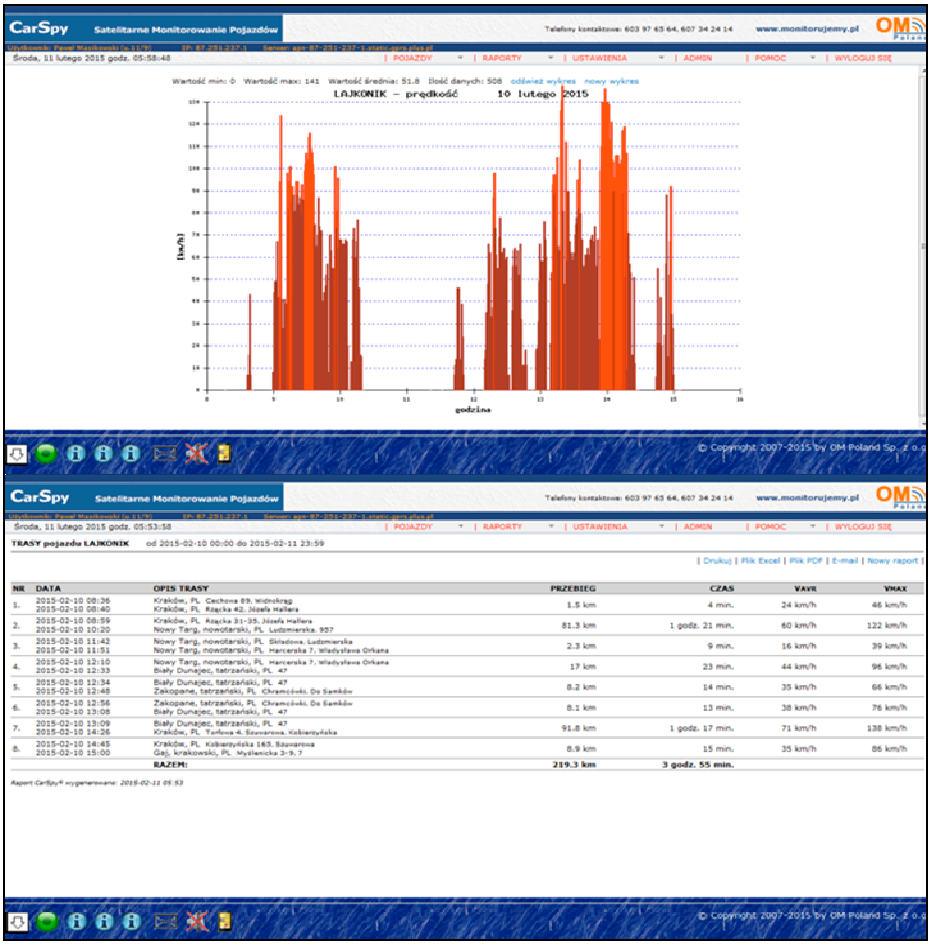

Fig. 4. Vehicle speed chart (at the top of the page) and a report of the routes traveled (at the bottom of the page) [own study]

CarSpy makes it possible to generate reports on the operation of the vehicle and present them in tabular or graphical form.
Reports can document: routes, vehicle stops, daily and monthly runs, speed as a function of time, the status of digital and analogue inputs, temperature, driver identification, driving style (eco-driving), etc.
The L110 controller is a multifunctional, very small device designed for use in the protection and management of a car fleet. It is characterized by high reliability and accuracy of measurements. The device is equipped with a GSM/GPRS

communication module and a GPS location module. It has a built-in motion sensor. The basic installation in the car requires only connection to the power supply in a place visible to the satellites.

Fig. 5. Driver L 110 [own study]

The device is equipped with 3 digital input ports, 2 digital output ports, an analogue port and 1-wire bus, to which you can connect thermometers or Dallas chip reader to identify the driver. Fuel level measurement is possible by connecting the float in the tank to the analog input of the controller. Based on the voltage being read, the amount of fuel can be remotely determined.

