



POTENTIAL FOR ESTABLISHING REGIONAL CYBER-PHYSICAL SYSTEMS AS A NEW CLUSTER MODEL FOR TOURISM DEVELOPMENT

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ABSTRACT

The regions of the Volga Federal District have experienced a notable increase in tourism and recreation indicators in recent years. These indicators include the emergence of new collective accommodation facilities, the establishment of tourism clusters and the development of their digital infrastructure, the emergence of modern national digital services and platforms in the tourism industry, an increase in effective demand, etc. The paper aims to analyse the administration of the local systems in the Volga Federal District, which represent a new model of cluster establishment. It also analyses the key indicators of tourism and recreation in various regions. In the context of Industry 4.0 and the digital transformation of the tourism sector, the setting up of local cyber-physical systems is suggested as the main strategy for local system development. The primary strategy and mechanisms for enhancing the development of the tourism sector in the Volga Federal District are outlined in this research. The paper provides, among others, quantitative and qualitative indicators of the development of local systems in the Volga Federal District's tourism industry; local tourism systems are examined from the perspective of the cluster approach.



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1. INTRODUCTION

The tourism and recreation industry is a rapidly expanding and actively developing sector of the economy. The multiplicative development of tourism and recreation entails joint advancement in a variety of spheres, including but not limited to catering, hotel services, hospitality, advertising, agriculture, and insurance (Dmitriev,2012). The development of tourism and recreation overall is facilitated by the development of digital platforms and services. All these demonstrate how important it is to establish fully functional digital ecosystems in order to support the development of tourism and recreation both at the cluster and economic entity levels.

According to V.V. Lezhnin, local cyber-physical systems represent a number of interconnected economic agents whose primary goal is to supply goods for the tourism and recreation business. It is suggested that local cyber-physical systems be established as the primary way for local system development in the context of the digital transformation of the tourism industry and the emergence of Industry 4.0.

A regional economic system of the cluster type, the local cyber-physical system in the tourism industry integrates digital technologies into a variety of biological and man-made physical objects, such as cultural heritage sites, and into the operations of tourism-related economic entities. Digital components

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are dispersed throughout all participating organisations in local cyber-physical systems, enhancing the quantity and quality of synergistic effects resulting from their networking (Gorbunov & Kolyadin & Burnyasheva,2018). The structure of the local cyber-physical system is depicted in Figure 1.

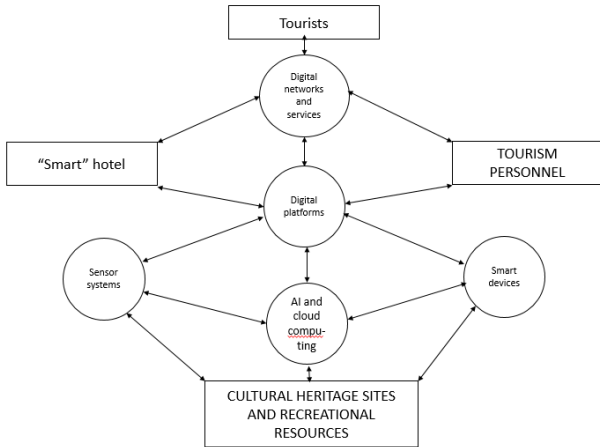


Figure 1. Local cyber-physical system in the field of tourism (compiled by the authors).

Local cyber-physical systems present a novel approach to cluster organisation in tourism and recreation. They support the development of novel tourism-related products, the introduction of new goods and services onto the market, and the demand for fresh concepts and means of bringing these concepts to market. The technological contours of the local cyber-physical system are presented in Figure 2.

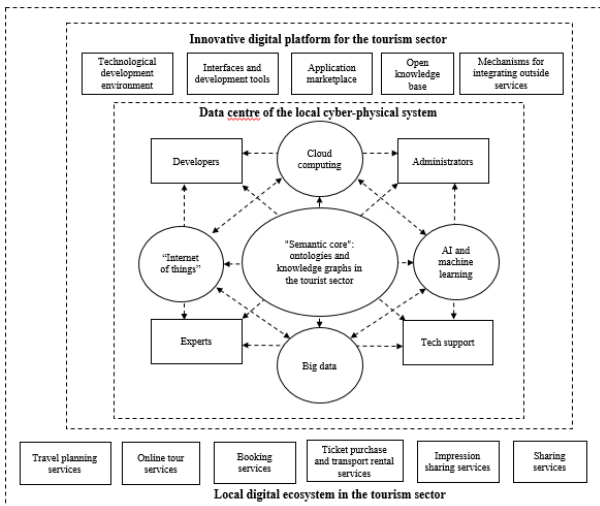


Figure 2. Technological contours of the local cyber-physical system in tourism (compiled by the authors)

The Volga Federal District of the Russian Federation, which comprises 14 regions, was selected as the object of research. Each region's local systems were analysed, the main tourist clusters in the Volga Federal District were examined, the local systems and tools of the cluster organisation of the tourism sector were studied, and the leading and outsider regions in terms of the

development of local systems were identified. The current study looks at how local systems are developing in the Volga Federal District (Linitseva,2006). Other regions of the Russian Federation will be considered in future research.

