

Theoretical and Practical Foundations of the Application and Use of the Telematics Solutions for the Development of the National Economy

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Abstract - The authors' research is interconnected with the socio-economic policy of the Republic of Belarus. Structural components and metrics of economic efficiency in the scientific work are studied based on government demand, which is reflected in the National Strategies for Sustainable Socio-Economic Development of the Republic of Belarus until 2020 and 2030. In addition, statistical data on the activities in economic sectors allows us to identify the most vulnerable areas of business, where telematics solutions can be used as drivers of growth and development. Considering that in the Republic of Belarus there are no fundamental studies on the application of business solutions based on the telematics tools for socio-economic development, the relevance, and reasonableness of the study is subsequently substantiated by economic results obtained from the analysis of the implementation of telematics solutions in foreign practice and in Belarusian business, that's reflecting significant savings and cost reduction.

Keywords - national economic development, telematics solutions.

I. INTRODUCTION

In a transitional economy, socio-economic systems are undergoing significant changes for sustainable development at the micro, meso and macro levels. At the

same time, the strongest aspects of the system are considered as the main criteria and foundation for growth, which in the transition period is a driver of development and support for many areas of the economy. Considering the national economy of the Republic of Belarus, in analyzing and substantiating the ways of long-term development, we proceed from the goals and objectives of state program documents describing strategic steps to achieve the final result in the socio-economic sphere. Among these documents is the National Strategy for Sustainable Socio-Economic Development of the Republic of Belarus until 2030, in which the basis for sustainable development and ensuring socio-economic security is the basing of the Belarusian economy on innovative solutions, the effective use of national resources, as well as the country's comparative competitive advantages [1]. If to consider growth and development, which, in principle, are not interchangeable or equal categories, then for their balanced position it will be important to rely on the advanced development of science, the information technology sector, as structures for optimizing the production process, as well as drivers of sustainable development of the national socio-economic systems. In authors' opinion, telematics as a socio-economic category covering the field of informatics and telecommunications can have a significant impact on the long-term and proactive growth and development of the national economy. It was pointed out, that telematics and economic solutions designed on its basis are poorly studied in

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Belarusian science. In the fund of the National Library of the Republic of Belarus, there were found only 3 Belarusian dissertations and only in the technical section: S.N. Kandybo considered analytical phototriangulation using the GPS method for determining the coordinates of the design centers of aerial photographs [2], O. V. Kravchenko presented automated systems processing of geodetic information based on the technology GPS-electronic tachometer [3], ON Pisetskaya studied the determination of the shape of the earth using GPS-measurements [4]. As can be seen, the above presented Belarusian fundamental works demonstrate the technical side of the issue of GPS service, which is a part of the structure of telematic solutions. Telematics in technical aspect from the perspective of geodesy and mapping was considered by such researchers as O. Gruber, E. Merrita, F. Acherman (F. F.), L. E. Blankerberg (LE), H. Burman (H. Burman), K. Torlegard K., A. Lobanova, V. I. Pavlov, I. D. Kargopolova, I. T. Antipova, Sh. E. Kuznetsova, S. A. Khmelevsky, S. I. Belikov; issues of designing geodetic networks are presented in the studies of Yu. I. Markuze, V. D. Bolshakov, V. A. Kouguy, M. M. Mashimov, A. A. Solomonov, A. S. Yarmolenko, etc. In fundamental research of the Russian school the most relevant works are the following: M. Yu. Ozherelyev, who studied improving the quality of information support for transport and telematic systems in cities and regions using the example of dispatch control of passenger transport [5]; B. Shamsi, who investigated the integration of INS / GPS-GLONASS in order to correct the orientation angles of a moving object [6]; S. I. Dolganiuk presented methods and algorithms for information processing for positioning mobile industrial facilities based on GLONASS / GPS [7]; P.V. Artamonov assessed the durability of load-bearing metal structures of dump trucks using a GPS satellite monitoring system [8]; GV Kiselevich substantiated the structure of information support for monitoring and controlling the movement of vessels using GLONASS / GPS [9]. The above dissertations are valuable in terms of the structural construction of a telematic solution, using it in various areas of socio-economic relationships. Furthermore, as per authors' research, both "telematics" and "telematics solutions" do not have an appropriate definition in socio-economic aspect in Belarusians studies. Therefore, using foreign experience is a valuable opportunity to formulate authors' definition vision. The economic view of "telematics solutions" was presented in the researches of the following foreign scientists: G. Waksman, M. Harkin, O. Tettero, D. J. Out, H. M. Franken, J. Schot, M. Duplaga, M. Leszczuk, K. Zielinski, E. A. de Castro, C. Rodrigues, C. Esteves, A. da Rosa Pires, Shu-Hao, Chin-Yuan Fan, A. Sacher-Macian, J. E. Lopez de Vergara, E. Pastor, L. Bellido, R. Janecki, S. Kraviec, G. Sierpinski, K. Schilling, H. Roth, M. Pajak, L. Muslewski, M. Woropay, Z. Smalko,

