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AUTONOMOUS AND UNMANNED TRANSPORTATION SHIPS AS REVOLUTIONARY SOLUTIONS IN FUTURE OF TELEMATICS

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ABSTRACT

According to Eurostat, in 2015 freight maritime transportation was responsible for 51% of share in transportation of overall EU international trade, what places it as a first transportation mode in Europe. [1] This is an important trigger for engineers to develop new solutions in ships' construction, which could enhance the optimization of costs and increase efficiency of maritime transportation. The publication presents two big on-going research projects, which will define the future in ships' technologies. First one, Maritime Unmanned Navigation through Intelligence in Network (MUNIN) and second, Ship Intelligence belonging to Rolls-Royce. In the first chapters, the article says about the latest trends according to European Union strategy in terms of maritime transportation. The third and the fourth chapter present both of the research projects in their current state. At the end, the author analyzes and compares both projects providing an overview how it meets the strategy for the future of cargo transportation in Europe, indicating the most important features.

KEYWORDS

Maritime Transportation, Telematics, Intelligent Ships, Autonomous Ships, Sustainable Transport

INTRODUCTION

The world of transportation observes a breakthrough as autonomous vehicles including autonomous subways, drones or autonomous cars are becoming now more popular in well-developed countries. One of the definitions says that an autonomous vehicle is *"A motor vehicle equipped with autonomous technology. . . . 'Autonomous technology 'Means which technology is installed on a motor vehicle and which has the capability to drive the motor vehicle without the active control or monitoring of a human operator."* [2] This means that drivers can be soon replaced by technology. Moreover, there are probes to create autonomous airplanes [3]. So far the world knows unnamed vehicles called drones, which be used in different industries and thus different purposes. Currently, there are two big research projects in European Union, which aim to replace a human work performed on ships in order to design autonomous ships. Maritime Unmanned Navigation through Intelligence in Networks is the European Union Commission project, which aims to revolutionize transportation ships with making decisions automatically without a crew onboard. Another, very promising research project is carried out by a British company Rolls-Royce. Ships Intelligence, similarly to MUNIN is s project, which aims to design a ship, which will be equipped with a technology, enabling to use a vehicle with a limited demand of a human work onboard. Both projects have a big potential to impact the world of telematics in a sea trade. Autonomous and unmanned ship as a very innovative solution, it can bring meaningful changes in economic and technological aspects of overall international trade.

1. EUROPEAN UNION STRATEGY FOR MARITIME CARGO TRANSPORTATION

1.1. ECONOMIC SITUATION OF MARITIME CARGO TRANSPORTATION

During World Maritime Day in September 2016, Eurostat released the newest statistics which present that maritime transportation had the biggest share in an international trade in European Union in 2015 out of other means of transportation. The value of a trade with non-European goods was close to 177 billion Euro, what in more details stands for 53% of EU imports from non-European countries and 48% of EU exports outside of European Union. [4] As of 2016, in Europe there were 23 big seaports, which were responsible for trading over three quarters of overall cargo trade between European Union and non-member countries. What is more, in 2013 it contributed with up to 147 billion of European Union's GDP. [5] Estimations provided by The Blue Growth say that by 2020 Gross Value Added will increase in European Union to 590 billion Euro thanks to the sea trade. [6] This means that maritime transportation has and will have a big contribution to an international trade of European Union.

1.2. TYPES OF TRANSPORTATION SHIPS USED IN EUROPEAN UNION INTERNATIONAL TRADE

Transportation of goods can be realized by different types of ships depending on a type of a cargo being shipped. Figure 1 presents the most popular transportation ships, which were present in European Union ports in 2015.

