MAIN PRIORITIY AREAS AND PROBLEMS OF UKRZALIZNYTSIA'S DIGITALIZATION

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In this paper we have outlined the main priority areas in digitalization of Ukrzaliznytsia according to the ones stated by the Community of European Railway and Infrastructure Companies in Vienna declaration, and also analyzed the current situation regarding digitalization in Ukrainian railway transport in each of these areas. The priority areas are Smart technical operations, Smart infrastructure, Smart freight and passenger transport, Smart ticketing, and Smart human resources. There are a few projects implemented by Ukrzaliznytsia (such as tracking rolling stock in real time with the help of the Internet of things, digital ticket, updating the automated "Monthly Plan" system, creating an electronic client's office, modernizing the customer service call center, etc.) and several ones which are in progress.

Smart human resources appeared to be the less developed area in which there are no relevant projects, only regular professional development courses provided once in 4 years. Therefore we suggested digitalization of HR departments so that their specialists will be able to deal with great amount of employees' documents more efficiently and therefore, boost effectiveness of dealing with personnel. Moreover, it might bring to life a shift to transparency, e.g. transparent application and recruitment process, transparent remuneration and feedback. But we should admit that a great problem connected with nepotism and

corruption makes aforementioned shift highly unlikely and this is an urgent problem to cope with.

Also, we have identified main problems impeding digitalization in Ukrzaliznytsia with the help of a cause-effect diagram (Ishikawa diagram). They appeared to be caused by financial factors (lack of investments), human factors (ineffective staff motivation and manager's reluctance to change), technical factors (insufficient technical level of fixed asset) and organizational factors (no system approach to digitalization). To our mind, the crucial one that should be solved first is manager's reluctance to change (due to corruption and outdated mindsets). It explains the absence of official Strategy or Programme of digitalization in Ukrzaliznytsia and consequently, a relevant department in its structure. Should this great obstacle be overcome, others will be solvable, especially with the help of European railways, as it is promised in Vienna Declaration on commitment to support Ukrainian Railways.

The results obtained in the paper can be used in further research in this realm, particularly in working out Strategy of digitalization for Ukrzaliznystia.

***Key words:** digitalization, railway transport, Ukrzaliznystia, smart ticket, smart freight and passenger transport, Ishikawa diagram.*

ПРІОРИТЕТНІ НАПРЯМКИ ТА ПРОБЛЕМИ ЦИФРОВІЗАЦІЇ УКРЗАЛІЗНИЦІ

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У цій статті ми окреслили основні пріоритетні напрями цифровізації Укрзалізниці відповідно до визначених у Віденській декларації Співтовариства європейських залізничних та інфраструктурних компаній, а також проаналізували поточну ситуацію щодо цифровізації по кожному з цих напрямків. Пріоритетними напрямками є «розумні» технічні операції, «розумна інфраструктура», «розумний» вантажний і пасажирський транспорт, «розумний квитковий продаж» і «розумний людський ресурс».

«Розумні кадри» виявилися менш розвиненою сферою, в якій немає відповідних проектів, лише регулярні курси підвищення кваліфікації, які проводяться раз на 4 роки. Тому ми запропонували впровадження цифрового відділу кадрів, для більш ефективної роботи з великою кількістю документів співробітників та, найголовніше, для переходу до прозорості у роботі з персоналом.

Також за допомогою діаграми Ісікави ми виявили основні проблеми, які заважають цифровізації в Укрзалізниці. З'ясовано, що вони викликані фінансовими (відсутність інвестицій), людськими (неефективна мотивація персоналу та небажання змін керівниками), технічними (недостатній технічний рівень основних фондів) та організаційними (відсутність системного підходу до цифровізації). Найважливішою проблемою виявилося небажання змін (через корупцію та застаріле мислення керівників), що пояснює відсутність офіційної стратегії чи програми цифровізації в Укрзалізниці і, відповідно, відповідного департаменту в її структурі.

