Digitalization of the transport industry: social-and-psychological emphasis

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Abstract. The transport industry is currently undergoing digital transformation in almost all respects, which is replacing automation. The process of digital transformation of transport is closely related to the implementation of long-term development programs for Smart Cities. The changes caused by the digital transformation of transport will have a positive effect on every urban resident and on society as a whole, especially in terms of reducing travel time, the number of errors in traffic schedules, reducing the number of traffic jams and reducing the size of land allocated for parking, improving the environmental situation in cities. The authors, based on existing developments and the results of their own research, identified and characterized the social-and-psychological components of the scenarios of digital transformation of urban transport. It is necessary now to pay attention to such social-and-psychological emphasis of the digitalization of the transport industry, such as rising unemployment among drivers, the development of sharing and car-sharing against the background of a lack of psycho-emotional satisfaction from the services provided, and social and physical isolation. These negative factors are seen as a signal for the development of proactive actions.

1. Introduction

In modern conditions of rapid changes, including the introduction of smart technologies into the urban environment, we can see the quick appearance of functioning data centers, smart sensors, automated power grids, intelligent transport systems on roads and other elements of high-tech infrastructure. All these innovations cease to be exotic exhibits, become an everyday component of the social structure of society. There are a lot of examples in the world: Smart London Initiative in Great Britain (London), IBM Smarter Cities technologies in Spain (Madrid, Barcelona), prototype of a new generation highway in the Netherlands, Smart Mobility project in Singapore and many others.

Digitalization, as a term, is not yet available in dictionaries. In addition, terms such as "digitalization", "informatization", "automation" can be used in modern speech and texts as synonyms. We consider it necessary to differentiate these concepts with a view to their correct use in the future.

Among the works available for study, especially dedicated to the digital economy, there is often a reference to N. Negroponte. N. Negroponte, based on the experience of the 1970-1980s and the first half of the 1990s, describes the process of digitalization, digitization, as well as a variety of devices that can change the world in the future [1]. In our paper, digitalization is broadly understood – as a total transition to the "digital", to digital technology, digital solutions, taking into account the principle of consistency. The transition from analogue (continuous, transmitted as continuous waves) to digital (discrete, transmitted as binary code) signal transmission, is implied. We are not studying the specifics
Automation is the use of technical means, economic and mathematical methods and management systems that relieve a person partially or completely from direct participation in the processes of obtaining, converting, transmitting and using energy, materials or information [2].

Informatization is a global process of production and use of information as a public resource, based on the mass introduction of technologies for the collection, processing, storage and transmission of information [3].

Technology is a combination of methods and tools to achieve desired result; a method for converting; production method [4].

Information technology (IT) or information and communication technology (ICT) is a combination of methods, production processes, software, technical and linguistic tools that are integrated to collect, process, store, distribute, display and use information in the interests of its users [5].

Among these terms, it is obvious that informatization is a generalized concept, and automation precedes digitalization (in the dictionaries of the 1990s the term “automation” is defined, but there is neither “informatization”, nor, moreover, “digitalization”). We follow the view that automation acts as the stage before digitalization. Digitalization, in turn, is a way to work with information.

In fact, digital technology was described by Klaus Schwab, founder and chairman of the World Economic Forum in Davos [6]. He has formulated the concept of Industry 4.0 in 2011. The twelve technologies of the Fourth Industrial Revolution (also known as Industry 4.0) are associated with the expansion of digital technology, the transformation of the physical world, human change, environmental integration: new computing technologies, block chain and distributed registry technologies, the Internet of things, artificial intelligence and robots, advanced materials, additive production and multidimensional printing, biotechnology, neurotechnology, virtual and augmented reality, generation, storage and transmission of energy, geo-engineering, space technology [6].

Representatives of specialized authorized Training Center for corporate learning on Big Data mention five differences of digitalization from automation:

1. The presence of common information environment for the continuous exchange of data between various fields of activity and structural units (unified platform)
2. The presence (design) of a virtual twin of the main production facility
3. The continuous nature of data management throughout the entire life cycle of an object
4. The possibility of advanced management through predictive analytics tools based on Big Data
5. The flexibility of corporate culture due to the operational interaction of geographically distributed employees via the Internet [7].

In almost every way, the transport industry demonstrates indicators of digital transformation. Transport is a set of man-made means to move people, various cargoes and information in space. The term “transport” comes from lat. «trans» (through) and «portare» (carry) [8]. Transport meets one of the most important human needs - the need for moving. Unlike other sectors of the economy, the transport industry does not produce material products, and therefore, there is no way to accumulate them, to create a reserve, we can talk about reserves of bandwidth and freight capacity. Almost half of the operational costs of transport are depreciation, fuel, and electricity. In addition, the transport market does not sell goods, as in industry and agriculture, but the production process itself, which determines the requirements for the efficiency and quality of the industry [9]. Uninterrupted interaction of individual parts of the transportation system is ensured by the organization of the work of the Unified Transport System (ETS) complex, which is a combination of various types of transport in the country, their integrated development, and the relationship of interaction [9]. Nowadays, automation of the processes of the transportation system is being replaced by digitalization. For example, the work of taxi fleets: automation is the fixing and processing of orders in the Excel spreadsheet, and digitalization is the rejection of taxi fleets altogether in connection with the functioning of a unified platform (Yandex. Taxi, Uber, etc.).
Social-and-psychological categories, such as personality, social group / community, communication and interaction \[10\], other social phenomena, are of most interest to us. We believe that the separation of technical and humanitarian fields is impossible. The purely technocratic approach damages humanity, which is reflected in the writings of authors rethinking the technocratic paradigm (G. Marcuse, J. Elul, K. Kastoriadis, J. Habermas, Marcos Garcia de la Gouerta) \[11\].