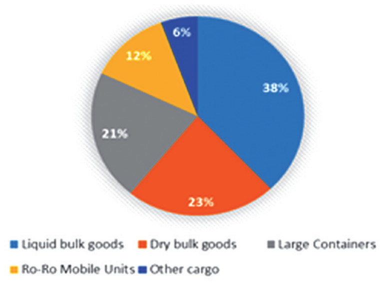

Fig. 1. Share of overall gross weight of seaborne goods transported by ships in terms of its type in European Union in 2015 Source: [7]

According to the Eurostat, in 2015 the biggest share in overall gross weight of seaborne goods handled in main ports in European Union belongs to liquid bulk goods delivered by tankers. The construction of tankers allows it to deliver goods including oil, gases and chemicals. The second biggest share, about 23%, belongs to dry bulk goods. Dry bulks carry mostly coal, grain or other goods in a loose form. This means that such goods do not have to be packed. What is more, dry bulks are able to carry up to 400 000 metric tons of deadweight. Large containers are also one of the most popular ships for transportation in main European ports. Such ships are ideal for intermodal transportations. Intermodal transportation includes at least two types of vehicles which transport the goods in containers: trucks, ships or trains. Therefore, this is the most efficient way of transporting the goods from one exact location to another. The lower share of gross weight of seaborne goods belongs to Ro-Ro Mobile units. Ro-Ro, which is an abbreviation to Roll-on/Roll-off, is a ship designed to transport another vehicles including cars, trucks, semi-trailer trucks or railroad cars. The construction of Ro-Ro ship enables to transport the vessels on a special platform, where they are parked on their own wheels or on a self-propelled modular transporter.

1.3. REDUCTION OF HARMFUL EMISSIONS OF GREEN GASSES TO THE ATMOSPHERE

The study conducted by International Maritime Organization in 2014, shows that maritime transportation is responsible for 2,5% of global greenhouse gas emissions. The number is predicted to increase even to 50% by 2050, what would affect in a negative way the concept of sustainable transport. Commission's' White Paper from 2011 says about a goal of reduction at least 40% emissions of green gases from 2005 to 2050. Therefore, in 2013, European Commission has released a report, which points out that it has taken a first step to reduce emission of greenhouse gases to the atmosphere produced by ships. Therefore, in April 2015 the MRV regulation was adopted, which will be implemented from 1st January 2018. [8] It will monitor the emissions of gases and fuel consumption in European Union by receiving reports from the ship owners of large ships, who use EU ports in order to control if they do not overproduce the harmful gases to the atmosphere. Apart from the regulation, European Commission points out, that a very important contribution to the reduction of green gases can be achieved by innovation technologies. Given the big number of predicted emissions, the innovative technologies might be crucial in order to protect future marine environment. Table 1. placed below indicates five types of fuel used in maritime transportation.

Table 1. Typical fuel types used in ships.

Fuel type	Explanation
HFO	Heavy Fuel Oil
MDO	Marine Diesel Oil
IFO	Intermediate Fuel Oil
MFO	Medium Fuel Oil
MGO	Marine Gas Oil

Source: [9]

Every kind of fuel has different chemical ingredients and therefore different prices. The most popular marine fuel is HFO, which has the lowest prices, but at the same time causes significant harm to environment. Therefore, IMO points out that Marine Gas Oil should have a growing trend in future due to its eco-friendliness. It emits 35 times less of sulfur to the atmosphere than HFO. From 2020, ships going outside of ECAs will have to use MGO with allowance of emission up to 5000 sulfur parts per million.

1.4. SAFETY OF MARINE ENVIRONMENT

An important aspect in European Commission policy is provide the safety of sea trade. Therefore, there are special safety Conventions including International Convention for the Safety of Life at Sea (SOLAS) [10] SOLAS is an international convention, which was adopted in 1974 by International Marine Organisation. It says about the protection of ships by providing the same regulations and documentation for the ships all over the world.

Apart from that, European Commission adopted in 2014 European Union Maritime Strategy, which shows the policy of EU of protecting maritime transportation. [11] It includes a comprehensive legal framework, which enhances and promotes a security of ships in European Union.