***Ключові слова:** цифровізація, залізничний транспорт, Укрзалізниця, смарт-квиток, інтелектуальний вантажно-пасажирський транспорт, діаграма Ісікави*

Introduction. Digitalization has been a priority for Ukraine for recent years. This process has been sped up by the COVID-19 pandemic and especially by the war, when a lot of enterprises had to switch to remote work. We have to admit that Ukraine is the

first country in the world in which digital passports in a smartphone have become full legal analogues of ordinary documents (in 2021). According to the report «Digital Economy: Trends, Risks and Social Determinants» [1, p. 123], the level of digitization of the Ukrainian economy varies significantly, depending on the specific industry. In such areas as financial services, communication services, and logistics, Ukrainian companies use the achievements of information technologies as widely as foreign competitors. However, in a number of industries, the intensity of use of digital technologies (as well as everything related to them - automation, robotics) is extremely low (in the mining industry, for example). This situation is the reason for a significant lag in labor productivity in the industry [1, p. 124].

Railway transport is not an exception in this case. In spite of some projects of digitalization implemented by Ukrzaliznytsia (digital ticket, for instance), the level of digitalization is still quite low, due to a number of problems. We should admit that railway transport is known to be a backbone of Ukrainian economy (according to the Integrated Report of JSC Ukrzaliznytsia, in 2020, the share of railway transport in traffic volumes was 51% [2]). It's significance has risen dramatically at the wartime, as it has transported millions of Ukrainians who had to flee to safety.

Additionally, in a summit in Vienna organized be the Community of European Railway and Infrastructure Companies (CER) in July 2022, the Declaration on Digitalisation in the Railway Sector was signed (declaration of intent) [3]. The European rail CEOs agreed that digitization is the key factor for the future success of the rail system. The declaration states that digitization will help the European rail system to develop further and thus make it more competitive and resilient.

Which is why, taking into account significance of the railway transport for our country, and in line with European tendencies in this realm, we devote this paper to main priority areas of Ukrzaliznytsia's digitalization.

Analysis of recent studies. The issue of digitalization of the railway transport has been studied by Ukrainian scientists V.L. Dykan, H.V. Obruch, [4, 5], V.V. Kompaniets [6], I.V. Tokmakova [7] and others, whose works outlined the prospects for the development of railway transport enterprises (for instance, in [8]). At the same time, the issues of promoting digitalization with limited investment during the war remained insufficiently researched, which is why in the paper [9] we suggested using experience of Indian Railways with startups developing as a way of enhancing digitalization in railway transport.

Unexplored aspects of the issue. In spite of the fact that some publications are dedicated to the digitalization issues on a railway transport, the issues of classifying existing and future projects of digitalization in line with European documents and agreements in this area and identifying main problems impending digitalization are still insufficiently studied.

The purpose of the study is outlining main priority areas in digitalization of Ukrzaliznytsia according to the ones stated by the Community of European Railway and Infrastructure Companies, and identifying main problems impending digitalization with the help of a cause-effect diagram.

Main body of the study. The Vienna Declaration on Digitalisation in the Railway Sector contains measures for a common future of the European railway in the following areas:

- "smart technical operations" (digital automatic coupling, automatic train operations, etc., for the sake of increasing the transport capacity of the Trans-European Transport Network (TEN-T) and Rail Freight Corridors;

- "smart infrastructure", where rail infrastructure is to be designed in such a way that cross-border rail traffic through Europe is simplified and there is more rail capacity for both passenger and freight traffic; passenger and freight transport itself should also become "smart" - and be harmonized through cooperation, even across national borders;

- "smart freight and passenger transport", which includes overcoming national operational specifications to create a harmonized future European rail architecture; continuing and deepening cooperation to accelerate interoperability; in particular the Europe-wide rollout of harmonised technical solutions; supporting the removal of specific national rules ("cleaning up of national technical rules") that hinder interoperability;

- "smart ticketing," where the European railways are committed to the joint CER Ticketing Roadmap, which, among other things, is intended to make it easier for passengers to book international train ticket;

- "smart human resources," to get employees on board with the path to the digital future at an early stage [3, 10].

