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ENERGY SECURITY MANAGEMENT SYSTEM IN SMALL PORTS

Michał Igielski

Abstract

The purpose of the article is to describe a prototype system for managing energy security in small ports based on the use of IT technology. Additional evaluation of the usability of the described sytem will be carried out based on the main pillars of the Industrial Revolution 4.0, which include the integration of advanced information technology (IT), automation (OT), "Internet of Things" (IoT) and artificial intelligence (AI) systems. This affects IT systems, which are becoming more complex and sophisticated all the time. This causes an increase in dependencies - the more complex the information system, the more complex the security must be.In the described system there will be the use of a modular system of hybrid installation of renewable energy sources mainly from wind energy, photovoltaics and biogas, stored in an energy storage. Based on the use of energy storage and management of technology through a secure intelligent information network, the needs for storage and secure transmission of information and data, green electricity production, in accordance with the priorities of the European Union (green energy, green transformation European data strategy) will be described. The article also presents the types of renewable energy sources (RES) in relation to the use of systems supporting their management. The author will also try to answer the question whether such measures will significantly strengthen the energy security of a modern organization.

Keywords: energy security management, renewable energy sources, innovation

JEL classification: D83, M15, O33, Q42

Introduction

Organizations that operate in the area of the broader maritime economy, just like any other contemporary market players, depend on three main determinants of the modern economy. The first is progressive globalization tantamount to very large-scale liberalization of the exchange of all goods and services. The progressive shrinkage of the markets in which companies have operated so far is forcing them (even the smaller ones) to prepare and implement strategies for global operations. The second characteristic of the modern economic world is the rapid and galloping technological progress like never before, which brings with it a great many challenges and dilemmas. This IT revolution, for that is probably what it can be called, has led to a change in society as a whole - workers, owners, and consumers themselves have changed. The third fundamental distinction is the increased importance of intellectual capital. In the new reality, product and financial markets will play a smaller role than before, and the relative advantage of a company or region will be determined more by its ability to find, retain and ensure the development of talented people.

All these factors are forcing changes in the maritime industries and their business environment. Turbulent political, financial, industrial or consumer changes have made it necessary for countries to implement new measures on an ongoing basis with the overriding goal of saving their national maritime economies. As we well know, some previous actions have not always yielded the expected results.

Poland, due to its direct access to the Baltic Sea, has conditions conducive to the development of the maritime economy. Maritime transport and port services are a very important area of the economy. Seaports perform commercial, transportation, industrial, city-forming, logistics and distribution functions. They are also transport points of international importance and places that connect different modes of transportation. Through concentrations of capital, knowledge and organization along with new technologies, the importance of all maritime centers has increased - they are now seen as places where economic growth is concentrated.

1. Determinants of the development of small ports

The maritime economy in Poland is most often perceived through the prism of media news talking about the financial troubles that Polish shipyards are experiencing. However, not everyone realizes that this is only a very narrow branch of activity of the entire economy, which is de facto currently experiencing not a crisis but, perhaps not a dynamic, but a gradual revival - an example being the Gdynia shipyard Crist. The entire maritime sector comprises many segments and industries, extremely important for the economic development of the entire country. It should therefore be approached as a living organism - a network of interconnected vessels. The great diversity of the activities of the business entities that make it up determines its enormous potential. It is through this that the implementation of innovative solutions becomes the key to modern management of the entire maritime economy (Igielski, 2016).

The main elements conditioning the functioning and development of such an important economy for the whole country include (Kacprowicz, 2016):

1. The transportation superstructure conceived as not only and exclusively port and logistics equipment and machinery, but primarily as a nationwide transportation network.
2. The TSL industry, i.e. transport, logistics and shipping are ubiquitous around ports and are an integral part of the maritime economy.
3. Other maritime industries - the number of businesses that directly or indirectly operate within the maritime industry is surprising.
4. Education and research, as the maritime economy without adequate research, development and, eventually, implementation, will never achieve the planned and measurable economic benefits.