Such regulations aim to ensure a comfortable and safe international trade which takes place on seas. However, in 2015 there were 306 piracy attacks all over the world. The most popular location of piracy attacks was noticed in South-East Asia and Indian Subcontinent and on West Africa seas. Analysis of a sea piracy in Southeast Asia shows that out of all cases of 100 piracy attacks, 53% belong to the actual thefts. The fact is that number of piracy attacks decreased about 24% from 2014. Nonetheless, sea piracy is still a big threat to international sea trade as the value of carried goods by ships is meaningful, so it can lead to significant financial loses.

Therefore, apart from strict law regulations there should be technologies, which would discourage thefts from attacking the ships.

2. MARITIME UNMANNED NAVIGATION THROUGH INTELLIGENCE IN NETWORK

3.1. OVERVIEW OF THE MUNIN PROJECT

The project MUNIN has been started by the European Commission in 2012 by presenting the first publication *Developments Towards the Unmanned Ship* during an international conference held in Hamburg. The research project aims to design a technology for a ship, which would not require a crew on a board. A responsibility of managing a ship would be provided with technologies implemented into a ship construction. Such ship would be equipped with special sensors, which would enable to navigate a vehicle by detecting any problems automatically during a vogue. The official definition of a new type of a ship provided on MUNIN website on Internet says about two main characteristics of the vehicle [12]:

- *the remote ship where the tasks of operating the ship are performed via a remote control mechanism e.g. by a shore based human operator and*
- *the automated ship where advanced decision support systems on board undertake all the operational decisions independently without intervention of a human operator*

The deadline for realization of the project was set up for 2015, however, at the end the final outcomes came out at the beginning of 2016. The budget for the project stands for 3.8 million Euro, whereas European Commission contributed to it with 2.9 million Euro. [13]

MUNIN aims to develop the new technologies in a dry bulk, which is currently the most popular vessel in European Union international trade. Innovativeness linked with safety, cost saving and environmental friendliness are the main characteristic features when it comes to defining the goals of the MUNIN project.

3.1. TECHNOLOGY DESIGNED TO PROVIDE A SMART SHIP NAVIGATION

The heart of the MUNIN project lies in its modern technology. The modular system designed by European researchers enables to control a ship in a very comprehensive way. Figure 2 presents the new technologies, which were design and equipped in a MUIN bulk.

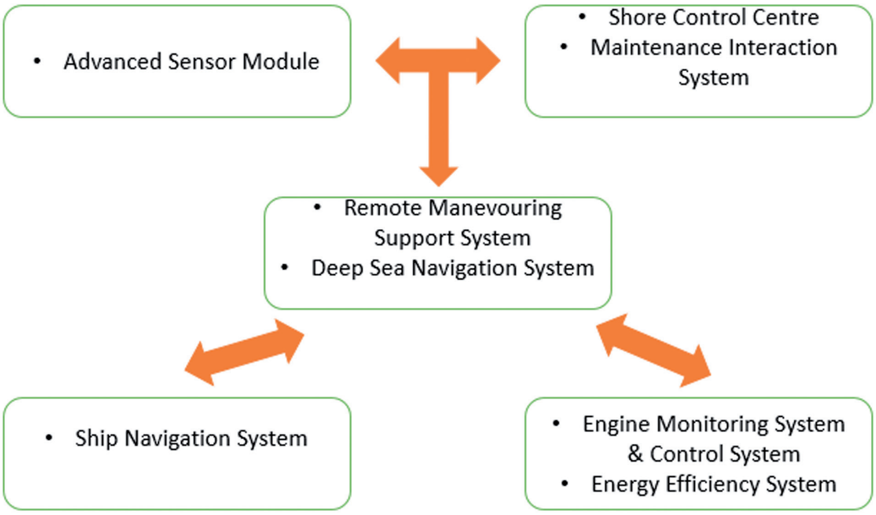

Fig. 2. System of technologies designed in MUNIN.