So, the declaration establishes the digital revolution as a turning point in the development of the European railway network.

Let's analyze the current situation concerning digitalization in Ukrainian railway transport. In the Integrated Report of JSC Ukrzaliznytsia (Management Report) for 2020 [2] (the freshest of the annual reports publically available) the word «digitalization» is mentioned only 5 times, including repetitions in the Accessoires part.

According to the Integrated Report, one of the tasks of JSC Ukrzaliznytsia is to organize the connection of electronic resources for the sale and execution of electronic travel documents in the internal connection to the transport portal of electronic services of SE "Sectoral Center for Digitalization and Cybersecurity" (which is a subject to the Ministry of Infrastructure of Ukraine). Ukrzaliznytsia also supported the digitalization of state-citizen relations and the launch of the ‖Diia‖ project in 2020 in order to improve the quality of passenger service. Users of "Diia" can present an electronic certificate (ID) in the application when boarding the train [2, p.55, p.147].

In March 2019 Association of Industrial Automation of Ukraine (APPAU)

issued its own version of the Roadmap for Digital Transformation of UZ, which was sent to the relevant managers of UZ. There was no reply [11].

Apparently, there is neither a strategy (or a plan, or a program) of digitalization in Ukrzaliznytsia, nor a specific department for it at the moment.

But there are some individual projects on digitalization which we arranged according to the areas outlined by Vienna declaration (given in the fig. 1.).

1. *Smart technical operations.* The Ukrainian national operator of the industrial Internet of Things (0G network) "Sigfox Ukraine" has launched a new stage of digitization of Ukrainian railway transportation. The network of base stations built in 2021-2022 now provides rail car owners with the opportunity to track rolling stock in real time.

Previously, businesses received information about their cargoes and wagons with a significant delay, despite the fact that it was not free. From now on, we know not only where each car is at this moment, but also on which railway track it is located. This, in addition to everything else, makes it impossible to move wagons onto access tracks for grain theft. It is indicative that in just a few hours of operation the tracker can recoup the cost of its five-year operation. Thanks to the use of the latest monitoring technologies, the operator learns in time about unplanned operations with a wagon or a row of wagons at a station [12]. We see how the Internet of Things finds practical use in domestic logistics. The concept of tracking assets with the help of smart trackers and the Sigfox network has proven itself well on five continents, and Ukraine was no exception.