In the area of the Polish coast (510 km long) there are 28 local ports of great diversity, due to their size and functions: transportation, industry, trade or logistics. We often forget that Polish seaports are not only large port complexes, which concentrate more than 99% of port transshipments, 96% of the shipbuilding industry's output, almost 100% of ship repair yards. They are also smaller organizations located primarily in the southern part of the Baltic coast, the Szczecin Lagoon and the Vistula Lagoon.

In general, the term "small port" is an overly subjective notion, as it is influenced primarily by the ability to accommodate large sea vessels and the level of cargo handling. Unfortunately, taking into account the volume of transshipments in small ports, they play a rather marginal role compared to large ports. The main reason for this situation and the main force hindering their development is primarily the lack of sufficient funds for infrastructure development. In order to talk about any increase in their cargo handling capacity, investments in infrastructure are needed - mainly the deepening of the approach roads to the ports and the water bodies themselves.

However, small ports, as the target group of the described system, are permanent and complex multifunctional entities that represent market potential and, importantly, influence regional development through the social and economic processes that take place in the ports themselves. The technical and technological links between the port and its urban surroundings, the region and the further economic hinterland mean that the social and economic processes taking place in a small seaport affect development processes on a regional scale.

For the local community, small seaports are one of the main factors generating jobs and income. The territorial scope of their impact is identified with the area of coastal municipalities. Small seaports belong to multifunctional economic structures - in addition to fishing activities, which have recently experienced a regression, recreational and sports activities are carried out - this is a prospective area of port activity (Nowaczyk, 2015).

In turn, research conducted by the Maritime Institute in Gdynia on the strategy of activation of the Baltic peripheral regions has shown that local ports, in order to efficiently and effectively take advantage of development opportunities, must function as a system of complementary elements. They can become de facto economic centers in their region with a strong economic impact if they receive support from local, regional and central administrations. For small local ports, the realization of a variety of economic functions is a strength, and in some ports also commercial or industrial activities. In addition, the possibility of developing port economic functions due to their land reserves and the successive modernization and expansion of port infrastructure.

A particularly important document in terms of the development of just these entities is the Program for the Development of Polish Sea Ports until 2030, in which, of the 18 points, point 2 is particularly noteworthy - the creation of conditions for the development of other port functions, such as service and rescue functions for offshore structures. An opportunity for local ports is the development of both existing economic functions and new activities, as well as precisely the construction and operation of wind farms. It should be noted that investments in ports have increased the parameters of infrastructure inside ports. Ports where new wharves and basins will need to be built will also benefit from the development of the wind farm sector. This includes smaller harbors such as Ustka, Darlowo, Kolobrzeg, Wladyslawowo and Leba. According to preliminary assumptions, it is from them that vessels participating in the construction of wind farms, and later service vessels, will operate. Port modernization will be necessary for such investments. However, since the typical lifespan of an offshore wind farm is at least 25 years, Leba, Ustka and Darlowo may turn into key service and maintenance centers for Polish OWFs.

Summing up the changes that are taking place in the functions performed by Polish small seaports, it should be said that their transport and passenger function in relation to large ports is losing its importance. The same is happening with the fishing function, to which the ongoing EU policy and overfishing of the Baltic Sea contribute. Some of these ports, such as Ustka and Kolobrzeg, also had other rare functions in the past, such as industrial or military - but these too have disappeared or are slowly disappearing. Thus, another main, well and very real function of small ports, which can become an important factor in their development, is the tourist function. In order to be able to realize it fully it is necessary for them to have marinas, and in the larger of them - yacht marinas. The example of Ustka or Władysławowo shows that the construction of these facilities, however, comes with difficulty (Szymańska & Michalski, 2018).

Therefore, the conclusion arises that at the moment small ports in Poland stand at an economic "bend" or, if you prefer, at a "fork in the road." - one needs to know which one to choose in order to move towards development. The old strategies, based on ancient development factors, have not passed the test in practice, and there is a lack of financial resources to implement the new ones, and, it would seem, courage more than once. However, due to the links between small ports and local government units, as well as significant funds from the European Union located in the new funding perspective, it can be hoped that in a few years the current situation will change positively. This will undoubtedly be helped by unconventional and therefore innovative solutions, such as those related to renewable energy and the IT system responsible for managing energy security, just mentioned in the article.

