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INNOVATIVE SOLUTIONS AS A MODERN DIRECTION OF THE SEA TRANSPORT DEVELOPMENT

Abstract

The aim of the article is to assess the potential of intelligent transport solutions. The article focuses on sea transport. It presents the latest trends in transport and logistics that we can expect in the coming years and describes highly advanced solutions – completed projects, as well as those in the development phase. The solutions concern both projects from the world market and the Polish market. The sources of changes and market needs were also presented and focused on the sources of financing for innovative projects. The research problem presented in the article is: is the constant and successive introduction and implementation of intelligent and innovative solutions in sea transport a contemporary and irreversible trend defining the directions of development of transport systems and their modernization on a global scale?

Keywords: sea transport, innovations, new technologies

Introduction

The transport industry is experiencing a sharp breakthrough and there is no doubt about it. Although it is not entirely clear in which direction the world of widely understood transport will go, one thing is certain – thanks to advanced technologies and concepts of large industrial concerns, we will experience real volatility in the coming years. Contemporary innovations, scientific and technical progress in the field of motorization and transport influence the increase of security of infrastructure and means of transport as well as the expansion of logistic concepts. Innovation implies favourable conditions for the proper functioning of transport. Innovations in the rapidly developing TSL sector are an inseparable element

increasing the level of management and, consequently, promoting economic cohesion by increasing the level of service quality.

1. Trends in transport and logistics

The TSL industry is undoubtedly getting stronger, from year to year introducing new technologies. Among the most important logistics trends lies widely understood automation under which the automation of warehouses and processes is hidden. An equally important and promising trend is autonomous transport and autonomous vehicles turn out to be realistic ways to reduce transport costs and increase safety. The other trends are the development of the internet model of B2B business relations, the management of large amounts of data – Big Data, and the idea of the Internet of Things, where the nodes of the network will be devices that communicate with each other without human participation¹.

2. Sources of changes and market needs

Changes are necessary for companies that want to stay in a rapidly growing market. The dynamics are subject to modification in time and quickly changing trends determine new market needs. Along with changes in technologies and life styles of societies, preferences, expectations and aspirations of transport users evolve. Transport is a process and a human plays an important role in this process, as he satisfies his needs and desires by transporting. When talking about the sources of changes, we also need to mention the transport needs that dictate these changes. The needs stem mainly from the development of the global economy, as well as the integration of the economy and society. Economic growth, growing international trade exchange and high level of foreign investments create excellent prospects for the development of the logistics services market, and thus generate demand for transport services². Transport services, on the other hand, are dictated by a human for whom quality, price and delivery time are what counts today.

3. Innovative solutions in sea transport

In sea transport, interesting and innovative solutions that are the result of technological development not only in the world, but also in Poland appear more and more often. More advanced units produced by the Polish industry create an excellent foundation for cooperation between shipyards, designers, ship owners, manufacturers of navigation systems and sea carriers. Dynamic changes are not only cooperation, but also the pursuit of ecological ships. Modern lubricants guarantee

¹ M. Malinowska, *Big Data w transporcie i logistyce*, Eurologistics 2017, 2, p. 52.

² http://www.logforum.net/vol1/issue1/no6/6_1_1_05.html (access: 26.02.2018).

safety, proper engine operation and cost reduction³. The key challenge for modern manufacturers are limits on the sulfur content and they are the direction of changes in fuel production. However, the prospect of the use of LNG-powered engines by ship owners brings financial benefits. It is planned that the production of gas in the world by 2030 is expected to double, with the development of transmission infrastructure shipping will gradually shift into ecological navigation. The ecological character of the units will consist of the introduction of partially autonomous ships with a reduced number of crew, which will reduce energy consumption and production, resulting in significant savings in the cost of maintaining the ship. Autonomous ships and solutions in maritime transport are “something” that is already happening, although current regulations need appropriate guidelines and radical changes, because technology undoubtedly overtook the legal sphere.