The primary goal of the project is to determine whether regional cyber-physical systems may be developed as a new paradigm for cluster organisation in the Volga Federal District's tourism and recreation industry. Finding out whether local systems in the tourism and recreation sectors have a chance of developing successfully involves the following core responsibilities: 1) management assessment of the local systems in the economic entities of the Volga Federal District; 2) consideration of management aspects in the local systems of tourism and recreation in the Volga Federal District; 3) analysis of the leading regions in the Volga Federal District in terms of the development of local systems in tourism and recreation.

The object of research is the activity of local cyber-physical systems in tourism and recreation in the Volga Federal District. The research focuses on local system management methods and advances in technology in the tourism and recreation sectors of the economy.

The characteristics that define economic activity also determine how the tourism and recreation sectors operate. The territorial characteristics of the regions, in addition to a variety of services and tourist products, the establishment and operation of tourism clusters, the "industry of impressions," and the tourist and recreational infrastructure made available to visitors, must be taken into consideration when analysing the local systems of tourism and recreation in the Volga Federal District (Lezhnin & Polukhina & Lyakhnitsky,2019). These factors all help to create a wide range of tourism and recreation products that are tailored to the target market's needs.

2. RESEARCH METHODOLOGY

National and foreign researchers focused their scientific efforts on analysing, searching for, and identifying opportunities and solutions to problems that arise in the context of managing regional cyber-physical tourism systems. We specifically acknowledge the contribution of the following national researchers: A.A. Alekseev, V.G. Guliaev, A.S. Zapesotskii, E.N. Iliina, A.V. Kalashnikov, G.A. Karpova, V.I. Kruzhalin, A.A. Mammadov, M.A. Morozov, N.S. Morozova, G.A. Mashukhova, and G.A. Papiryan.

Foreign studies of the development of local systems in the tourism sector are represented by the works of D. Bowen, R. Brymer, Y. Jablonsky, N. Kim, L. Minnart, S. Merwe, S. Mornarty, D. Walker, W. Wells, F. Urban, G. Harris. The following Russian researchers considered the development of economic

systems in the tourism sector: I.T. Balabanov, V.S. Bogolyubov, Ia.V. Dracheva, M.A. Zhukova, L.V. Kostareva, T.A. Lavrova, S.V. Lazovskaia, N.I. Larina, N.K. Larionov, A.L. Leonov, V.V. Leontev, T.V. Lvova, E.A. Maksarova, I.V. Pilipenko, I.I. Reshetnikova, Iu.V. Saveliev, V.S. Senin, S.A. Stepanova, A.A. Tatarinov, T.V. Cherevichko, G.A. Iakovlev. The following representatives should be referred to as foreign specialists studying the development of economic systems in the tourism sector: T. Bieger, R. Butler, O. Garrett, M. Green, S. Jackson, K. Cooper, N. Leiper, S. Pike, P. Pierce, B. Spencer, D. Tribe, A. Hartl, A. Hirschmann, K. Hall, J. Holloway, G. Wall, D. Fletcher, M. Enright.

The issues of clustering as a means of organizing the tourism and recreation spheres are taken into consideration in the works of A.M. Pakhalov and D.G. Sachs, as well as the key methods for developing cluster policies in the Russian Federation's regions and a statistical analysis of cluster improvement. The identification of a tourism and recreation cluster was proposed and investigated by O.N. Kostriukova and E.G. Karpova. A broad strategy for the establishment and administration of cluster development in the Russian Federation's regions was developed by T.I. Klimenko in her academic research, "Building a management system for sustainably balanced cluster development in the region". N.N. Pidgurskaia presented a methodology for tourism cluster research in her work, "Cluster Approach to Tourism Regulation in the Region". L.N. Fedorets viewed the management component of local systems in the Russian Federation's regions as a mechanism for clustering.

Local tourism cyber-physical systems are being researched under the "Tourism 4.0" digital platform, which showcases the industry's primary technological opportunities. The issue of how global economic trends are affecting tourism is brought up in the publications by E.A. Frolova. Researchers N.G. Ustinova and I.V. Bogomazova examine how local systems and tourism clusters in the region are being digitally transformed. N.I. Osipova observes how clustering affects the development of cyber-physical local systems in the Russian Federation's tourism and recreation business.