In conclusion, business entities operating in the broadly defined maritime economy must build their competitive position in the market by implementing innovative solutions. Of course, this is extremely difficult, since the innovation processes of companies in this industry are of a completely different nature than, for example, manufacturing companies - this is a result of the specifics of the services provided. After all, it is difficult to capture product innovations in the field of services, which are characterized by immateriality and quite often impermanence. But on the other hand, one cannot agree with the view that innovation in the port industry is reduced only to the implementation of soft innovations in the field of organization and management..

2. Characteristics of the renewable energy sources (RES) industry in Poland

The slowly depleting stock of conventional fuels and the growing need to increase the intensity of environmental protection efforts are two main driving forces behind the introduction of modern technologies using natural energy resources on an increasing scale.

In the literature we can find many definitions of renewable energy sources, which nevertheless boil down to the same thing. Therefore, for the purposes of this article, let's assume that renewable energy sources include all energy sources whose use for the production of heat energy and electricity is not associated with their long-term scarcity - their resources are easily renewable. Renewable energy sources are mainly water energy, wind energy, solar energy, geothermal energy, as well as biomass (Table 1). Natural processes are used to produce electricity and heat, and the entire process does not contribute to the emission of environmentally harmful substances. RES are therefore clean energy, safe and friendly to the planet (Mirowski, 2017). This is in line with the definition in the Energy Law of 2006, which defines renewable energy sources as sources that use the following in the conversion process: wind energy, solar radiation, geothermal energy, waves, currents and tides, river fall, energy derived from biomass and landfill biogas.

Table 1. Types of renewable energy sources.

No.	Source	Description
1.	Water energy	This is the source that is most often used in hydropower plants to produce electricity. For this purpose, water turbines are required, which, when moving, create mechanical energy that goes to hydrogenerators. There, in turn, it is converted into electricity.
2.	Solar energy	Thanks to photovoltaics, solar energy has become one of the most undistributed sources of renewable energy. Photovoltaic panels mounted on the roof of a building or on the ground capture solar radiation and transform it into electricity that is directed to electrical outlets in homes, businesses, farms or other buildings of choice. Solar energy can also be used for heating purposes. This requires solar collectors, which, through a heating medium and heat exchanger, provide heating of water in tanks. This solution is used to prepare domestic hot water and to support the operation of central heating.
3.	Wind energy	Renewable energy sources can also use wind energy in the conversion process. To generate electricity, special wind turbines are set in motion by the wind, resulting in the generation of mechanical energy. In order for electricity to be generated, it must first go to the device, which is a generator
4.	Biomass - biodegradable matter	Renewable energy sources can also be talked about in the case of biomass. Biomass is all kinds of matter, such as products and waste from agricultural or forestry production, which is biodegradable. It can be used to create solid, gaseous and liquid fuels. It is most often used to produce heat energy when biomass is burned. The heat generated can in turn be used to produce electricity.
5.	Geothermal energy	Geothermal energy is energy from inside the earth. It can be used both to produce electricity and to produce thermal energy, including for heating purposes. In order to obtain it, it is necessary to drill wells. A technology that uses heat energy from the ground is ground source heat pumps, which can be used to provide heating for a building and to heat domestic hot water.

Source: own study based on https://hymon.pl/co-to-jest-oze-jakie-sa-rodzaje-zrodel-energii-odnawialnej/.

Renewable energy resources are practically unlimited, but as we can see, however, their potential is dispersed, and the use of them requires the use of higher capital expenditures. Hence, today the investment costs of eco-energy generation are even higher than the costs of obtaining and processing fossil fuels. The reason is the still globally controlled top-down prices of energy carriers. The cost-effectiveness of applying technical solutions that use the energies of renewable resources can be justified when the prices of all energy carriers are liberalized and eco-fuels are fully charged for the use and degradation of the environment (Zimny, 2014).