Its unique feature is the built-in "eco-driving" function, which monitors the driver's driving style and through our CarSpy app notifies remotely about excessive accelerations, sudden braking and excessive speed in curves. The driver can also be informed of such events via a buzzer or LED connected to the locating device in the vehicle. To activate the function, it is also necessary to connect the ignition circuit.

3.4. Standards requirements for management and devices

In the area of personnel management, it is recommended (points out) to specific standards, which concern mainly competences. There is no uniform model of standards and standards developed for all organizations. Only the indications (standards) described in ISO standards, certificates, quality and directives as well as recommendations contained in international and national regulations are specified.

In the recommendations of the European Parliament and the Council of the European Union of 18 December 2006 on key competences for lifelong learning (2006/962 / EC), the European Parliament and the Council recommend EU Member States to develop key competences for all as part of their learning strategies all my life. At the same time, there is a need to apply such norms and standards in the field of recruitment and selection, which may promote the honesty and compliance with the law of recruitment and selection, so that in all cases the best candidate for a given position is selected. Key competences - are defined in this document as a combination of knowledge, skills and attitudes appropriate to the situation. Key competences are

those that all people need for self-fulfillment and personal development, social inclusion and employment, and being an active citizen.
In the assumptions of the applicable norms of 07/10/2015, the amendment of ISO 9001 (PN-EN ISO 9001: 2015-10) appeared, where companies had until September 14, 2018 to implement those changes. It requires specific actions in the field of personnel management, only recommending compliance with certain processes and principles in human resources management. They concern significant processes in the scope of observing certain rules in acquiring, using their shaping and development of competences in order to give and provide them with an appropriate level of quality. The content of the above ISO standard specifies that employees should have appropriate competences resulting from education, training, skills and experience. However, in relation to workstations that affect their quality, the necessary competences should be determined, which must be held by employees employed on them. Each company / organization should define these competences in the scope of specific professional and qualifying groups, adapting to its specificity
The comprehensive standard of human resources and quality management is the interdisciplinary approach that reflects the concept of TQHORM (Total Quality Human Resources Management). It is a human resource management system compliant with the techniques and methods characteristic of a comprehensive approach to quality management in TQHORM modeling and design, serving to ensure the effectiveness of its implementation and operational efficiency.
This systemic approach to personnel management processes, taking into account the holistic approach, can bring tangible benefits in all areas of remedy in road transport.
The proposed system should use GPS and GSM technology for handling business and IT processes. It will enable responding to crisis situations - and this can significantly decide about business. The latest technology will provide increased safety, which is important especially in the transport of goods. The constant pressure of time, punctuality, the need to select optimal routes, control of efficiency and cost-effectiveness - all this makes companies constantly seek new solutions to meet growing expectations. A good solution is a monitoring system that gives you the opportunity to view the location of a given car and the status of the order. The main task that vehicle monitoring has to fulfil is the location of the fleet. But its advantages can be much greater - depending on its extension with additional functions. Additional benefits that result from the use of monitoring are: optimization of the efficiency of a given car, sealing of fuel management and prevention of abuse, control of the working time of a given vehicle and the route travelled along with stopping places. In the case of providing services to, for example, a city, such information is necessary, as each municipality allocates a certain amount to municipal services, which must be well used and, above all, settled. Without a well-functioning monitoring system, this can be very difficult.
System should be in line with all specifications (environmental, physical and electromagnetic compatibility) determined by EU directives and standards defined by CEN, ISO and ETSI. The main of tem are following:

- Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits;

- Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility;
- Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity;
- PN-ETS 300 135:1997/A1:1999. Radio Equipment and Systems. Angle-modulated Citizens' Band radio equipment. Technical characteristics and methods of measurement;
- PN-ETS 300 673;2005. Radio Equipment and Systems RES. Electromagnetic Compability (EMS);
- PN-ETSI EN 300 433-2 V1.1.1:2003. PN-ETSI EN 301 489-1 V1.6.1:2006. PN-ETSI EN 301 489-13 V1.2.1:2003. Electromagnetic compatibility (EMC) and Radio Spectrum Matters;
- PN-EN 60950-1:2007/A1:2011**.** Information technology equipment – Safety.