II. MATERIALS AND METHODS

The authors put forward the assumption that telematic solutions can have a positive impact on the socio-economic development of the national economy, thereby being the drivers of growth and development of the national economic system. Research methods include analysis, synthesis, generalization, induction, deduction. The novelty of the research lies in the authors' study of telematics solutions as drivers of the development of the national economy. The exclusivity of the research is emphasized by the lack of existing fundamental works in the Belarusian science on the topic of telematics, considered in the socio-economic aspect.

III. RESULTS AND DISCUSSION

At the beginning, it was important to define the main investigation categories: "telematics" and "telematics solutions". It's noted that telematics consists of two interrelated concepts, such as telecommunications and informatics (information technologies). At the same time, telematics is inextricably linked with a GPS tracking technology, which was originated in the 1960s, when the US Department of Defense and the Applied Physics Laboratory of Johns Hopkins University began developing a global positioning system (GPS) [10]. GPS used satellites in the sky and a receiver on the ground to help the US military track military personnel, installations, facilities and equipment. GPS has also improved American missiles, making them more accurate in targeting and airborne control. Basically, telematics is a new concept, and for the first time it was mentioned in 1978 in the work of French scientists Simon Nora and Alain Minc. When writing a report for the French government, they described telematics as the process of transmitting information using telecommunications [11]. In the process of development, the terminology underwent changes, and subsequent formulations were relative to the scope. Analysis of the existing approaches in defining the category of "telematics" showed that in many respects the conceptual apparatus of scientists and researchers is similar in structure, and, at least, means a technology, a set of technological tools or a field of technology. Further, this fundamental approach covers the structure of the telematic complex, considering scope and a type of monitoring objects. At the same time, as a result of the study of the concept of "telematics" as a socio-economic category, the authors come to the conclusion that the definition does not have a universal character and for the topic of the research, should be clarified in the direction of commercialization and business, which is important for the formation of telematic solutions as drivers of the development of the national economy at the micro, meso, macro levels. The authors' definition has not only theoretical value, but also practice-oriented significance in the development, creation and implementation of telematic solutions in the domestic and international markets. Thus, the category "telematics" in the authors'