Source: [14]

Advanced Sensor Modul is the core technology of a designed ship, which is responsible for tracking a bulk and cargo without need of a crew onboard. The camera installed on a bulk, synchronized with a radar and AIS data (Automatic Identification System) enables to detect if a bulk is in any danger during its vogue. The sensor sees objects, which are on a way of a ship and determine if there is a need to take an action. Moreover, the sensor finds the location and environmental conditions around a bulk and thanks to that the system creates a map with all details. The Advanced Sensor Modul sends gathered information to the Deep Sea Navigation System and Shore Control Centre. The Deep Sea Navigation System is responsible for navigating a ship into a right direction taking into account weather and traffic conditions. Therefore, it ensures the safety of a ship and optimizes its routes. It also plans the whole routes to make it the most efficient way. The Deep Sea Navigation System is able to work autonomously in order to navigate a bulk, but it also communicates to the Shore Control Centre in case when there is a reason to navigate a ship remotely. During a voyage, when a vessel is managed in a unmanned way, it is very important to have a technology, which can calculate the algorithms for performing maneuvers on a sea. The Remote Maneuvering Support System provides predictions of motions and change the position of a bulk or avoid any difficulties occurring on waters. The Engine Monitoring and Control System prevents a bulk from any problems, which might occur during the sea voyage by detecting technical

problems. For instance, it is able to detect broken, missing or burned parts of a ship. The Maintenance Interaction System has a very important responsibility, meaning, it extends the monitoring of a bulk and condition of aggregation functions to optimize the communication by satellites, which are linked with the Shore Control System. The Shore Control System is a station, where the specialists are monitoring and controlling a bulk by screening al information provided by a satellite and cameras on a ship. Engineers located in the station make decisions regarding the proper maintenance and navigation of a ship, when the automated systems are not able to do so. Apart from that, the Shore Control System provides VTS reporting (Vessel Traffic Service) in order to determine conditions of a vehicle and VHF (Very High Frequency) communication. When the commands from the Shore Control System need to be executed, the ship system changes it to the remote work. The Energy Efficiency System is a crucial element for cost-saving in terms of the fuel usage. It controls the demands for fuel so there is only a flow of energy, which is needed in a particular moment. What is more, the Energy Efficiency System uses a waste heat recovery in order to additionally find some extra sources of the power. The complexity of all eight elements, which ensure an unmanned management of a ship, are equipped with a high technology in order to provide a smooth cooperation between them. Therefore, it can lead to the most efficient and optimized usage of a sea vehicle.
The process of making decisions starts with automatic detection of a problem by technologies of a bulk. Then, the problem should be solved autonomously unless it's impossible due to the more complicated issue. In order to decide upon, the information about the problem is sent to the Shore Control Station. In case of a serious matter, the problem is being solved by remotely. Figure 3 shows the process of making right decisions designed by MUNIN researchers.

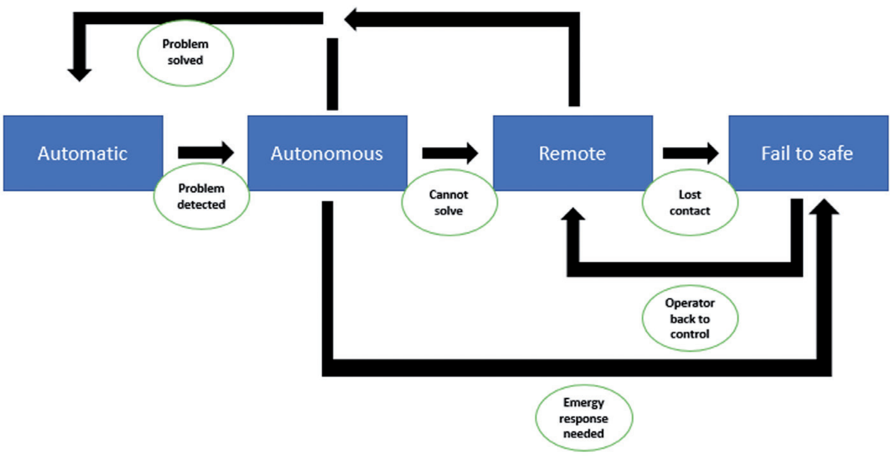

Fig. 3. Decision making system by Maritime Unmanned Navigation through Intelligence in Network.