This does not change the fact that one of the main priorities of energy development in the coming years is precisely the development of renewable energy sources. Rational use of energy from renewable sources, i.e. water energy, wind energy, solar radiation, earth energy i.e. geothermal energy and biomass, is one of the important components of sustainable development with measurable environmental and energy effects. The increase in the share of renewable energy sources in the fuel and energy balance of the world contributes to improving the efficiency of use and conservation of energy resources, improving the environment by reducing emissions of pollutants into the atmosphere and water, and reducing the amount of waste generated. Therefore, supporting the development of these sources is becoming an increasingly serious challenge for all countries of the world, and Europe in particular - this is reflected in many EU programs (Borgosz-Koczwara & Herlender, 2018).

To sum up, the use of renewable energy sources, due to their advantages, not only those related to environmental protection, has become a basic priority of EU activities in the field of energy. We should stop looking at the implementation of RES projects only through the prism of fighting global warming or leveling CO2 production. These are also opportunities for the development of local environments, where by using resources that have been available for many years, new jobs are created, social ties are strengthened, and the cost of living is reduced.

In addition, the increase in the exploitation of renewable energy allows greater independence from the supply of imported energy, enables stronger diversification of supply sources, and contributes to the creation of distributed energy, which will be based on locally available raw materials. This will increase energy security and reduce transmission losses, due to the possibility of locating close to the consumer. And this, after all, affects the formation of the country's energy balance, which translates into increased electricity security (Ignarska, 2013).

3. The innovative nature of the energy security management system

Perhaps the most popular definition of innovation today, is found in the Oslo Manual, which says that it is the implementation of a new or significantly improved product (product or service) or process, a new marketing method or a new organizational method in business practice, workplace organization or relations with the environment. Analyzing the above definition, one can conclude that innovation should be understood in relations with the environment as the alternative of implementing:

1. A new or significantly improved product (product or service) or process.
2. A new marketing method or a new organizational method in business practice.
3. Organization of the workplace.

Of course, in the literature it is difficult to find clarity in defining this concept. It all started with J. Schumpter (1960), who stated that the creation of knowledge, that is, invention, is quite different from innovation, that is, the introduction of knowledge into production - it is not the invention itself, but the readiness to change production that determines whether innovation will be undertaken or not - only the first application of an invention has the mark of originality, requires the involvement of the forces of particularly talented individuals and the incurring of high risks, while imitations are mere copying. This problem has divided, probably already permanently, the successors of J. Schumpeter, so that two approaches crystallized: in the first, only the initiating application of the invention was considered an innovation, and in the second - also each subsequent application (Wisniewska, 2019). In the opinion of the author of the article, the second approach seems far more common today. Hence, for the purposes of this paper, it will follow P. F. Drucker (1992), who considers innovation to be a kind of entrepreneurial tool - a procedure that suggests to resources new opportunities for wealth creation, while claiming that innovation is attributed more to the economic and social sphere than to the technical sphere (only at the enterprise level are technical innovations of decisive value). In a similar vein, contemporaries W. Janasz and K. Koziol (2017) defining innovation as the first use of a product or manufacturing method.

As for the classification of innovations, there are many typologies in the literature, which refer to various criteria. In Table 2, the author described, in his opinion, the most important 4 of their categories.

Table 2. Categories of innovation

No.	Name	Description	Examples
1.	Product innovation (within a product)	Introduction of products or services that are new or significantly improved in their features or applications	– significant improvements in terms of technical specifications, components and materials, embedded software, ease of use or other functional features – significant improvements to existing products may consist of changes in materials, components, and other features that ensure better performance of those products.
2.	Process innovation (within a process)	Implementation of a new or significantly improved method of production or delivery of services	– significant changes in technology, equipment and/or software – innovations within processes that may be aimed at reducing unit costs of production or delivery, increasing quality or providing new or significantly improved products
3.	Marketing innovation	Implementation of a new marketing method	– involves significant changes in product design/construction or in packaging, distribution, promotion or pricing strategy
4.	Organizational innovation	Implementation of a new organizational method	– involves in the operating principles adopted by the company, in the organization of the workplace or in relations with the environment

Source: own study based on Oslo Manual.