A.V. Bobkov, S.A. Bogoliubova, O.S. Boronin, D.V. Vasilikh, D.D. Kushnir, M.O. Manvelian, E.A. Mashkovich, E.L. Pisarevskii, V.I. Suslov, L.I. Ushivitskii, and S.N. Iashina elaborate in their research works on the particular aspects of the development of tourism infrastructure in the cyber-physical local systems of regional economies. F. Wellas, L. Dwaer, S. Leon, A. Papateodorou, P. Forsyth, and A. Hernandez stand out among international researchers by addressing the development challenges related to tourism infrastructure and their role in regional development.

Certain recreational and tourism products offered in the Volga Federal District's cyber-physical local systems necessitate significant financial investments in the regions' tourism infrastructure and high quality of service (Republic of Tatarstan, Republic of Bashkortostan, Nizhny Novgorod region, etc.). Some regions, including the Republic of Mari El and the Chuvash Republic, have underdeveloped tourism and recreational infrastructure as well as little funding for tourism development (Polukhina & Sheresheva & Rukomoinikova & Napolskikh, 2016). The main outcome of tourism and recreational activities in the Volga Federal District is the organisation of tourism supply on the national market. An example of such an indicator, the number of UNESCO World Heritage Sites in the regions, is required while analysing the tourism potential in the local cyber-physical systems of the Volga Federal District.

This indicator shows that the Republic of Tatarstan, which is home to three sites—the Assumption Cathedral, the Kazan Kremlin, and the Bulgar architectural complex—is in first place in the Volga Federal District. Veliky Novgorod, which is part of the Novgorod region, is home to another UNESCO World Heritage Site (the historical monuments of Veliky Novgorod and the surrounding area). It is important to consider a prospective number of popular tourism destinations within the Volga Federal District (Maximova, 2020). The Republic of Bashkortostan, the Samara region, and the Perm Territory are examples of such regions (where there are a significant number of visited and potential tourist sites). The following issues must be addressed in order to analyse the managerial aspect of the development of local tourist systems, using the Volga Federal District as an example: 1) the number of cultural heritage sites in the regions of the Volga Federal District; 2) the number of archaeological heritage sites; 3) the number of tourists using accommodation facilities in 2022-2023.

3. RESULTS AND DISCUSSIONS

3.1 Analysis of cultural heritage objects in local cyber-physical systems of the Volga Federal District.

Based on statistics reporting data, cultural heritage sites located within local cyber-physical systems of the Volga Federal District's tourism and recreation sphere were studied. A comparative analysis of quantitative indicators of cultural heritage sites of federal and regional significance in the regions of the Volga Federal District was conducted by examining statistical data for the period 2022–2023 (Table 1).

In the context of this indicator—which is the existence of cultural heritage sites in the tourism sector—it can be inferred from the data in Table 1 that the Nizhny Novgorod area is the dominant economic entity in the Volga region. The Law No. 14-3, issued on February 2, 2016, "On Cultural Heritage Sites (Historical and Cultural Monuments) of the Peoples of the Russian

Federation Located in the Nizhny Novgorod region," defines the preservation of the sites within the region. This activity is financed by municipal budgets and extra-budgetary earnings in addition to the federal and regional budgets.

The following areas are where work is being done to ensure that cultural heritage sites are integrated into the Nizhny Novgorod region's tourism and recreational products: planning and hosting events on the grounds of regional cyber-physical systems devoted to cultural heritage preservation; developing cultural and educational tourism in the region; providing unrestricted access to cultural heritage sites for educational purposes; and publishing information and reference materials about Volga region cultural heritage sites (Platonova,2015).

Table 1. Quantitative indicators of cultural heritage sites (historical and cultural monuments) in tourism and recreation of the Volga Federal District for 2022-2023. (compiled by the authors).

Name of the region	Quantitative indicators of the cultural heritage sites in the region
Nizhny Novgorod region	3592
Perm region	3123
Republic of Bashkortostan	1861
Orenburg region	1712
Republic of Tatarstan	1663
Saratov region	1069
Republic of Mari El	1064
Samara region	1023
Ulyanovsk region	956
Kirov region	949
Republic of Mordovia	872
Chuvash Republic	724
Penza region	541
Udmurt Republic	428

Competent and high-quality planning of event tourism to uphold the region's increasing recognition and protection of cultural assets is one of the strongest points in the development of activities targeted at working with cultural sites in the Nizhny Novgorod region. Indicators of the functioning of archaeological

heritage sites, which are an essential component of cultural heritage and can be presented as objects of cultural and educational tourism, must be taken into consideration when analysing the activities of economic facilities and local cyber-physical systems in the field of tourism in the Volga Federal District. (Figure 3).