As for the future prospectives in this area, they could be an intellectual railway station, a self-diagnozed rolling stock, according to the Roadmap of Digital Transformation of Ukrainian Railways [13], which unfortunately remains out of attention of Ukrzaliznytsia's authorities.
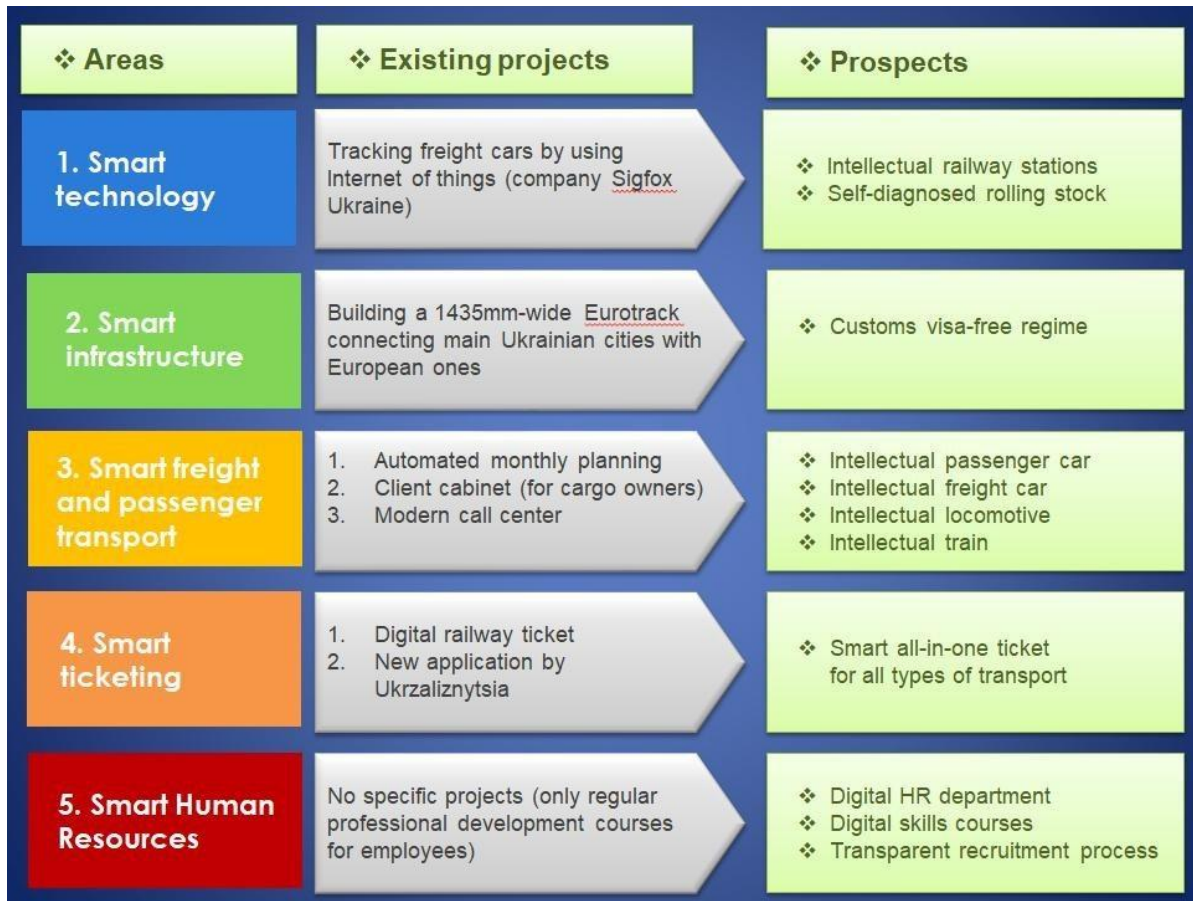
Fig.1. Existing projects and prospects of digitalization in Ukrzaliznytsia according to the areas outlined by Vienna declaration (worked out by the authors)

2. *Smart infrastructure.* Ukraine is announced to start construction of a narrow European gauge to connect its railway with the European one. According to Prime Minister Denys Shmyhal, at first it will be a connection of large hubs and large cities (Lviv-Kyiv, Lviv-Odesa, Lviv-Kryvyy Rih), and then a gradual expansion throughout the country.

In addition, Ukraine plans to sign a "customs visa-free regime" in the near future, that is, to join the Convention on a Joint Transit Procedure. This document, as he noted, is the basis for the movement of goods between EU member states. Technically, the country is ready for this. Such connection will significantly speed up customs clearance and speed up the flow of goods. This is the best quality of customs and new opportunities for Ukrainian business [14].

3. *Smart freight and passenger transport.* Ukrzaliznytsia will have implemented three projects related to the digitalization of freight transportation by the end of 2022 (according to [15]). The biggest project is the update of the transportation planning system of the automated "Monthly Plan" system. The second project concerns the creation of an electronic client's office with many possibilities: exchange of letters and electronic document flow, reports of completed works, tax invoices with digital signatures, and issuance of a transport document. The third project concerns the modernization of the customer service call center. Work is also underway to create an office for large clients. In addition, it is planned to automate the planning process as much as possible [15].

As for the future prospectives in this area, we see this as implementation of an intellectual carriage, an intellectual train, an intellectual locomotive and an intellectual freight car concept, according to the Roadmap of Digital Transformation of

Ukrainian Railways [13]. For instance, intellectual carriage and train can include E-commerce on board: the sale of goods and services to the passenger, which can be provided immediately or upon arrival at the station, passenger control of car elements: lighting (individual, in a compartment), microclimate in a compartment.