2. **Methods**

Domestic experience in introducing digital technologies in the transport industry is no less indicative than foreign one. The transport system of the world, having a heterogeneous structure, is developing in unified direction. The interaction of the space of movement of different countries enriches capabilities of each person, allows foreseeing possible negative consequences, and allows you to consider the variability of digital transformation.

The social and scientific importance of transport, in addition to economic, defense and political importance \[8\], it seems fundamentally important for us, since the social-and-psychological aspects of the digitalization of transport industry, in our opinion, help to keep the development of technologies in line with the focus on the health and comfort of human life, to prevent situations where the harm of innovations exceeds the benefits.

We examined the digital transformation of transport through Smart City programs around the world with a focus on social-and-psychological factors. The top positions were taken based on several international ratings, compiled according to slightly different criteria. We highlighted Singapore as an example, because Singapore invariably present in all these ratings: “2018/19 top 50 smart city government rankings” \[12\] (Singapore – second place after London), “Top 10 Growing Smart Cities” \[13\] (Singapore – first place), “The 7 Top Smart City around the world” \[14\] (Singapore – second place after New York), “Top 5 smartest Smart Cities in the world” \[15\] (Singapore – first place), “IMD Smart City Index 2019” \[16\] (Singapore – first place).

Zahraei S.M., Kurniawan J.H. and Cheah L. studied the opinions of experts and focus groups, used the scenario planning method to anticipate the development of Singapore as a smart city \[17\]. We have identified the social-and-psychological components of the two main scenarios, correlated them with the available developments of social psychologists and the results of our own studies.

3. **Results**

Since the 2000s, when the concept of smart city was formed, which has since quite quickly become an integral part and even the foundation of modern cities. Residents of various settlements, especially townspeople, are dynamic, the modern pace of life is very high, but the transition to the category of smart city is characterized, among other things, by the transfer of activity from muscle to technical, mechanical, electronic. Communication, overcoming distances, labor, education are transferred to virtual space, which is a projection of physical reality. Security is provided by video surveillance systems. Live emotions are packed into a set of limited symbolic parodies. Conditions are created for attenuation and even the loss of mechanisms of physical and mental plasticity, self-preservation, emotional response, mental activity, and social skills. Stress was a partner in industrial society, and emotional and cognitive coarsening can become a partner in the smart, digital society.

Zahraei S.M., Kurniawan J.H. and Cheah L., who explored scenarios for the development of Singapore’s transportation system (urban mobility) until 2040, proposed two main scenarios: Common World and Virtual World \[17\]. Moreover, according to the criteria selected by the group of authors, general conclusions were described. For example, according to the “Demography” criterion, there has been a population growth due to the influx of migrants and non-residents, with a quarter of the total population being elderly people, which means that planning for future urban transport should take into account the needs for movement and work of these social groups. Criteria such as technological progress and increased environmental awareness suggest that the development of civilization in the direction chosen by mankind makes sense only with a developed environmental awareness and compliance with “green” norms.
The “Common World” scenario clearly highlights two key aspects: general mobility (an innovative transport strategy for short-term users’ access to various modes of transport as necessary) and multi-zone areas. Multi-zone areas cover approximately 3-4 square kilometers and consist of clusters of self-sustaining zones (residential neighborhoods along the perimeter, centers of commercial, educational activity and health care, metro stations and other facilities), which radically changes the structure of trips and reduces their number. For example, these are autonomous shuttle buses; refusal of personal cars in favor of car sharing; emphasis on convenience when traveling short distances; developing innovative ways to provide people (including seniors and low-mobile persons) with accessible services and amenities in each area; round-the-clock work of the centers and flexible work schedule of employees whose place of work is as close as possible to their place of residence (or does not require moving at all, thanks to the use of a virtual reality headset), and the age of work activity reaches 80 years due to improved health caused by improved quality of life. Freight transportation will also change, people will stop mass shopping, and will use the delivery service. Even if they want to visit a real store, purchases are not picked up on their own, but delivered through underground tunnels [17].

According to the authors of forecasts, such changes will favorably affect each inhabitant and society as a whole, because the number of errors in the schedules of public transport will be reduced, the number of traffic jams and parking areas will decrease, which will positively affect the environmental situation and free up space in districts for other needs. On the other hand, the labor market will change, as the need for drivers will be reduced, extensive qualification retraining of existing personnel will be required.