The product innovation that interests us most in this case can be the result of the company's own research and development activities, cooperation with other companies and institutions, as well as, more and more often, the purchase of knowledge in the form of intangible (patents, licenses, software, know-how, services of a technical, marketing, organizational, training nature) or tangible (machinery and equipment with improved parameters).

Taking the above contents into account, one should not forget about the significant degree of innovation of the system in question, which results from the practical application of a new, and in some areas significantly improved solution, including the implementation of a new organizational method on the basis of the proposed level of technological advancement, redefining the way of work and the relationship of the infrastructure of small ports with their environment (Table 3).

Table 3. Criteria for innovation of the energy security management system

No.	Criterion	System description
1.	product	To date, it has not been known and in some areas can be significantly modernized.
2.	Technological	It has the possibility of modifying the factors and properties of information and management processes.
3.	Social	It introduces new modernized social and organizational systems.
4.	organizational	Introduces major changes that may affect the entire sector of the mainly maritime economy in the EU (scale of change).

		In the area of processes that will affect the day-to-day operations of ports, it represents creative solutions that are the result of scientific and research work.
5.	complexities	As a result of the implemented changes in port management, they will affect changes in other branches of the economy (tied innovation).
6.	pro-environmental	Provides a solution that relates to activities aimed at the development of ecology - a pro-ecological attitude to the natural environment.
7.	couplings	Participants in the process will represent people from different professions and specialties related not only to the maritime economy.

Source: own study based on Oslo Manual.

The above data is the result of the so-called behavior of devices, as determined by science - a three-element approach, the components of which are tuning, collection completion and reactive conditioning. Tuning is the automatic collection and transmission of function arguments (data) at a specific time from a specific source. Algorithmic collection completion (ordering), on the other hand, will involve comparing key elements, indications in the context of safe and desirable conditions of a given technological process, taking into account its high probability. Reactive conditioning, on the other hand, will aim to induce changes in the system in the broad sense of the word (self-regulation, tuning and continuation of the process, its stopping, activation of other systems). Causal conditioning (operant conditioning) will also refer to the reaction of a person in the decision-making process, under the conditions of connecting him to the information of other network nodes - this is essential for the efficiency and benefits of the system. At the same time, the quality of such activities will depend on the high quality of IT predictive products. In addition, their technological development will reduce the tolerance band between prediction and measured observation to approximate certainty - a task for the problem-profiled scientific and research activity. In the process of "fine-tuning," which is nothing more than the collection of various data around a specific process from a specific source(s), the so-called surplus of data may arise, which the system ultimately did not use in the causal conditioning algorithm. At the same time, the occurrence of this surplus may suggest hitherto unknown circumstances in another, hitherto unrelated, area of necessary prediction for the broader safety and gaining benefits from the action (machine learning, changing norms and the entities subject to them, scientific value).

4. Analysis of the functionality of the energy security management system

The system is clearly distinguished, in the adopted European standard criterion of innovation, by the degree of scale and complexity of changes - this is reflected in its functionality and usability, in the dimension of mainly technological process and economic and environmental benefits. This kind of product and process innovation was based on indicators of innovative effects and objectives, as well as individual qualitative and quantitative indicators for a specified group of recipients - small seaports. The safe usability of the use of the new technology results in: a reduction in the cost of services and production, and the ability to customize products to meet the individual needs of customers. The innovative approach focuses on both the application of existing technologies to new areas and the development of new technologies for existing areas, which boil down to:

1. Data management within a clarified framework of this management in a common information space through standards for secure data collection and use.
2. Innovative contributions to the space of data shaping the port's energy security, which affect the security of port infrastructure.

In addition, the system uses intelligent networks and information and communication technologies in the following creative technologies:

1. Innovative design methods using advanced IT systems.
2. Innovative recording and communication tools to improve decision-making.
3. Creation of innovative content distribution channels dedicated to various entities - real-time content delivery (technical excellence and feasibility).

Among the basic factors of the system, which shape the security of the maritime economy and sensitive port infrastructure, the influence of diagnosed data - the efficiency and potential of the supply system, supervision and regulation of the system, sources of storage and supply, forecasting, planning, development and investment decisions is essential.