opinion is presented as follows. Telematics is a related area of socio-economic and information-technological relationships on the matter of creation, development and promotion, as well as the implementation of telematic solutions to meet the various needs of the national economy, taking into account the specifics of market supply and consumers demand. As it can be seen, the above terminology covers the area of related telematics applications. At the same time, for the process of creating telematics products that are interesting to the market and the consumer, an in-depth study of the theoretical and structural components of telematic solutions is essential, among which there is a telematic complex that forms the structure of a telematic solution. The theory and methodology of the formation of economic solutions based on telematic services are interrelated components in the creation, promotion and implementation of a telematics product. Today, there are many approaches to building, managing and marketing a product. The authors share the opinion of O. V. Ilyina on the organization of product marketing management; the concept of life cycle management is among the key components of the researchers' methodology. The model focuses the business on forecasting short and long-term trends in supply and demand, as well as conducting a comprehensive and systematic work to assess the competitiveness of each service and developing control actions to increase its level, planning and developing new services, using an integrated approach to the formation of marketing activities at all stages of production [12, p. 4]. O. V. Ilyina's research is valuable in constructing the structure of marketing problems that arise at the stages of the life cycle of high-tech products. This concept allows to timely respond to changing market conditions, track supply and demand to increase the demand for the product, as well as to improve the tools for its promotion to the market. We understand that with an increase in the quantitative and qualitative level of supply in the telematic services market, the life cycle of a telematic product decreases due to increased competition and decreased demand from the consumer. In studying the parameters of demand and factors influencing it in the process of forming a telematic solution, we consider it valuable to consider the position of A.M. Levin, who represented demand and price factors through the prism of mathematical measurements. According to the scientist, if we analyze the demand curves and supply curves from the point of view of the manifestation of the vector properties of the price, then these properties do not appear, since the price functionally depends on the quantity of goods that is not a vector quantity. At the same time, the economic meaning of A. M. Levin's model is as follows: if a tendency towards an increase in prices is assumed, the buyer will strive to purchase the next quantity of goods or the next batch of goods. The same applies to the situation in the market, when only a downward trend in prices is expected. In this case, the buyer delays the next purchase

of the product, expecting a larger actual decline. The presence of a vector characteristic of the price of a product is manifested everywhere, for example, thanks to advertising, which creates a more favorable direction of the vector towards an increase in the general utility function [13, p. 70]. Among the models of interaction of A.M. Levin, it's suggested to explore his assumption that when considering the free movement of a point-product, it is worth considering the absence of any connections that rigidly restrict its movement in any direction. Using the time axis of the quantity of goods, the scientist represents the nature of the manifestation of dependencies associated with the general utility of the goods and the total costs of its supply in the market [13, p. 84]. We believe that the value of this opinion lies in identifying an additional criterion for the formation of an economic solution based on telematic services, namely the criterion of the value of the product for the consumer, which, in conjunction with price and quantitative factors, determines consumer behavior and subsequent choice. The similarity of A. M. Levin's model can be traced to the studies of such authors as: J. Hicks, who performed a four-dimensional model of interaction between the price of two goods and their quantity [14, p. 106]; A. Marshal, who presented the elasticity of supply and demand; J. Stewart, A. Smith, who identified the relationship between supply and demand in the market [15], etc. It's also been found interesting for the research to overview the concept of the relationship between price and product marketing and the potential benefit to the consumer. The concept structure includes the process of collecting, analyzing, introducing and promotion of a product to the market, seeing changes in market conditions, demand and supply. F.K Kotler, in his concept of a four-level product model, imagined that each element of the aggregate product increases the consumer value of the product - all together they form a hierarchy of consumer value. The purpose of the product is to demonstrate benefits through satisfying a need. Thus, through the formation of an economic solution based on telematic services, the business creator determines what will be valuable components for the consumer in the product structure, what added utility each component will bring individually or in batch use [16]. Another model of F. Kotler, the theory of the "Black box" [17], allows to correctly determine the final composition of the telematic solution. This theory was originally applied to define consumer behavior. An imaginary black box - consumer thinking and behavior at the time of analysis and purchase of goods, works and services. In the telematic business, the "black box", according to the authors, is a space of consumer requirements and needs that must be satisfied by a telematic product or service. Thus, at the entrance, the telematics company analyzes the demand from a potential buyer, identifies his needs and weaknesses of his existing solution, in order to further present a unique offer suitable for a specific client. At this point, we conclude that the final service or product of the telematic business

is directly related to the level of demand and competition among companies offering similar services to consumers. In this regard, the more detailed we approach the analysis of the components of the "black box", the greater our chances of meeting the approval of a potential buyer and making a sale.