Source: [15]

Basically, the most preferred situation is that a bulker makes a decision itself basing on a system's knowledge, meaning an autonomous reaction. However, in case of more complicated issue the decision has to be made by an operator placed in the Shore Control Center. All the steps are designed in a way that at the end of providing a better performance of a ship on the seas a human work is needed.

MUNIN did first analyses in terms of costs saving for a designed dry bulker. Accordingly to their estimations, by using HFO as a main fuel type, the costs would be saved about 2.8 million USD thanks to more efficient maintenance of a ship during a vogue. The biggest share in cost saving would stand for reduction of a crew for about 7.5 million USD. This is a big saving, the station centers from where ships would be managed remotely would involve only 2.8 million USD. Additional costs would be related to building of new facilities for 3.4. million USD. At the same time a bulker would save 2.8 million USD thanks to better management of fuel consumption. Altogether, MUNIN predicts that the financial outcomes of the project would save 7 million USD. Such saving brings a significant positive change for maritime transportation increasing its attractiveness.

3. ROLLS-ROYCE WITH THE IDEA OF SHIP INTELLIGENCE

3.1. ROLLS-ROYCE AS A FUTURE CREATOR OF UNMANNED AND AUTONOMOUS SHIPS

The British company Rolls-Royce was found in 1884 by a businessman Henry Royce. The company was selling car parts of electronics and mechanics. Few years later, in 1904, another businessman Charles Rolls joined to the company. From that time Rolls-Royce started manufacturing cars. Through next years, the company was increasing their occupation. After cars, they started manufacturing engines to airplanes, airplanes itself, aero engines and also ships.

The idea of designing the technologies for autonomous and unmanned ships were started by Rolls-Royce already in 2005. Ship Intelligence is a research project of creating an autonomous and unmanned ship, which is going to be fully implemented by 2035. The overall costs of the project are high, it stands for 6.6 million Euro and it is funded by Finnish Funding Agency for Technology and Innovation. Finnish leading universities will design and develop the idea of Ships Intelligence by realizing the project - Advanced Autonomous Waterbone Applications. The research project started in 2015 and it run till the end of 2018, after which the implications will be put onto real ships in order to test them out.

The idea is focused on a usage of Big Data, which can help to measure, analyze and provide scalable results for making right decisions for a sea cargo vessel during its vogue. During international conference hold in London, November 2016 Rolls-Royce defined Ships Intelligence as consisting of three concepts altogether: Health Management Solution, Optimasation & Decision Support and Remote and Autonomous Operations. Rolls-Royce emphasizes shipping as a very important part of intermodal transportation.

Figure 4 shows the timeline which includes all steps in the research project which starts with the idea of the concept and at the end aims to implement to the market autonomous and unmanned ships.

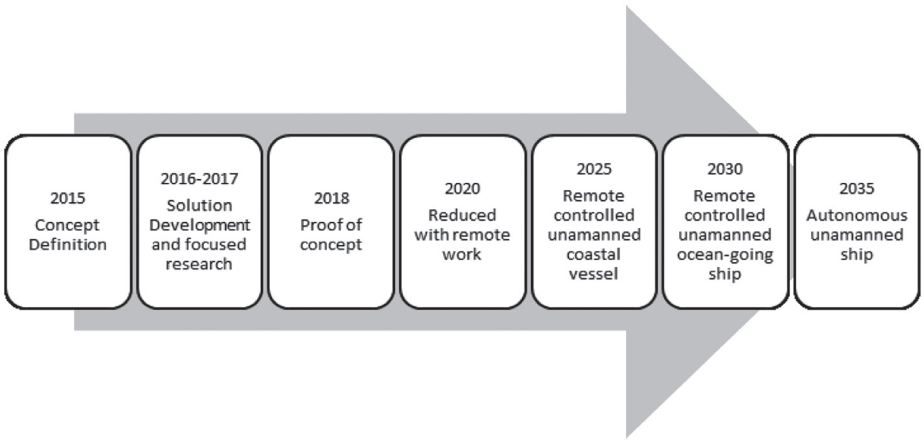

Fig. 4. A timeline of implementation o ships by Rolls-Royce.