4. *Smart ticketing*. This area is the most developed in Ukrzaliznytsia as it implemented digital booking and paying for tickets several years ago and provided acceptance of such tickets by train conductors without printing them out (in a smartphone), which is extremely convenient and easy as well as returning tickets and getting a refund. Additionally, a new application has been launched by Ukrzaliznytsia recently, where passengers can buy and return tickets for all long-distance trains in Ukraine, receive notifications about the route and the way of arrival/departure of the train, and so on [16].

The next step in Ukrzaliznytsia digitalization will be the development of a new website, a single portal for on-board services and the development of online ordering for the usual railway services: transportation of a car in a carriage, services of station porters, search for lost things, booking a lounge, etc. Undoubtedly, onboard information and entertainment services in carriages, as well as dynamic updating of information support about schedules at stations and stops for passengers will be extremely useful, especially for development of railway tourism.

There is also a smart all-in-one ticket, which is a single ticket for all types of city public transport. Its pilot project started in 2020 in Kyiv. It is planned to cover all types of passenger transport to increase convenience during the purchasing process.

5. *Smart human resources.* This area is the least developed in Ukrzaliznytsia and, unfortunately, there are no specific projects on digitalization in it. Only regular professional development courses for Ukrzaliznytsia's white collars are provided, according to the standards, once in 4 years. Which is why we suggested in our paper [17]

implementation of special courses on teaching digital skills that will enable digitalization in all spheres, especially in passenger transportation (for instance, for train conductors and train managers). Additionally, we suggest digitalization of HR departments so that their specialists will be able to deal with great amounts of employees' documents more efficiently and, therefore, boost effectiveness of dealing with personnel (as it is given in the article [18]). Moreover, it might bring to life a shift to transparency between employees and management, e.g. transparent application and recruitment process, transparent remuneration and feedback. But we should admit that a great problem connected with nepotism and corruption makes aforementioned shift highly unlikely and this is an urgent problem to cope with.

This is not the only problem which impedes the process of digitalization in Ukrzaliznytsia. We have identified main problems with the help of a cause-effect diagram (Ishikawa diagram) which is presented in the fig.2.