On the basis of the built new culture of energy mix data processing, using energy storage, based on data pools, it will become necessary to develop new procedures, creating a space for the development of port technology on the basis of:

1. Machine learning with the reuse of information for its intended purposes and the division of algorithms according to the systemic risks they may generate.\
2. Assigning information duties by the institutional manager and ensuring supervision of their circulation and the quality of their implementation.

In addition, in a further stage of system development, it will be possible to design or use tools that already exist on the market. They will make it possible to structure and measure data flows (European analytical framework for measuring data flows), and will make it possible to analyze flow directions and, on this basis, identify existing barriers in port processes, as well as regulatory needs. In addition, the formation of a new quality of technical and technological security of port infrastructure, taking into account the climatic and environmental situation, through the selection of new specialists for the analysis of data sets, will increase personal digital competence in a distributed and information-saturated environment.

Considering the Technology Readiness Level scale TRL (Technology Readiness Level - its purpose is to determine how far away from implementation a project innovation from the technology industry is), the analysis of the described system shows that the system components (silos, sets and subsets) and basic technology subsystems of small ports have been verified, along with the actual elements supporting the process. As a result, the system provides an interactive information infrastructure for local energy security, which, occurring in information collections, gives users secure access to a consistent and common set of data and its flow. It also enables integration, optimization of value-generating processes to manage the port's task catalog.

This is confirmed by the conducted assessment of the degree of implementation maturity of the system (Table 4), which took into account: technical maturity (technology), capabilities of the commercial version production process (manufacturing), organizational readiness (organization) of the implemented innovation project.

Table 4. Assessment of the degree of implementation maturity of the system.

No.	Phase	Actions	Sub-actions
1.	Concept phase	Identification and description of the basic principles of action	– research into the scientific basis of the problem, – development of a descriptive model, – preliminary analysis of the formulated concepts, – identification of basic properties of the solution, – formulation of solution variants (selection of the best variant or several for further

			study),
		Solution concept	– development of the solution concept and the possibility of its technical implementation, – analytical studies, – analysis of the applicability of the designed, – solution in practice,
		Confirmation of the correctness of the solution concept by analytical and experimental means	– theoretical analyses using modeling and simulation, – laboratory studies leading to confirmation of theoretical models, – experiments and sub-tests confirming the feasibility of achieving the assumed functions or parameters of the solution,
2.	Construction phase	Implementation and verification of operation	– development and execution of a prototype version of the system using, at least in part, the target elements, – conducting tests under near-real conditions for relevant operating parameters,
		Verification of the functioning of basic components and subassemblies under operating conditions	– development and implementation of the basic components of the experimental model, – integration of the experimental model and verification of operation under near-real conditions, – evaluation of the level of reliability of the determined parameters and suitability.

Source: own study.

The target application of the system and its functionality may result from the harmonization of the use of other IT applications that work together and connected to existing database systems at the ports. This will result in the fusion of fragmented data from information collections. On this basis, information coordination of port processes and their routing (historical proxy data) will become possible. This means that the project assumptions provide for the use and handling of so-called proxy (historical) data for the reconstruction of former technological conditions of the port. Here, proxy data, are the preserved features of the technological process of the electric mix supply, which can be used to carry out analyses and forecasts, understood as comparable measurements. By analyzing the records from these and other surrogate sources, it will be possible to expand the knowledge of the subject of efficiency, parameter performance, far beyond the current technological and operational record. The essence of the problem is that nowadays in IT technologies it becomes possible to build software that performs certain data routing operations (usually establishes connections on behalf of the user) in a specific task of the subject, configured purpose.

As for ecological aspects, the reduction of greenhouse gas emissions will result in a positive change for the climate - clean, affordable and safe energy will be provided within the operation of small ports. This will dramatically reduce dependence on uncertain and volatile fossil fuel markets (in line with the Renewable Energy Directive and the EU Commission's Communication on a European Green Deal).