Source: [16]

According to the information provided by Rolls-Royce, the concept of designing a new ship is divided into separate phases, which will develop the idea in a more and more advanced way. In the first phase in 2020, the company would like to focus on reducing a crew onboard which would support and operate certain functions. It would show how the first implementations can work with human work on-site but at the same time implementing remotely operated local vessels. In next 5 years coastal vessels would be equipped with technologies which would allow for an unmanned control. However, by 2035 the ships would be fully automatized with independence with no requirement of a crew onboard. What is interesting, Rolls-Royce wants to use the autonomous ships on a different types beginning with local vessels going to larger container ships. Figure 4. presents the prototype of a future autonomous ship designed by reseachers.

Fig. 5. Future autonomous transportation ship designed by Rolls-Royce.

Source: [17]

The design enables to easily notice significant changes in a construction of an autonomous ship. First of all, no need of cabins for a crew members leads to possibility of loading more containers what is a huge economic benefit for cargo companies. However, since Rolls-Royce aims to implement new technologies into different ship types, the maximum capacity for a cargo may differ regarding the type of a vessel.

3.2. THE TECHNOLOGIES DESIGNED AS SHIP INTELLIGENCE

The technology in a future unmanned and autonomous ship in project od Rolls-Royce will depend on a so-called Big Data. The Big Data recorded by technologies of a ship would be harnessed through Equipment Health Management. The Equipment Health Management (EHM) is a tool used in Rolls-Royce since 1970 in the construction of aircrafts. EHM analyzes the data regarding the position, speed and fuel consumption of a ship in order to manage the vessel without any mistakes. The data which include also information regarding: vibration, oil monitoring, environmental conditions, temperature and pressure. Altogether, EHM will allow to make appropriate decisions autonomously. *"A ship's ability to monitor its own health, establish and communicate what is around it and make decisions based on that information is vital to the development of autonomous operations."* [18] Therefore, Advanced Autonomous Waterbone Application Initiative will create special algorithms for a ship to use the data gathered from visual cameras, a thermal imagining and from LIDAR devices. LIDAR (Light Detection and Ranging) will deliver information about the wind conditions on and off-shore. Apart from EHM, Rolls-Royce works also on a system called Energy Management (EM). The Energy Management would be responsible for an analysis and for reporting about fuel consumption. However, there would be always specialists placed in a special building on-shore called Control Center. In case of particular situations when the ship is not capable to make autonomous decisions.
Additionally, a ship would be equipped with Autonomous Navigation System (ANS), which will enable to plan the whole route by choosing an optimal way. ANS would be connected with Global Navigation Satellite System which would be finding a position of a ship. The ship will record an original plan of the voyage so it can later follow the right way, however, in case of sudden occurrences the operator will be responsible for handling the maneuvers.
The same logic relates to maneuvers performed by a ship which, would be possible in two ways, autonomously as well as by an operator placed in the Control Center. Additionally, the new technology would also enable to park a ship by an automatic docking. A ship would be equipped with sensors, which would cooperate with special sensors placed at a harbor. The wireless connection between two of them: a ship and a port would enable to park a vessel with an avoidance of a collision.