The Republic of Tatarstan is another region that has a large number of cultural heritage sites. Within the Volga Federal District, the Republic is the only territory that contains three cultural heritage sites listed on the UNESCO World Heritage List. The law "On Cultural Heritage Sites" of the Republic of Tatarstan governs the republic's efforts to control its cultural heritage assets. They are protected, preserved, and secured in terms of their use, and financial measures are determined in order to implement this law (Lezhnin & Terenteva &., Mukhomorova,2016) An assessment of the protection and safety of cultural heritage sites in the regions is conducted, and conditions for accessibility to the territory of cultural heritage sites for all tourism segments are provided.

In terms of the existence of cultural heritage sites on the territory of regional tourism and recreation systems, the Samara region and the Perm Territory are among the five economic entities of the Volga region (Zakharov & Ignatiev, 2012). The tourism and recreation sectors have the potential to grow in both regions, creating new jobs for people as well as new infrastructure and opportunities for development. The federal law "On Cultural Heritage Sites (Historical and Cultural Monuments) of the Peoples of the Russian Federation living in the Samara region dated December 8, 2008 No. 142- GD" governs the management and operation of cultural heritage sites in the Samara region's tourism and recreation sector (Ovcharenko,2018). Conditions have been established in the region for the preservation and increased popularity of cultural heritage sites in the tourism and recreation sectors: government agencies are working to control and oversee the sale of cultural heritage sites in the region, and targeted programmes are being developed and implemented to work with the historical and cultural resources of the region.

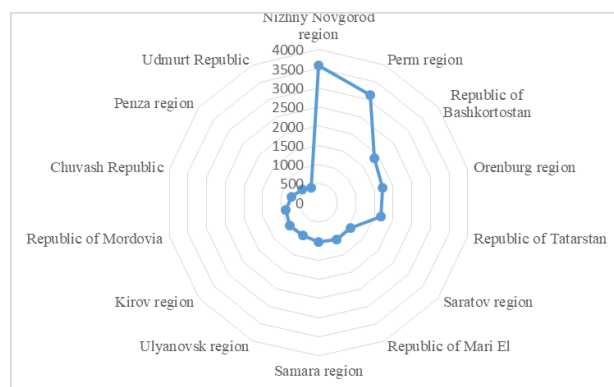


Figure 3. Quantitative indicators of cultural heritage sites in the regions of the Volga Federal District (compiled by the authors)

There are other regions beyond the Volga Federal District, such as the Penza region and the Udmurt Republic, in addition to the top regions in terms of how cultural heritage sites support tourism and recreation activities in the District. Based on the results of the analysis, we have identified the problems associated with integrating cultural heritage sites into the operation of the tourism and recreation sector. First of all, there has not been much effort put into rebuilding, restoring, or working with most of the areas' cultural heritage sites; therefore, they are in poor condition (Shcherbakova,2007). Second, there are instances of non-compliance with and violations of local regulations pertaining to the security and preservation of cultural heritage sites, such as violations of boundaries or failure to provide relevant information about the site.

3.2 Analysis of archaeological heritage sites in local cyber-physical systems of the Volga Federal District.

Quantitative indicators were analysed as part of the Volga Federal District's archaeological heritage research (Table 2). The research examines cultural and archaeological heritage sites to discover quantitative indicators in the economic entities of the Volga Federal District.

Table 2. Statistical indicators of archaeological heritage sites in the Volga Federal District in 2022-2023. (compiled by the authors)

Name of the region	Quantitative indicators of the cultural heritage sites in the region
Perm Region	1811
Orenburg region	1211
Republic of Bashkortostan	1219
Nizhny Novgorod region	946
Republic of Mari El	518
Kirov region	411
Republic of Tatarstan	277
Chuvash Republic	177
Saratov region	99
Udmurt Republic	70
Republic of Mordovia	69
Ulyanovsk region	46
Samara region	26
Penza region	21

Regarding the quantity of archaeological heritage sites in the Volga Federal District, the Perm Territory holds the leading position. A great deal of unique archaeological sites may be found within its borders, such as prehistoric settlements, caves, cemeteries, battlegrounds, sanctuaries, villages, grottoes, and artefacts from temple, industrial, and civil architecture (Linitseva L.N.). The law dated June 25, 2002 No. 73, "On objects of cultural heritage (historical and cultural monuments) of the peoples of the Russian Federation", governs the zones of protection of archaeological heritage sites in the Perm Region. The object of federal

importance known as the "Borodino I Settlement" is the best example of how architectural heritage sites have been incorporated into the Perm Region's tourism industry.

A number of activities are carried out at the Borodino I. Gorodishche site in accordance with the directives from the Ministry of Youth Policy of the Perm Territory. These include: carrying out a variety of maintenance works (ground works, economic activities, and construction) to preserve the archaeological heritage monument; providing free access to the monument for tourist groups and the local community; and doing jobs associated with the installation of identification and information posters on site.