Thus, the EU's sustainability and blue economy criteria will be strengthened, which is an important part of the package of measures needed to reduce greenhouse gas emissions. In addition, by contributing to technological development and innovation in small seaports, it will shape their technological and industrial leadership at the local level, while ensuring environmental, social and health benefits. On November 30, 2016, the European Commission announced the so-called Winter Package - a package of climate and energy regulations setting targets until 2030. In it, the EU pledged to reduce CO2 emissions by at least 40%, source at least 27% of energy from RES, and achieve a minimum of 27% energy savings in the efficiency sector compared to 1990. The Winter Package aims at a comprehensive transformation of the European energy system, which will take into account the active role and interests of energy consumers, such as: security of supply, the creation of an internal energy market, energy efficiency and coordination of energy transition towards clean energy.

In summary, the measures taken will contribute to the promotion of decentralized use of renewable energy and cost-effective decentralized production of renewable energy carriers. On this basis, an inclusive intergenerational strategy for a great social and economic transformation combining climate and economic goals will be implemented given the potential of the entire region.regionu.

Conclusion

To sum up, on the basis of the mix of renewable energy consumption, it will be possible to produce and implement maintenance services in small ports, based mainly on the built monitoring and control system of energy production taking into account sensitive infrastructure (small ports, electricity). This is an important part of the package of measures needed to reduce greenhouse gas emissions in the public space (in accordance with the National Energy and Climate Plan 2021-2030. Thus, a small port will benefit from closed-loop renewable energy and a secure computerized system, which is especially important in places where today the electricity grid runs mainly on fossil fuels. This also means activities in line with the 4th National Smart Specialization and its main areas:

– sustainable energy,
– innovative production technologies and processes (horizontally),
– intelligent creative technologies.

Thus, the identified smart specialization based on automation and IT technologies stems from the current need to have innovative design methods by innovative entities and entities that are innovatively active in the maritime economy in the main area, safe sustainable energy, high-efficiency, low-carbon and integrated energy generation, storage, transmission and distribution systems.energii.

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SYSTEM ZARZĄDZANIA BEZPIECZEŃSTWEM ENERGETYCZNYM W MAŁYCH PORTACH

Streszczenie

Celem artykułu jest jest opis prototypu systemu zarządzania bezpieczeństwem energetycznym w małych portach w oparciu o wykorzystanie technologii IT. Dodatkowa ocena użyteczności opisywanego sytemtu zostanie przeprowadzona w opraciu o główne filary rewolucji przemysłowej 4.0, które obejmują integrację zaawansowanych systemów informatyki (IT), automatyki (OT), „Internetu Rzeczy" (IoT) oraz sztucznej inteligencji (AI). Wpływa to na systemy informatyczne, które cały czas stają się coraz bardziej rozbudowane i skomplikowane. Powoduje to wzrost zależności – im bardziej złożony system informatyczny tym bardziej złożone muszą być zabezpieczenia. W opisywanym systemie wystąpi wykorzystanie modułowego systemu hybrydowej instalacji odnawialnych źródeł energii pochodzących głównie z energii wiatrowej, fotowoltaiki i biogazu, gromadzonych w magazynie energii. W oparciu o zastosowanie magazynu energii i zarządzanie technologią poprzez bezpieczną inteligentną sieć informatyczną, opisane zostaną potrzeby magazynowania i bezpiecznego przekazywania informacji oraz danych, zielonej produkcji energii elektrycznej, zgodnie z priorytetami Unii Europejskiej (zielona energia, transformacja ekologiczna europejska strategia danych). W artykule przedstawiono także rodzaje odnawialnych źródeł energii (OZE) w odniesieniu do wykorzystania systemów wspomagających zarządzanie nimi. Autor spróuje również odpowiedzieć na pytaie czy takie działania znacząco wzmocnią bezpieczeństwo energetycznego współczesnej organizacji.

Słowa kluczowe: energy security management, renewable energy sources, innovation

Klasyfikacja JEL: D83, M15, O33, Q42

Michał Igielski
Gdynia Maritime University
Morska 81-87, 81-225 Gdynia
m.igielski@wznj.umg.edu.pl