In cooperation with two specialized companies – TECONJA (German juice manufacturer) and LIQUA (expert in the field of packaging technology), the world’s second largest container carrier CMA CGM proposed a solution dedicated to transporting liquids in 40 – foot refrigerated containers. The system called REEFLEX allows for filling with liquids, i.e. fruit juices, milk, syrups, oils and other liquids to the designed bag, filling the container tightly. Thanks to the special properties of the bag, this technology allows filling between 12 000–24 000 liters. Filling the bag with liquid or emptying takes place thanks to the external pumping system and takes about 35 minutes. Installing the bag in the container takes only 3 minutes and does not require that during loading there is someone inside, through which the loading is safe. Each of the bags is disposable and is fully recyclable and is manufactured based on the needs of customers meeting the highest hygiene and safety requirements. The modern solution is an alternative to the current liquid transport in mass transport. Thanks to REEFLEX, from the place of loading to the destination, fruit juices, milk, oil and other liquids are kept at the optimum temperature during transport and delivery. According to CMA, CGM REEFLEX helps to maintain the nutritional and chemical properties of the product thanks to a sterile environment and controlled temperature maintained precisely in the range of -35°C to $+20^{\circ}\text{C}$ ⁴.

The first P310 ferry built in Poland on 18 May 2017 left the Crist S.A. shipyard in Gdynia. The ship is 96.35 m long and 15 m wide and 5 m high. The unit is designed to transport 90 passenger cars and 372 passengers. The ship was designed and built in accordance with the provisions of the classification society DNV GL for the class notation + 1A1 Car Ferry, B, Battery (Power) E0, Ice 1B, PET, R3; GMNKC.

³ A. Kulbacka, P. Kołoda, *Innowacje w morskich środkach transportu podnoszące jego ekologiczny charakter*, Scientific Journals 2014, 102, p. 68–73.

⁴ <https://www.cma-cgm.com/local/mexico/news/103/reeflex-the-new-cma-cgm-flexitank-solution-for-transport-of-liquids-in-40rh> (access: 22.02.2018).



Figure 1. Reflex technology

Source: <https://www.cma-cgm.com/local/mexico/news/103/reflex-the-new-cma-cgm-flexitank-solution-for-transport-of-liquids-in-40rh> (access: 22.02.2018)

It is a modern diesel-electric hybrid unit, it is equipped with three main diesel engines, two azimuth propulsors and a set of batteries. The azimuthal propulsors supplied by Rolls Royce, 900 kW – each, at 1200 rpm, provide the unit with a speed of 11 knots. Thanks to technologies adapted to unfavorable climatic conditions through the use of a system based on Siemens subassemblies with a lifetime of, among others, for 10 years, it is possible to work during low northern temperatures and in case of heavy snowfall. The ship has a set of batteries that are loaded automatically when loading and unloading the shuttle, which takes about 7 minutes.



Figure 2. Hybrid ferry Elektra

Source: <http://www.crist.com.pl/podpisanie-kontrakt-z-finferries,91,pl.html> (access: 20.02.2018)

Battery charging is supported by two independent photovoltaic installations with a total capacity of 12 kW and the entire installation is built in the front and rear wall of the superstructure and consists of 86 polycrystalline panels of the company Activesol. A highly automated unit can be operated by only a three-man crew. Support for the crew is the installation of an automatic mooring system at the marinas

in Nagu and Pargas and a battery charging system developed by Cavotec. The ferry is intended for navigation on sheltered waters, on a 1.6 km long route linking the islands of Nagu and Pargas in the Turku Archipelago⁵.

The project “Applied research in the area of navigation, control, communication and data exchange between an autonomous floating vessel and the aircraft” by the National Center for Research and Development received co-financing under Measure 4.1 of the Intelligent Development Operational Program 2014–2020 co-financed from the European Regional Development Fund, Sub-measure 4.1.4 “Applied research”. The project was given the codename AVAL-Autonomous Vessel with an Air Look. The project implementation period will cover the period from 01/06/2017 to 31/05/2020, while the project budget is PLN 10 341 336.94 and the co-financing awarded is PLN 9 272 030.64⁶.

The goal of the AVAL project is the implementation of industrial and development research, the results of which will be implemented in the technology of an autonomous sea ship. The key element of the technology is the system of innovative maritime navigation, which will also use navigation devices installed on the ship, as well as data from visual observation conducted by unmanned aircraft. The effects of the project will be used in a product based on AVAL technology, and its implementation in the maritime transport market is expected in 2021⁷.

The assumption of the program is:

- designing the technology of an autonomous sea ship cooperating with an autonomous drone;
- certification of autonomous surface vessels, drones and operators;
- development of procedures and expert opinions;
- increasing the safety of environmental users;
- risk assessment for the use of drones in the marine and offshore environment;
- transfer of knowledge and implementation of technological innovations.