Scenario “Virtual World”, virtual reality technologies (artificial intelligence and the Internet of things) play a key role in everyday life. Here, the concept of self-realization or / and individualism comes to the fore, as Internet access allows you to solve your problems without contacting other people. This includes the ambitious mobility project, based on the introduction of transport infrastructure, where individual capsules and containers move along electrified lines, recharge on the way, are completely autonomous. This imposes obligations on the government and the transport management to formulate and maintain an adequate legislative framework for determining the telecommunication rules necessary to ensure the smooth operation of the intelligent transportation system. Virtual and augmented reality extends the environment of real life and allows you to travel, meet, study, communicate without physical presence. City transportation is carried out through proactive logistics, goods are delivered by drones and robots. The number of interaction acts is reduced, as are the traffic jams [17].

According to Zahraei S.M., Kurniawan J.H. and Cheah L., such changes will also have a beneficial effect on every citizen and society as a whole, especially in terms of freeing up time reserves (remote work, artificial intelligence, automation and robotization, etc.) and environmental benefits. But this scenario has its obvious risks. For example, it sharply increases isolation, both physical and social, makes large-scale unemployment [17]. Possible social-and-psychological consequences of the digitalization of the transport industry are presented in Table 1.

| Technology                  | General characteristics | Comfort and convenience | Negative consequences                                                                 |
|-----------------------------|-------------------------|-------------------------|----------------------------------------------------------------------------------------|
| Smart city technology       | Introducing smart technology into urban infrastructure | Speed of delivery of goods / services, facilitation of everyday life | Strengthening the feeling of loneliness in crowded megacities due to the influx of population into cities, aging populations |
| Common Information Space    | Continuous data exchange | Uninterrupted functioning of the unified transport | Anonymizing social interaction, replacing live communication with virtual |
4. Discussion

Among the fascinating high technologies being introduced into the transport industry, the issue of preserving a person, human health, mental balance, and social status of an individual remains an acute issue for us. Personality is an indicator of human social nature. In this regard, changes in society affect the individual life of a person. We see how the convenience of using unmanned vehicles turns into problems. First of all, it is unemployment, the scale of which, due to the introduction of digital technologies, was designated by K. Schwab [6]. According to reports from companies such as McKinsey, by 2030, 800 million people may be left without work due to the automation / digitalization of work processes [18]. On the other hand, it is known that crisis periods serve as the basis for self-development (retraining, advanced training, the mastering of new areas for self-realization). But on a massive scale, the problem remains acute, because the feeling of security is reduced. The demographic issue (population growth and aging) reinforces concern on this issue.

Sharing vehicles creates the basis for interaction. This is the basis for the communication framework, inclusion in the common space of social connections. Optimism about this is again undermined by the virtuality of communication. In addition, the replacement of real, live employees with chat bots and mobile applications in order to simplify and speed up the process of providing transportation services can become frustrating, stressful factors. This is such a situation when mobility needs are satisfied, but at the same time they do not bring satisfaction in a psycho-emotional sense.

Isolation is another important social-and-psychological focus of the digitalization of the transport industry. Services remove the need for movement, many services are available "without leaving home". Closure on one’s own world filled with devices cuts off existing social connections. People are moving away from each other, forget about indicators of the quality of communication in the real, not virtual world. An example of extreme isolation is the hikkimori phenomenon (literally meaning “to stay indoors”) in Japan [19]. And this is not an example of introversion, autistic thinking or escapism. It is important that we do not seek to attribute to digitalization “all the evil of the world”, but we outline the trends and their extreme consequences. Another shocking Japanese phenomenon is kodokushi (literally - “lonely death”), it is directly associated by researchers with both the aging of the population and isolation [20].
5. Conclusions
The modern city, as a socio-cyber-physical complex, has powerful potential. The fears of modern researchers are often associated with the fact that technology can become both the salvation of mankind and a weapon of mass destruction.

The researchers can determine the formation of dominant trends now. The development of technology and civilization as a whole has repeatedly come across the situation of the need to make a decision and make a choice in one direction or another. For example, at the beginning of the XX century, it was impossible to say what would be more relevant: steam, electric or gasoline engines. Both electric cars and their gasoline counterparts were equally popular. Then, over the course of several years, it became clear that the future is in the internal combustion engine, because there was no talk of a shortage of oil supplies, the ozone layer and global warming. Now the future prospects lie in the efficient use of affordable energy sources [21]. For hundred years, the automotive industry and the whole world have faced new challenges, what is going on to this day. Therefore, the desire to predict the future remains an urgent topic of today and now you should pay attention to such social-and-psychological emphasis of the digitalization of the transport industry as large-scale unemployment, the development of sharing and car-sharing on the background of a lack of psycho-emotional satisfaction from the services provided and total isolation. The negative connotation for us is not a reason for refusing to develop the technology, but a signal for the development of proactive actions.

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