Based on the studied existing research and scientific works in the field of formation, marketing and product management, the authors enclosed that, in general, experts focus on the theoretical component of the issue, since it is the foundation for building and promoting a product to the market. Just like in business or in negotiations with a large partner, the creator of a telematics solution must be sure that he has made the necessary preparation for presenting his product, work or service to the market. However, the analyzed models cannot fully represent the necessary steps for the formation of economic solutions based on telematic services, since the telematics field and the components that are included in the structure of telematic solutions require an individual approach in analysis and selection. Our model of the formation of economic solutions based on telematic services is aimed at applied application. The value of the model lies in the detailed and deep study of the issues that arise at each stage of the formation of a telematic solution and the model of its sale and promotion in the telematic market. The advantages of the model:

1. Versatility. It is focused both on existing users / integrators of economic solutions based on telematic services, and on beginners (startups).
2. Fundamentality. Allows you to carry out the necessary preparatory research and study the issues of forming, collecting and implementing decisions based on existing experience, which reduces the risks of making incorrect administrative decisions and increases the chances of project success.
3. Proactivity. The author's model is focused on the prospects for the development of a telematic solution, considering the current situation and future changes, which allows timely monitoring of the competitive supply and socio-economic situation in the region of implementation, and, as a result, to respond to dynamic market conditions to maintain / increase consumer demand.

To form the structure of future telematic solutions, suitable for the needs of the national economy, the authors analyzed the dynamics of the composition and structure of the Belarusian telematics market. It was found out that among the main components of telematics solutions are telecom and IT products, which form the ICT sector in the Republic of Belarus. It is noteworthy that in 2017, in the ranking of the global Index of Information and Communication Technologies (hereinafter referred to as ICT), the Republic of Belarus ranks 32nd out of 176 countries, ahead of neighboring countries Lithuania (41st), Latvia (35th), Russia (45th), Poland (49th place) [18]. This indicator demonstrates the competitiveness of

the Belarusian ICT sector. According to the current data, there are 12 Internet providers [19] and 3 mobile operators in the Republic of Belarus, including A1 (owned by Telecom Austria), MTS (part of MTS Group), life :) (part of Turkcell) [20]. Since in the structure of the telematics complex there is a telematics unit, which includes telematics equipment and a SIM card, it is important for us to analyze the mobile communications and Internet market in the Republic of Belarus. The leader in terms of the number of connected subscribers is MTS, which has demonstrated a growth rate of 104% over a four-year period. According to the reporting information from three mobile operators A1, MTS, life :) for the period of 2018-2020, the leadership is held by MTS as a provider of mobile services, which generates a larger volume of revenue in the Republic of Belarus. In our opinion, to understand the reasons for the positive financial and subscriber growth of a mobile operator, it is worth paying attention to the pricing policy, which is one of the important factors when choosing mobile communication services. In general, the analysis demonstrated the price leadership (relatively lower price) of life :), where the average cost of mobile services and Internet services is lower than that of competitors. Nevertheless, it was noticed less demand for this mobile operator among connected subscribers. The reason for this dissonance, in our opinion, lies in the coverage volume (zone of reliable reception) in various settlements of the Republic of Belarus. As of 2021, the maximum coverage is provided by MTS [21], whose zone of reliable 2G, 3G, 4G reception covers almost the entire territory of the Republic of Belarus (all regions), in comparison with the coverage map life :) and A1, which have a zone confident reception will apply only to individual regions and settlements.

Considering that the software is an integral part of the telematics solution, the researches draw attention to the current trend and dynamics in the field of IT in the Republic of Belarus, which will determine the development of the information technology market, including in the development of GPS monitoring systems. As of 2018, the IT sector formed 5.7% of the GDP of the Republic of Belarus (3.1 billion US dollars), for comparison, agriculture and forestry 6.4%, construction 5.4%, transport 5.8%. The volume of exports of IT products and services in 2018 amounted to US \$ 3.1 billion [22]. In 2019, the share of the IT sector in the GDP of the Republic of Belarus was 6.5%, demonstrating the largest contribution to GDP growth - 0.5 pp [23]. In 2019, there were detected more than 50 thousand IT specialists in the IT sector. At the same time, the Belarusian IT sector has more companies offering outsourcing services (60%). Considering labor productivity in the HTP as an export per employee, Belarusian experts note that this indicator has grown 4 times since the creation of the High-Tech Park. It is also worth noting that Belarusian IT products and services are in demand in 50+ countries around the world, 91.9% of the software produced is exported [24].

