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Analysis of the influence of information and communication technologies on the development of transport and logistics activities in the regions of the Arctic zone of the RF

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Abstract: The paper describes the features of the development of transport and logistics activities in the regions of the Arctic zone of the Russian Federation. The main factor of successful logistics activities is the level of development of information and communication technologies that ensure necessary coordination of participants in logistics activities. The paper presents the results of the analysis of the ICT development in the regions of the Arctic zone of the RF and concludes that the development of the transport and logistics system in the regions of the Arctic zone of the RF is determined by the level of ICTs.

1. Introduction

In the Arctic regions, information and communication technologies (ICTs) play a special role in ensuring and coordinating effective logistics activities. In the current context, implementing various types of logistic activities such as transportation, industrial logistics, procurement, inventory logistics, customs activity, is associated with the use of information (or digital) technology. The use of ICT allows for growing economies of scale [1], logistics services are becoming more digitalized. Effectiveness of any of these activities is determined by the degree of development of digital technology [2, 3, 4].

Such a technology as the Internet considerably improves the lives of its users, regardless of their location and the type of activity; it helps to eliminate certain logistical limitations of regional business models, gives the opportunity for creating a competitive environment for enterprises located in remote regions, and contributes to the development of innovative products and services [5, 6, 7]. As a result, the use of ICT provides numerous economic and social benefits to certain regions.

2. Lines of research

2.1. Description of the logistics services of the Arctic zone

Transport and logistics is a strategic activity for the Arctic zone. In the regions of the Arctic zone of Russia, all modes of transport are developed to various extents: rail, road, freight, marine, aviation, and pipeline.

The most significant form of transportation is marine transport. The main transport arterial remains the Northern Sea Route, which connects such large centers as Murmansk and Arkhangelsk with the sparsely populated territories of Yakutia and Chukotka. The Northern Sea Route functions not only to
satisfy the internal needs of the northern territories, but it is also developing as an international mainline [8, 9, 10, 11].

Rail and road transport are less developed in the Arctic zone and are aimed at the delivery of goods and raw materials to sea ports [12, 13].

The remote location of the Arctic regions requires the use of air transport [14]. The airports available in the Arctic are mainly intended for small aircraft which is important for the current life of the regions [15,16]. Pipelines in the Arctic zone transport oil and gas to sea ports.

Improving the operating conditions of transport and logistics companies in the Arctic zone will increase accessibility of territories, reduce excessive transport costs, and improve the living standard of the population.

2.2. Analysis of the development of information and communication technologies in the regions of the Arctic zone of the Russian Federation

Information and communication technologies, as well as the emergence of relevant services and applications, are proceeding rapidly and are being applied in various areas of the economic activity. Various ICT applications are related to the introduction of "cloud services" and the use of Big Data technologies [17].

Here are the main areas of applying some information and communication technologies in the transport sector.

1. Optimization of capacity for transport units and transportation routes, tracking goods on-line throughout the entire route. Only modern innovative ICTs enable us to implement tasks of such a high level. There are many solutions to reduce the time of goods delivery and the costs associated with it, to plan and track the movement of goods in the most efficient way. Such solutions are available for all types of transport, but in particular they have been extensively developing in road transportation with the advent of GPS-navigation, which allows real-time tracking of the location for each transport unit.

2. Optimization of connecting operations between different modes of transport during the transportation of goods. In this case, there is a need for coordination during the transition from one data processing system to another, due to existing regulations in different transport sectors. Modern innovations such as using GPS monitoring (by means of GLONASS satellite system), virtual distributed computing (or cloud computing) and Internet services make it possible to achieve the goals of the modern logistics.

3. Taking into account the peculiarities of international passenger transportation and goods traffic, only a free transport corridor allows for timely delivery of goods, which is the key to increasing competitive advantages of companies. Creating an integrated Eurasian transport system, a united open information space based on the Internet, common standards for processing and transmitting information is the basis of global integration in the field of transport logistics.

Transport logistics can no longer be imagined without special Internet services that enable you to design goods delivery channels and supply chains, without prototypes of virtual forwarding services, without transport route planners that allow you to interactively create routes. Internet video windows enable dispatchers of transport companies to monitor the situation in the border areas, in places of transshipment of goods, to control transportation on request. In addition, we should mention a large international logistics and telematics program TEDIM, which is intensively implemented [8].

For transport and logistics activities in the regions of the Arctic zone, the practical need for applying ICT is caused, in addition to the above reasons, by the fact that due to harsh climate conditions, using satellite communication systems is absolutely necessary for marine navigation in order to receive information from the meteorological and maritime security services [18, 19]. The Ministry of Transport of the Russian Federation has developed the concept of a unified secure information and telecommunication system for the transport complex of the Arctic zone [20]. Reliable information and navigation environment is the basis for the safe and efficient operation of the transport complex of the Arctic zone of the Russian Federation.
One of the ways to assess whether the regions are ready to use the existing information and communication technologies is such an indicator as the ICT development index. Its components are presented in Table 1. The ICT Development Index in the world is calculated by the methodology of the International Telecommunication Union. According to a 2017 study, Russia ranked 45th in the ICT development ranking.