4. ANALYSIS OF FUTURE OF AUTONOMOUS AND UNMANNED SHIPS

4.1. BENEFITS OF MUNIN AND SHIPS INTELLIGENCE PROJECTS

The analysis of both projects present main benefits which they bring to the new technologies taking into account similarities and differences between them. Either MUNIN as well as Ship Intelligence are going to revolutionize the world of maritime transportation and telematics. However, given the perspective of European Union goals it is crucial to fit to the trends which are seen in the trades as well as regulations requirements. MUNIN as a research project with establishing the construction was already finished by 31st of August 2015. Currently, there is a time for testing the ideas in the reality what will be happening on Norwegian seas. When it comes to the Ships Intelligence, the project will be finalized by 2017, when there should be first autonomous ships on European seas. Nevertheless, in both cases it is possible to analyze the outcomes of bringing out autonomous and unmanned ships to the reality. Table 2. presents main similarities of MUNIN and Ship Intelligence projects.

Table 2. Similarities of unmanned and autonomous ships in comparison - MUNIN to Ship Intelligence.

No.	Similarity	Additional comments	
		MUNIN	**Ship Intelligence**
1	**Safety of ship and of transported cargo**	Cameras, radars, Automatic Identification System Shore Control System	Visual cameras, thermal imaging, LIDAR, Control Center
2	**High technology allowing for autonomous voyages**	Advanced Sensor Modul, Remote Maneuvering Support System, Maintenance Interaction System	Health Management Solution, Optimasation & Decision Support and Remote and Autonomous Operations, Autonomous Navigation System
3	**Costs-saving**	Reduction of maritime costs about 7 million USD	No costs of crew onboard, fuel cost reduction
4	**Improved efficiency of a vessel**	Energy Efficiency System using waste heat recovery in order to find some extra sources of power	Lower power demand, lower weight of a container ship:700-1000 ton
5	**More space of a transported cargo**	No hotel, no deck house	No hotel, no deck house
6	**Need for new law regulations in order to adapt autonomous and unmanned ships, new regulations for cybersecurity**	Cooperation with IMO	Cooperation with IMO
7	**Need of building new facilities, where operators can control remotely the work of a ship what creates additional costs**	Control Shore Station	Control Center
8	**Increase of meaning of intermodal transportation by centralizing decision making process**	Control Shore Station controls all ships from one location by connection with satellite	Control Center controls all ships from one location by connection with satellite

[Own study]

Table 2. includes 6 important benefits, which will influence on a better performance in maritime transportation. The safety of ships will be improved through technologies which will handle the operations of a sea vessel. Moreover, ships will be equipped with cameras and radars what can detract sea pirates from attacking the ships. In case of both projects, the safety will be also provided by high technologies. The cyber safety will be crucial for providing undisturbed work of technologies, protecting from hackers who could get onto the ship systems. The systems will be enable vessels to make maneuvers of a ship and react efficiently to any situation on the sea. However, the control and monitoring by humans will still remain an important feature. Both projects require special stations: Shore Control System and Control Centre, where specialists will control the ship and take actions in case of particular situations. Those stations will also lead to the huge finance involvement. The stations have to be capable to have a connection with satellites, the ship and with a control unit in order to ensure the communication and ease of decision making. After building such facility the costs will be only hidden in maintaining them. The aim is that one station would be capable to manage all ships being in a vouge. Moreover, the stations can be placed in different locations and a big advantage of it can be provided by the fact, that huge logistic centers can centralize the management of intermodal transportations in a more efficient way. One intermodal

transportation process could be managed from one decision making center what would simplify and improve the management part of supply chains.
However, both designs of autonomous ships will implicate a need of new law regulations needed to be implemented by IMO an accepted in all the ports where such ships would be connected with. Moreover, this will be a trigger to create regulations for cyber security. Thefts might be interested not into attacking like it is now ships in a way how it is now, but by attacking IT systems of autonomous ships in order to take over control of a vessel. In case of both ships there will be a change of managing the vessel the difference lie in the systems which will be having different parts and however, the process of decision making will have the same logic of reacting to the situations by programmes implicated to the ships and if it is not sufficient – by operators in control units.

5.2. DIFFERENCES BETWEEN MUNIN AND SHIP INTELLIGENCE

Despite of the fact that both research projects have the same goal, there are also features, which might differentiate them in few ways. Table 3. presents the main differences between MUNIN and Ship Intelligence of Rolls-Royce.