Numerous types of soil that were produced as a result of human activity approximately a century ago are also to be protected, as are fragments and components of ceremonial, commercial, and residential constructions that humans built throughout history, as well as preserved artefacts from archaeology and human remains (Schmidt, 2008). As a result, we provided a graphical analysis of the Volga Federal District's commercial entities using the framework of the indicator of the existence of archaeological heritage sites located on the territory of nearby cyber-physical systems. (Figure 4).

The Volga Federal District's top regions for protecting and bringing tourists to archaeological heritage sites include the Orenburg region and the Republic of Bashkortostan, in addition to the Perm Territory. Numerous ancient towns, burial mounds, earth burial grounds, and archaeological sites have been found within the Orenburg region (Mazhar,2011). When it comes to the development of archaeological and ethnocultural tourism, all of these locations are very important. Popular trips that involve field camps and allow tourists to see both nature and excavations are called archaeological tours (Lezhnin,2018).

After examining how the Republic of Bashkortostan's local tourism and recreation sectors operate, it is important to emphasise that this area is not by chance at the forefront of the development of cultural and educational tourism. In order to provide visitors with new perspectives, the republic is home to numerous sites of cultural, historical, and archaeological value. In the Republic of Bashkortostan, the Shulgan-Tash Cave, the Salavat Yulaev monument, the Church of the Nativity of the Virgin, the Aksakov People's House, and other sites became the most visited destinations in 2022–2023 (Lezhnin & Chkalova & Efremova & Polukhina & Sheresheva,2019).

Thus, the Perm Territory, the Orenburg region, the Republic of Bashkortostan, and the Nizhny Novgorod region should be listed among the economic entities of the Volga Federal District, where archaeological

heritage sites are developing to a greater extent than in other regions, based on the data on the number of archaeological heritage sites in the Volga regions. The Penza region, the Republic of Mordovia, and the Ulyanovsk region are among the regions with lower growth rates of archaeological heritage sites. But still, these regions are noteworthy due to their potential for development (Figure 5).

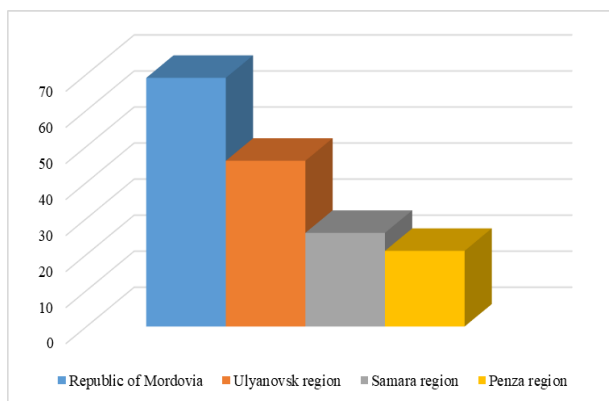


Figure 5. Regions in the Volga Federal District that are lagging behind in terms of the number of archaeological heritage sites (compiled by the authors)

3.3 Analysis of collective accommodation facilities in local cyber-physical systems.

It is vital to examine the quantitative indicators of collective accommodation facilities' activity in relation to the number of tourists they accommodate while analysing the operations of local systems in the Volga Federal District's tourism and recreation sectors. (Table 3).

Table 3. Indicators of tourists registered collective accommodation facilities for the period 2022-2023, (thousand, people) (compiled by the authors).

Name of the region	Number of tourists, staying overnight in collective accommodation facilities of the Volga Federal District
Republic of Tatarstan	2007,8
Republic of Bashkortostan	1087,8
Nizhny Novgorod region	1027,1
Samara region	840,7
Perm region	637,9
Saratov region	428,1
Orenburg region	359,3
Ulyanovsk region	306,8
Kirov region	280,8
Udmurt Republic	280,4
Chuvash Republic	275,3
Penza region	209,6
Republic of Mari El	125,4
Republic of Mordovia	114,2

Figure 6 presents the findings of an analysis, which included 14 economic entities of the Volga Federal District and examined both individual and group tourist accommodations.

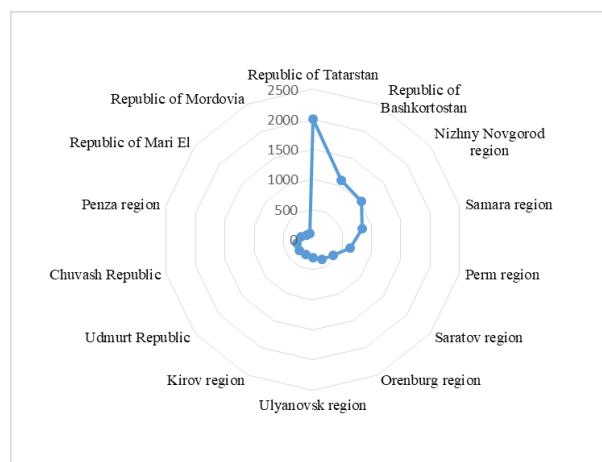


Figure 6. Quantitative indicators of the number of tourists accommodated in collective accommodation facilities in the regions of the Volga Federal District (compiled by the authors)

With 2,007. 8 thousand tourists staying in collective accommodation facilities during the study period, the Republic of Tatarstan emerged as the top region for both individual and group tourist accommodation in the Volga Federal District hotel enterprises in 2022–2023. We have identified the following indicators that determine the number of tourists in collective accommodation facilities as part of our statistical analysis of the overall number of tourists staying in these types of facilities: 1) quantitative indicators of the amount of paid services in the tourism sector; 2) the amount of income from collective funds in the Republic of Tatarstan (Utkina & Gracheva, 2015).