Turning to the analysis of the Belarusian market of GPS monitoring, it is worth noting its low saturation, since according to the authors' calculations using the Google search engine, only 50+ companies with Belarusian and international capital provide GPS monitoring services in the Republic of Belarus, which is slightly more than 1% of all Belarusian IT companies. Among the key market players, it is worth highlighting Gurtam, BelTransSputnik, VISSSEN, Unified Navigation System, Omnicomm, Resurskontrol Group of Companies, Lektum Prof. Separately, we note the Belarusian IT company with 18 years of experience in the industry - Gurtam and its commercial platform for GPS monitoring Wialon [25]. Wialon provides a wide range of functions, including fuel consumption control, driver identification, passenger monitoring, notifications, geofences, etc. As of today, 2.8+ million monitoring units are connected to Wialon, the platform supports 2300+ GPS devices from 600+ equipment manufacturers. The number of Wialon partners in 130+ countries around the world has already reached 1900+ [26]. Plus, Gurtam also offers Ruhavik, a non-commercial GPS tracking solution, which is targeted at the end-user segment for monitoring small fleets. Ruhavik has already connected 150,000+ objects in 70+ countries around the world, the number of platform users is 130,000+ [27]. The Ruhavik application is installed on an Android or iOS smartphone and allows a private user or small business to track the location of a car, family members, employees, etc. in real time, receive notifications about the movement and status of the monitored object, as well as analyze reports generated on the basis of data about the monitored object. For a full-fledged GPS monitoring process, a GPS device must be connected to the object, which serves as an intermediary between the satellite and the software, subsequently transmitting data about the state and location of the object for analysis on software (for example, object speed, location, fuel consumption, etc.).

Based on the above data, we established that the telematics market of the Republic of Belarus, formed by telecom and IT sector companies, demonstrates high development indicators, including financial ones, which has a positive effect on the macroeconomic result of the Republic of Belarus. In turn, the Belarusian IT sector can rightfully be called the driver of the national economy, which forms a significant share of GDP and demonstrates high export rates. Thus, solutions based on the interaction of the IT sector and other sectors of the economy contribute to optimizing production processes, reducing costs, as well as rational allocation of resources. The authors' idea is based on the desire to "collect" the existing experience of using telematic solutions that can optimize business processes in companies, as well as help reduce / minimize costs, which is very important for a long-term development perspective. The existing international experience in the use of telematic solutions shows the variety of their application: in the transport,

logistics areas, personal monitoring, control over the state of property or personnel in the service sector, etc. By the way, in 2017 London Economics, a leading independent European consulting company, conducted a large-scale study to calculate and estimate possible losses in the absence of satellite monitoring systems, which are used to determine the location of an object on the ground. By means of a GPS tracker, the data can be received and subsequently transferred to the platform (software), where the user can control and analyze the data received about the object. The agency's study found that the benefits of, for example, GPS-based applications and telematics solutions in the UK rail system are estimated at 11 million pounds per year. And a five-day non-use or shutdown of the system will cause problems for railway infrastructure managers, railroad and freight companies, which is equivalent to direct and indirect losses of 110 million pounds. The most obvious problem is the lack of a centralized system that allows to control routes and rail transport, thereby causing losses due to downtime, delays, etc. [28]. In our opinion, the experience of introducing telematics solutions into the trade, transport and logistics sector could become more relevant for the Belarusian economy. Among the most promising is the experience of using telematic solutions for transport companies in Africa, which made it possible to achieve the following results [29]:

- Savings of \$ 45,000 per month as the solution reduced fuel consumption by 40% by controlling speed while driving and reducing theft.
- The business owner / C-level managers got the opportunity to control the transportation chain of valuable and at the same time dangerous cargo in real time, as well as to determine the driving behavior and respond in time to violations of drivers.