Table 3. Differences of unmanned and autonomous ships in comparison MUNIN to Ship Intelligence.

No.	**Difference**	**Additional comments**	
		MUNIN	**Ship Intelligence**
1	**Application**	Dry bulker	Application to different types of ships.
2	**Budget of a project**	3.9 million Euro	6.6. million Euro
3	**Timeframe of finishing the project**	Designing the technologies for a dry bulker till 2016	Timeline divided into 4 phases, research project predicted to be done by 2018

[Own study]

In case of project MUNIN the application of technologies will be possible only for a dry bulk cargo. The research group was designing the technologies adequately to a dry bulk construction. Therefore, it means that the project has limited use of technologies considering only one type of a ship. This means that Ships Intelligence will have a dominance due to different applications regarding the ship type including even passenger ships. The timeline of Ships Intelligence has therefore a longer period.
The budgets of the projects also differ from each other. Researchers from universities involved in project MUNIN with European Commission decided to invest 3.9 million Euro which is less than in case of Ship Intelligence, where the amount stands for 6.6. million Euro. The matter of fact is that MUNIN aims to develop the idea for one type of a ship and Rolls-Royce wants to implement the technologies into different vessels during a longer time.
The advantage of MUNIN lies in the time where they will be able to introduce the ship. This allow first companies to try the idea and see the benefits which it brings as well as risks which might occur. Faster implementation can also bring information from the real usage of new ships and therefore it can enable reaction of the researchers to improve what is important.
Additionally, MUNIN decided to use HFO as a main fuel for ships what is not in accordance with strategy of IMO which suggest to use more eco-friendly fuels like Marin gas oil. This might be a risk because if the ships will find a trust in sea trade companies there will be still a need to decrease the usage of HFO fuel

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CONCLUSION

Given that maritime transportation is currently one of the most important means of transportation in European Union, new solutions in ships' construction are crucial in order to provide a better and more sustainable process of transporting the goods. Both research projects: MUNIN and Ship Intelligence aim to design a futuristic cargo ship, which will limit a human work for replacing it with automatic and autonomous decision making as well as with remote control of vessels on the seas. However, the risk lies in the need of complex new regulations for cyber security. It also creates new costs of building control stations as well as new costs of a building ships from the beginning and adaptation of those to the existing ports. Apart from that, since the crew would be excluded from ships it will change the way of their work since most of engineers will be needed in the control units what might also implicate the bigger costs. MUNIN who will, according to the regulations have first insight into reality of bigger bulk since it focuses on those. On the other hand Rolls-Royce can see different adaptations of autonomous ships due to different sizes and also passenger ships, therefore, it can imply more complex regulations and thus more processes for making the autonomous and unamanned ships to be used in international vouges.

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AUTONOMICZNE I BEZZAŁOGOWE STATKI TRANSPORTOWE JAKO INNOWACYJNE PRZYSZŁOŚCIOWE ROZWIĄZANIA TELEMATYCZNE

STRESZCZENIE

Obecnie obserwuje się wzrost znaczenia transportu morskiego. Według badań przeprowadzonych przez Eurostat, w 2015 transport ładunków drogą morską posiadał 51% z ogólnego podziału na środki transportowe dla ładunków, co oznacza, iż transport morski cargo jest drugim środkiem transportu w Europie. Fakt ten jest istotny dla inżynierów, aby wprowadzać nowe rozwiązania w konstrukcji statków morskich, które mogłyby zoptymalizować koszty oraz zwiększyć efektywność transportu morskiego. Publikacja prezentuje dwa duże projekty, które mogą zadecydować o przyszłości konstrukcji i technologii statków morskich: europejski projekt Morska Bezzałogowa Nawigacja poprzez Inteligencję w Sieci (MUNIN) oraz Inteligentne Statki wdrażane przez brytyjską firmę Rolls-Royce.

SŁOWA KLUCZOWE

transport morski, telematyka, inteligentne statki, statki autonomiczne, transport zrównoważony