### Table 1 ICT Development Index Scorecard (Based on the data of the International Telecommunication Union. [https://www.itu.int](https://www.itu.int))

| Sub-indexes                  | Content                                                                                                                                                                                                 |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ICT access sub-index        | the number of telephones of the local telephone network per 100 population; the number of connected mobile radiotelephone terminals per 100 population; bandwidth of international Internet channels per Internet user; the proportion of households with a personal computer in the total number of households; the proportion of households with Internet access in the total number of households |
| ICT use sub-index           | the proportion of the Internet users in the total population; the number of fixed broadband Internet subscribers per 100 population; the number of mobile broadband Internet subscribers per 100 population |
| ICT skills sub-index        | adult literacy rate; the proportion of secondary school students in the total population; the proportion of students in higher education in the total population.                                           |

Since this index does not provide information on the level of ICT development in certain regions of the Russian Federation, it was decided to assess the development of ICT on the basis of indicators such as the number of personal computers, information and communication technologies costs, and also use of the digitalization index calculated according to the Skolkovo methodology.

Assessment of ICT development in the regions of the Arctic zone of the Russian Federation was carried out using statistical information from the Federal State Statistics Service (data are shown in Tables 2 and 3).

The analysis showed that between 2012 and 2018, the number of personal computers increased significantly in the Chukotka Autonomous region (70.7%) and the Nenets Autonomous region (57.7%), a slight rise was observed in the Komi Republic (8.8%) and Murmansk region (6.7%) (see Fig. 1).

The costs for information and communication technologies in the regions of the Arctic zone of the Russian Federation for the period under review varied unevenly by region (see Fig. 2). In the Nenets Autonomous region the costs decreased by 73.5%, in the Arkhangelsk region they fell by 41%. In the Murmansk region the costs increased by 32%, in the Komi Republic the growth was 30%.

### Table 2 Number of personal computers in the regions of the Arctic zone of the RF. (Based on the data of the Federal State Statistics Service. [https://showdata.gks.ru](https://showdata.gks.ru))

| Region          | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | Change from 2012 to 2018 (%) |
|-----------------|-------|-------|-------|-------|-------|-------|-------|----------------------------|
| Komi Republic   | 89661 | 95549 | 96129 | 96122 | 96852 | 96529 | 97591 | 8.8                        |
Table 3. Costs for information and communication technologies in the regions of the Arctic zone of the RF (Based on the data of the Federal State Statistics Service. https://showdata.gks.ru)

| Region                    | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | Change from 2012 to 2018 |
|---------------------------|--------|--------|--------|--------|--------|--------|--------|--------------------------|
| Thousand roubles          |        |        |        |        |        |        |        | %                        |
| Komi Republic             | 553462 | 5643895| 6919114.2 | 6924738 | 7323151 | 8752322 | 721630 | 30.38477                 |
| Arkhangelsk region        | 4.8    | 4.8    | 4.8    | 4.8    | 4.8    | 4.8    | 4.8    | 4.8                      |
| Nenets Autonomous region  | 837447 | 13913630.8 | 4773447.2 | 7604444 | 9071670 | 5460412 | 494058 | -41.0042                 |
| Saha Republic             | 396089 | 10511923.7 | 2139302.5 | 1518484 | 2779217 | 1685274 | 104949 | -73.5037                 |
| Chukotka Autonomous region| 3.3    | 7      | 7      | 7      | 7      | 7      | 7      | 7                         |
Figure 2. Costs for information and communication technologies in the regions of the Arctic zone of the RF.

Table 4 Digitalization Indexes in the regions of the Arctic zone of the RF. (Based on the data of Skolkovo. https://finance.skolkovo.ru/downloads/documents/FinChair/Research_Reports/SKOLKOVO_Digital_Russia_Report_Full_2019-04_ru.pdf)

| Region                        | 2018 score | 2017 rank | 2018 score | 2017 rank | Change in 2018 to 2017 score |
|-------------------------------|------------|-----------|------------|-----------|----------------------------|
| Saha Republic (Yakutia)       | 71.11      | 18        | 60.36      | 17        | -1                         | 17.81%                          |
| Murmansk region               | 68.84      | 23        | 61.29      | 15        | -8                         | 12.31%                          |
| Komi Republic                 | 68.64      | 25        | 56.82      | 26        | 1                          | 20.80%                          |
| Arkhangelsk region            | 59.26      | 43        | 43.39      | 45        | 2                          | 36.58%                          |
| Nenets Autonomous region      | 49.5       | 61        | 39.43      | 52        | -9                         | 25.55%                          |
| Chukotka Autonomous region    | 41.64      | 80        | 25.19      | 85        | 5                          | 65.31%                          |
The analysis of regions’ positions in the ranking by the digitalization index showed (see Table 4) that the Murmansk region in the ranking of 2018 moved 8 positions down, the Nenets Autonomous region also worsened its position and moved 9 positions down. The rankings of the Republic of Komi, the Arkhangelsk region and the Chukotka Autonomous region have improved.

3. Research findings
The results are rather contradictory: the costs for ICT in the Murmansk region are growing, but the overall level of digitalization is decreasing and, on the contrary, the Arkhangelsk region is showing an increase in the level of digitalization in the context of reduced ICT costs.

In general, it can be said that the regions of the Arctic zone of the Russian Federation, where a low population density is observed, are not adequately provided with broadband due to vast geographical distances, the lack of necessary infrastructure and service providers, as well as the high cost of connection.

The costs of information and communication services tend to decrease in almost all the regions under study, with the exception of the Murmansk region. One of the reasons for this may be that in the field of transport and logistics in this region, a greater number of projects are being implemented.

4. Conclusions
Currently, the development and reliability of the transport and logistics system of the Arctic zone is largely determined by the state of information and communication technologies and the willingness of economic entities to use the latest achievements in the field of digital technologies.

5. Directions for future research
Further research aims to specify the factors and indicators that characterize the level of transport and logistics system as well as the level of information and communication technologies in the regions of the Arctic zone of the RF and to find a correlation between them on the basis of statistical modeling.

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