The experience of the Russian business in refrigerated transportation focuses on the effectiveness of telematics solutions due to the ability to control temperature conditions, which is a key factor in the successful transportation of goods requiring special temperature conditions, for example, ice cream, medicines, flowers, etc. In this case, the problem of damage or loss of cargo is eliminated by notifications about violation of the temperature regime. As a result of the introduction of a telematic system, the company reduced fuel costs by 18%, reduced operating costs, and also reduced the cost of expensive regular temperature recorders by 1.3 million Russian rubles due to the expert installation of high-quality equipment by a system integrator [30].

In the meantime, according to analysts in May 2020, the Belarusian consumer also prioritized food delivery services, which were second in the top 5 list. Bookmakers are in the lead. At the same time, Belarusians paid for food delivery during April 2020 by 31-37% more often than last year. The coronavirus situation and the general lockdown / self-isolation have played into the hands of the

delivery services [31]. Along with the arrival of greater consumer demand, uncertainty and delays also appear due to the unwillingness of the business to instantly re-profile from offline to online modes, as well as to organize competently the service, while controlling the process of transporting orders, as well as the quality of their work by couriers. Thus, according to the authors, the use of telematic solutions in services for the delivery of goods or food is a tool for optimizing operating costs, increasing control over the delivery of goods, as well as reducing costs. An example is the experience of Papa John's pizza chain, which, in addition to a telematics solution, also uses the iiko restaurant business automation system to control production facilities and finances. The integration of the fleet management system with the iiko platform allowed reducing the time spent on processing customer addresses, as well as creating routes for order delivery and their distribution between drivers. In addition, the integrated solution allows you to track the status of the vehicle fleet of the delivery service (busy / free) with the aim of optimal and timely distribution of cars to couriers for subsequent transportation of the order to the client [32]. It should be noted that the above telematics solution can be applied not only to the pizza delivery service, but also in any restaurant services, or it can be adjusted to the needs of e-commerce delivery.

IV. CONCLUSIONS

As a result of the research carried out within the framework of the dissertation work, the author concluded that the structural and comprehensive study of the issue of the application and use of telematic solutions in the national economy is not only relevant, but also important in the Republic of Belarus both at the macro and micro levels. In the process of studying the field of telematics and solutions based on it for socio-economic development, we solved the following tasks:

1. In the process of researching existing approaches to defining the category of telematics, the author formulated a complex definition that reflects the whole essence of telematics as a component of the socio-economic system.
2. As the results of studying the structure of a telematic solution have shown, it is multifaceted and involves many components, each of which has its own functional and value load in the process of collecting, processing, transferring data about an object. At the same time, the Belarusian scientific school does not define the category of a telematic solution, and therefore, the author's approach is one of the provisions put forward for defense.
3. The choice of an effective methodology for the formation of economic decisions based on telematic products and services is one of the key factors in obtaining a positive result from the application.

4. The structural component of the telematic market of the Republic of Belarus includes IT and telecom companies. Based on the authors' analysis, it was revealed that the activity of the data forms a significant positive contribution to the development of the national economy through an increase in the macroeconomic indicator. Thus, being the drivers of socio-economic development, IT, telecom and solutions based on the interaction of these areas can be a tool for the development of various areas of Belarusian business in the long term.
5. The study of indicators of sustainable development of the national economy showed that the Belarusian model of socio-economic growth provides for an emphasis on the introduction of innovative technologies in traditional sectors of the economy in order to increase their competitiveness.
6. The current state of some Belarusian economic spheres and the analysis of their activity at the macro level showed negative changes that affected the spheres of logistics, transport and trade. Considering the negative growth rates of these areas, we propose to consider telematic solutions that contribute to the optimization of business processes, as well as to reduce / minimize costs.
7. Analysis of the international practice of introducing telematic solutions into the activities of various business areas showed a significant reduction in costs, as well as opportunities for optimizing business processes and interaction in the organization. Ready-made cases of using GPS monitoring systems and a telematics unit allow you to proactively assess the possibilities of using similar solutions to minimize costs and optimize transport / logistics or business in the field of trade with a delivery service.
8. Theoretical and practical analysis of drawing up a telematic solution for specific sectors of the economy showed that with a high-quality setting of all system components, as well as using the necessary set of options and equipment, the organization saves up to 14% on reducing costs from the quality of driving drivers and fuel costs.

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