Figure 3. Prototypes of AVAL technology tested on ships in 1:25 scale
Source: <http://www.aval-project.pl/> (access: 18.02.2018)

⁵ <http://www.crist.com.pl/podpisanie-kontraktu-z-finferries,91,pl.html>; <http://www.portalmorski.pl/stocznie-statki/35762-oficjalny-chrzest-promu-elektra-ze-stoczni-crist-video> (access: 20.02.2018).

⁶ <http://pb.edu.pl/archiwa/25634> (access: 15.02.2018).

⁷ <http://www.aval-project.pl/> (access: 18.02.2018).

4. Financing transport innovations

Demanding transport sector requires financing on many levels, and the main sources of transport strategies implementation are: European funds, state budget, local governments budget, private investors' funds, loans and credits, National Road Fund, National Fund for Environmental Protection and Water Management.

The potential of autonomous solutions was noticed not only by the largest producers and entrepreneurs such as Volvo, Tesla, Google, Rolls-Royce, Elon Musk, but also the European Union, through its EU programs, supports research and development in the field of intelligent transport⁸. The National Research and Development Centers, competitions and start-ups as well as university researchers come with help. The driving force leading industries to multi-million investment in the field of autonomous vehicles is not only technological development, but what's more – customer needs. Although, for now, innovations are largely focused on support, only industry 'giants' are testing full automation.

Conclusions

The concept of introducing intelligent transport vehicles has enormous potential. Innovative solutions require further development of details, ranging from the lack of conditions and legal regulations to deficiencies in the appropriate infrastructure. The breakthrough can only take place due to particular and determined actions, with the simultaneous cooperation of states and entrepreneurs. The analysis clearly shows that the revolution in intelligent and innovative solutions in transport has a global dimension and we are unable to stop it. Successive implementation and implementation of advanced solutions in road, rail and sea transport is one of many irreversible trends in logistics. The prospects are promising, but only decisive steps will help consolidate this future concept.

Despite challenges such as:

- technological capacity;
- security;
- responsibility;
- legal policy and regulations;
- high financial expenses;
- automated or fully autonomous vehicles in transport will significantly affect the future of transport and logistics.

The closest to the introduction of fully autonomous vehicles is road transport, which is also the most developing branch, making it the largest potentate for

⁸ Official Journal of the European Union L 347 Volume 56 Legislation 20/12/2013 Polish edition Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11.12.2013 laying down rules for the participation and dissemination of Horizon 2020 – the Framework Program for Research and Innovation (2014–2020) and repealing Regulation (EC) No 1906/2006 Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11.12.2013 establishing "Horizon 2020" – the framework program for research and innovation (2014–2020) and repealing Decision No. 1982/2006/EC.

the introduction of intelligent solutions. The most popular market players such as Google Car set the direction of following intelligent solutions. Competitive advantages are exerted by pressure on automotive giants who are outdoing themselves in their innovative concepts. However, before the automotive industry there is an equally important exam which is building trust among people, because evolving technical progress and legal regulations without people's trust do not matter.

Intelligent solutions also do not omit sea transport. According to marine reports, ship-related accidents happen less frequently, thanks to the systems that modern units are equipped with. Autopilots and anti-collision systems are just a prelude to the future autonomy of ships, which has its origin. Switching sea transport to the innovative development course requires involvement of several entities, i.e. public authorities, entrepreneurs, industry, research and development communities as well as transport users. Only and exclusively the creation of a new generation of infrastructure, means and transport systems will allow for the innovativeness of maritime transport branches.

The goal which is guided by innovative and intelligent transport vehicles is above all safety. The unproductive human factor will be eliminated or reduced to a minimum and the forecasts indicate that the number of accidents will fall sharply. As it is known, a computer versus a human is always a 1:0 result. The second equally important factor that appears in many debates about autonomous vehicles is the reduction of CO₂ emissions and the reduction of fuel consumption. For many years, the European Commission was looking for optimal ways to make the economy more environmentally friendly and at the same time economical. The European Union plan assumes that by 2050 the European Union should reduce greenhouse gas emissions by 80% compared to the 1990 level, and all sectors must be involved, including the transport sector. The reduction of CO₂ emissions will be achieved thanks to network-powered hybrid and electric vehicles as well as increasingly popular biofuels.

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