3.4 Analysis of indicators of paid services in the tourism sector in the Republic of Tatarstan.

Within the scope of researching the number of tourists registered in the Republic of Tatarstan's accommodation facilities, the amount of paid services provided in the tourism industry is the first indicator. Table 4 displays the figures for the period 2022 and 2023.

Table 4. Indicators of the amount of paid services in the tourism and recreation sector in the Republic of Tatarstan (compiled by the authors)

Year	Quantitative indicators of the amount of paid services in tourism sector of the Republic of Tatarstan (billion rubles)
2022	11,63
2023	13,2

The Republic of Tatarstan's tourism and recreation sector generated 13.2 billion rubles in revenue from paid services in 2023, 1.57 billion more than in the same period in 2022. Tourist services provided to individuals or groups visiting the region, services provided by health and wellness businesses, complexes, destinations, and tourist clusters, as well as lodging services, are the primary indicators of the amount of paid services in the tourism sector (Platonova,2015). The amount of services rendered to the public by small and medium-sized businesses, entrepreneurs, and large businesses is included in the volume of paid services in the tourism and recreation sector of the economy. A comparison of indicators for the amount of paid services in the Volga Federal District's tourism and recreation sectors of the economy for the years 2022 and 2023 is presented in Figure 7.

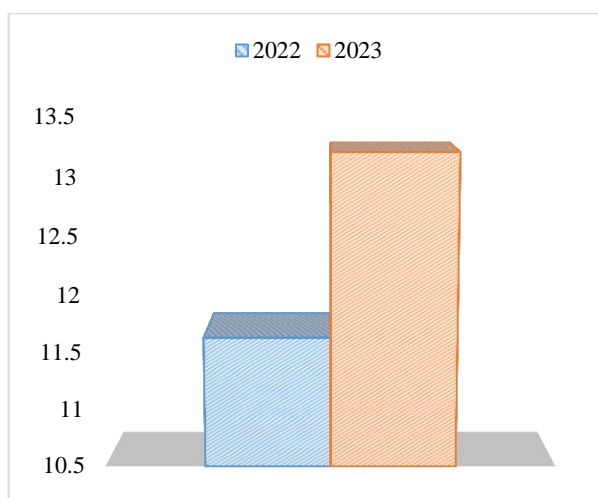


Figure 7. Defining quantitative indicators of the amount of paid services in tourism and recreational sector of the economy of the Republic of Tatarstan for 2022-2023. (compiled by the authors)

The amount of money earned from the sale of hotel accommodations is another significant indicator that helps determine the number of tourists that come to the Republic of Tatarstan (Polukhina A.N., Rukomoinikova,2016). The amount of money received from hotel accommodations in the tourism and recreation sectors was 8.3 billion rubles in 2022, while in 2018, the same indicator amounted to 8.9 billion (Table 5). Figure 7 illustrates the amount of revenue received by the Republic of Tatarstan's collective accommodation facilities.

Table 5. Quantitative indicators of the amount of income from collective accommodation facilities in the Republic of Tatarstan for 2022-2023. (compiled by the authors)

Year	Revenue from collective accommodation facilities in the Republic of Tatarstan (billion rubles)
2022	12,9
2023	12,3

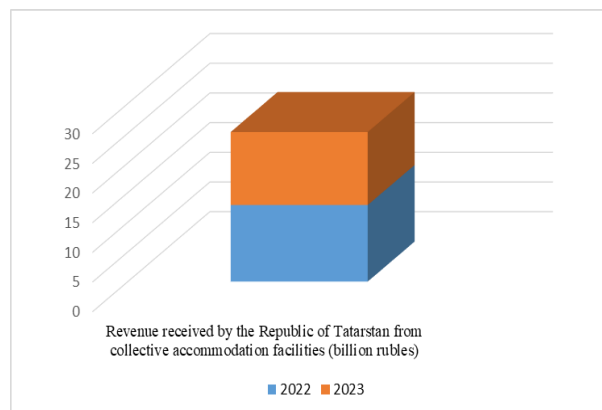


Figure 8. Revenue from hotel accommodations of the Republic of Tatarstan (compiled by the authors)

The dynamics of visitor flow are a key indicator of how local cyber-physical systems in the Volga Federal District's tourism industry are developing. As one of the top destinations, the Republic of Tatarstan has strong data regarding the number of visitors to the area (Taratin,2016). We examined statistical information on the Republic of Tatarstan's tourism flow to determine quantitative indicators (Figure 9).