Conclusion

The development of the Fleet Monitoring System and Personnel Management can significantly contribute to:

- Filling the existing information gap between theory and practice, by supplementing knowledge about new technologies and standards in the mentioned area,
- Introduction of new solutions to the science of vehicle fleet monitoring systems, which will translate into support for Polish units and enterprises in the field of increasing the experience of scientific staff and transport managers, acquiring new skills in the areas of knowledge presented by developed in the framework of technologies project,
- Initiating the implementation of new technologies, because management in the information age requires comprehensive tools reducing uncertainty resulting from the environment and supporting the implementation of the strategy.

Professional competence of personnel (administration staff, carriers, drivers, inspection services, emergency services) relate to knowledge, experience and skills improvement by staff, which will significantly help to organize and monitor transport, meet legal and organizational requirements, control vehicle movements, detect and updating threats - procedures should be based on an integrated approach to risk.

The proper technical condition of the infrastructure will enable uninterrupted passage of vehicles on the roads throughout the country. The development of new technologies within the framework of Intelligent Transport Systems (ITS) enforces appropriate selection, proportional to the risk analysis, means of transporting dangerous goods, using devices for the transmission of messages, which should be kept in a proper technical condition. Minimizing the consequences of threats consists in coordinating the activities of all entities responsible for transport safety as well as preventing and effectively eliminating the effects of threats, as well as carrying out rescue operations.

Monitoring system should come standards requirements and be interoperable with another Intelligent Transport Systems in Poland. Interoperability is defined as the ability of ITS systems to [8]: provide information and services to other systems, use exchanged information and services to operate together effectively.

References

1. Armstrong M.: Human resource management, Economic Office, Kraków 2002. s. 244.
2. Directive 2010/40 / EU of the European Parliament and of the Council of 7 July 2010 on a framework for the deployment of intelligent transport systems in the field of road transport and interfaces with other transport modes, Official Journal of the European Union L 207/1.
3. Eurostat, http://ec.europa.eu/eurostat/statistics-explained/index.php/, [05/06/2017].
4. Filipowicz G.: Competence management. Editions Wolters Kluwer business, Warsaw 2016, s. 79.
5. Local chemical and ecological threats (MZCE) in Poland in 2007-2011, http://www.sgsp.edu.pl/uczelnia/kdrg/zrch/cw/adr_rm.pdf.
6. Michalik J. S., Gajek A., Grzegorczyk K., Gredecki S., Piękniewski M., Słomka L., Janik P., Dziewulski D., Zając S.: Causes of threats to road transport of hazardous chemicals in Poland. In: Work Safety. Science and Practice No. 10/2009. CIOP, Warsaw 2009.
7. National Road Safety Council - The cost of all road accidents in Poland in 2016 is PLN 48.2 billion, https://www.prawodrogowe.pl/informacje/statystyka/krbrd-48-2-mld-zl-to-koszt- event-road-in-2015-year, [01/01/2017].
8. Nowacki, G.: Development and Standardization of Intelligent Transport Systems. International Journal on Marine Navigation and Safety of Sea Transportation. Volume 6, Number 3. September 2012.
9. Oleksyn T.: Competence management. Theory and practice, Economic Office, Kraków 2006, s. 39.
10. Small vintage statistic. GUS, Warsaw, 2018.
11. Statistics of Fire Brigade, https://www.straz.gov.pl/panstwowa_straz_pozarna/2017, [03/09/2018].
12. Statistics of Police, http://statystyka.policja.pl/st/ruch-drogowy/76562,Wypadki-drogowe-raporty-roczne.html.
13. Statistics of Transport Technical Supervision http://www.tdt.pl/przewoz-towarow-niebezpiecznych/adr.html, [05/06/2017].
14. The Act of 19 August 2011 on the transport of dangerous goods, Dz. U. 2011, No. 227, item 1367.
15. The Act of March 9, 2017 on the road and rail transport monitoring system. Dz. U. 2017, item 708.
16. The announcement of Group on Dangerous Goods, 6.02.2017, http://www.esd-adr.pl/files/Komunikat%20z%20dnia%206.02.2017r..pdf.