The main identified problems appeared to be caused by financial factors (lack of investments), human factors (ineffective staff motivation and managers' reluctance to change), technical factors (insufficient technical level of fixed asset) and organizational factors (no system approach to digitalization). To our mind, the crucial factor that should be solved first is manager's reluctance to change. Despite the fact that some of the managers claim digitalization as an important way of increasing Ukrzaliznytsia's performance, apparently the management system is highly corrupted and therefore is not interested in transparency which the digitalization brings, in working out any digitalization strategy and organizing a relevant department in its structure. Should this great obstacle be overcome, others are solvable, especially with the help of European railways, as it is promised in Vienna Declaration on commitment to support Ukrainian Railways [19] signed on July 9th, 2022.
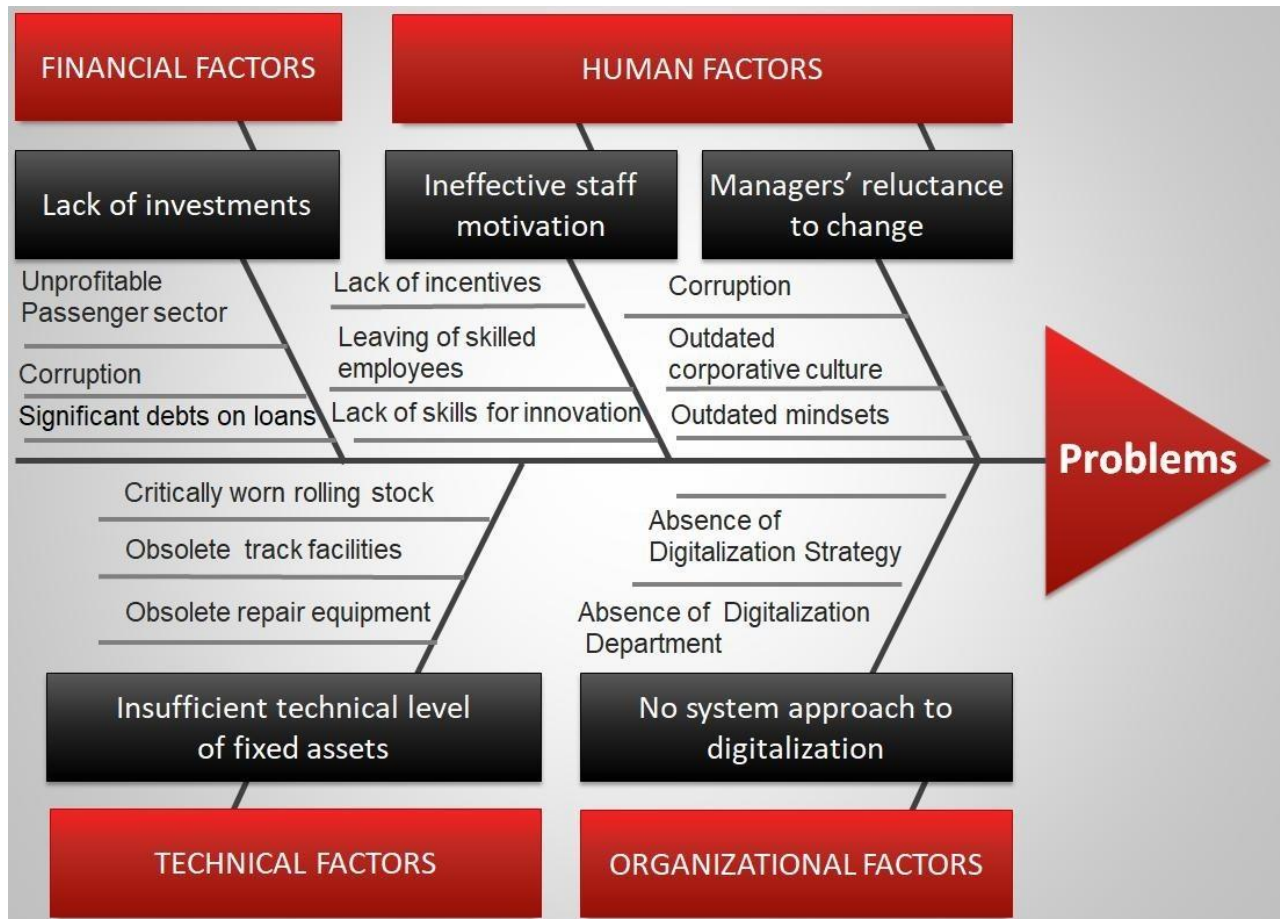
Fig.2. Cause and effect diagram of factors impeding digitalization in Ukrzaliznytsia (worked out by the authors)

Conclusions and prospects for further research. In this paper we have outlined the main priority areas in digitalization of Ukrzaliznytsia according to the ones stated by the Community of European Railway and Infrastructure Companies in Vienna declaration, and also analyzed the current situation regarding digitalization in Ukrainian railway transport in each of these areas. The priority areas are Smart technical operations, Smart infrastructure, Smart freight and passenger transport, Smart ticketing, and Smart human resources. There are a few projects implemented by Ukrzaliznytsia (such as tracking rolling stock in real time with the help of the Internet of things, digital ticket, updating the automated "Monthly Plan" system, creating an electronic client's office, modernizing the customer service call center, etc.) and several ones which are in progress.

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official Strategy or Programme of digitalization in Ukrzaliznytsia and consequently, a relevant department in its structure. Should this great obstacle be overcome, others will be solvable, especially with the help of European railways, as it is promised in Vienna Declaration on commitment to support Ukrainian Railways.

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