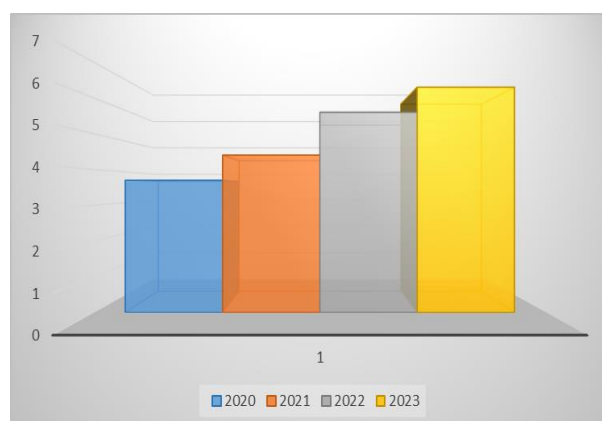


Figure 9. Dynamics of the tourist flow in the Republic of Tatarstan for the period 2020-2023. (compiled by the authors)

Thus, as a result of the analysis, it was found that the republic's tourist flow indicator amounted to 3.7 million by the end of 2020, 4.4 million in 2021, 5.6 million in 2022, and 6.3 million in 2023. Tourist inflow statistical data to the Republic of Tatarstan show the highest numbers in 2023.

3.5. Analysis of indicators of the amount of paid services in the tourism sector in the Republic of Bashkortostan

In 2022–2023, the Republic of Bashkortostan emerged as the second most prominent region when it came to the number of individual and group tourists who booked hotel accommodation. The following should be included in the analysis as the primary indicators determining the

number of tourists visiting the Republic of Bashkortostan: 1) quantitative indicators of the amount of paid services in the field of tourism; 2) the amount of income from accommodation facilities in the Republic of Bashkortostan (Snegireva, 2017). The amount of paid services in the republic's tourism industry is the next indicator for analysing the number of visitors accommodated in hotels in the Republic of Bashkortostan. Table 6 shows data for 2022 and 2023.

Table 6. Indicators of the amount of paid services in the tourism and recreation sector in the Republic of Bashkortostan (compiled by the authors)

Year	Quantitative indicators of the amount of paid services in the tourism sector of the Republic of Bashkortostan (million rubles)
2022	7,72
2023	10,27

The Republic of Bashkortostan's tourism industry generated 10.27 million rubles in revenue from paid services in 2023, whereas 7.72 million rubles were generated in 2022. After the Republic of Tatarstan, the Republic of Bashkortostan is the second-ranked entity of the Russian Federation in terms of the amount of paid tourism services. In the Republic of Bashkortostan, the amount of paid services includes the revenue gained from the operations of sanatorium organisations, hotel services, and tourism exhibitions, fairs, and festivals. Much attention in the Republic of Bashkortostan is paid to event-driven tourism, which is in great demand among individual tourists and tourist groups. The River of Time Festival, the Bashkir Honey Festival, and the crayfish fishing festival were the most remarkable examples of such events. Figure 10 comparatively analyses the indicators of the amount of paid services in the tourism and recreation sector in the Volga Federal District for the period 2022 - 2023.

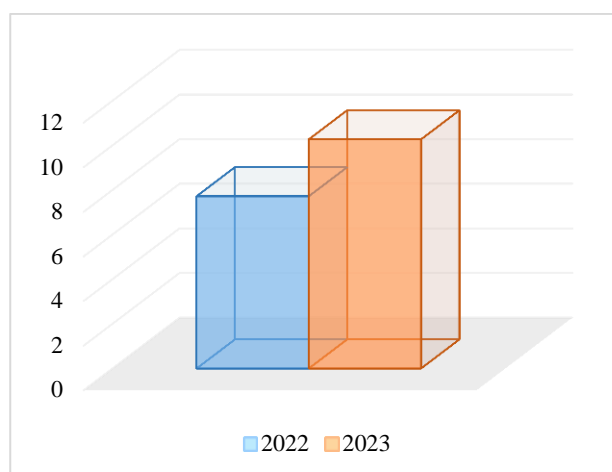


Figure 10. Determination of quantitative indicators of the amount of paid services in tourism and recreation sector of the Republic of Bashkortostan for the period 2022-2023. (compiled by the authors)

Another indicator characterizing the activity of collective accommodation facilities in the Republic of Bashkortostan is the amount of income from hotels and other collective accommodation facilities in the region.

Table 7. Quantitative indicators of the amount of income from collective accommodation facilities in the Republic of Bashkortostan for 2022-2023. (compiled by the authors)

Year	Amount of income from collective accommodation facilities in the Republic of Bashkortostan (million rubles)
2022	5,2
2023	5,9

In terms of the money received by the Republic of Bashkortostan from hotel businesses that operate in tourism, it ranks among the top regions of the Volga Federal District. When it comes to the development of accommodation providers in the Volga Federal District, the Republic of Tatarstan leads overall, with the Republic of Bashkortostan and the Nizhny Novgorod region rounding out the top three. Figure 11 displays the revenue earned by collective accommodation facilities in the Republic of Bashkortostan.

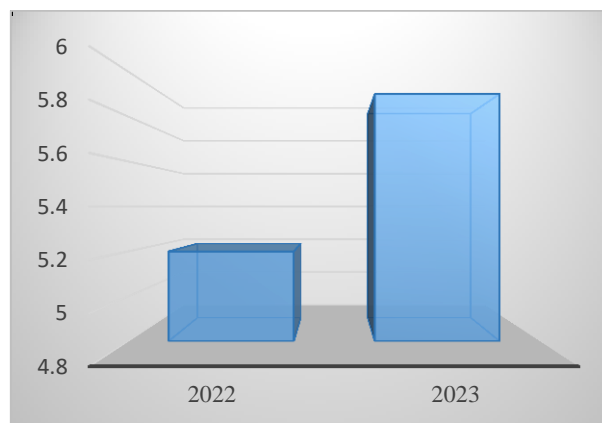


Figure 11. Quantitative indicators of the amount of income from collective accommodation facilities in the Republic of Bashkortostan (compiled by the authors)

Therefore, in the context of this research, the following local system indicators in the Republic of Bashkortostan's tourism industry were examined: 1) the number of paid services in the tourism and recreation sphere; 2) indicators of income from hotel enterprises in the Republic of Bashkortostan. Based on the analysis, statistical data were provided for each of the indicators and graphs were constructed.

3.6. Analysis of indicators of the amount of paid tourism services in the Nizhny Novgorod region.

In the Volga Federal District's hotels in 2022–2023, the Nizhny Novgorod region rose to the top as a destination for both individual and group travellers. Based on the

given statistics, this region ranks among the top three regions of the district, along with the Republic of Tatarstan and the Republic of Bashkortostan.

The total amount of paid tourism services is the next indicator in the framework of evaluating the number of tourists accommodated in hotels of the Nizhny Novgorod region. The figures for 2022 and 2023 are presented in Table 8.

Table 8. Indicators of the amount of paid services in the tourism and recreation sector of the Nizhny Novgorod region (compiled by the authors)

Year	Quantitative indicators of the amount of paid services in the tourism sector of the Nizhny Novgorod region (million rubles)
2022	4,64
2023	5,15

The tourism sector in the Nizhny Novgorod region plays a very important role: it contributes to the creation of new jobs in the region, increases the level of well-being of society, engages active population in employment. When comparing the indicators of the amount of paid services in the Nizhny Novgorod region, it is important to note that in 2022 the indicator was 4.64 million rubles, and in 2023 the amount of paid services increased by 0.51 million rubles to 5.15 million rubles. The tourism and recreation industry of the Nizhny Novgorod region economy is represented graphically in Figure 12 with indicators of the amount of paid services for 2022 and 2023.

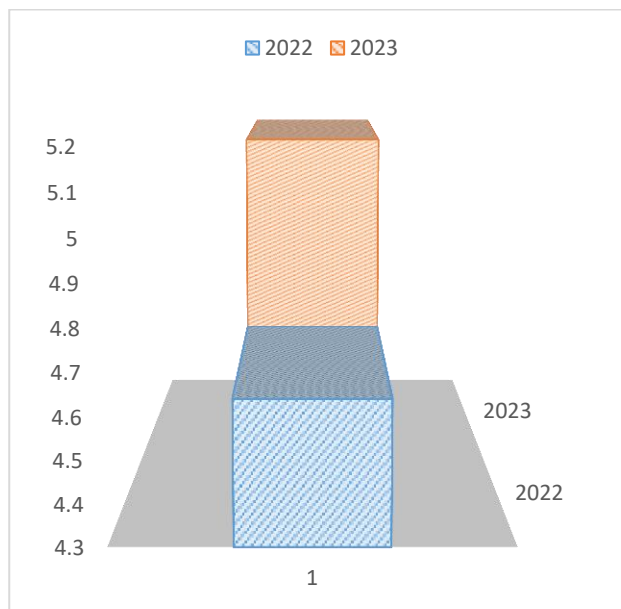


Figure 12. Defining the quantitative indicators of the amount of paid services in the tourism and recreation sector of the Nizhny Novgorod region (compiled by the authors)

Another indicator characterising the activity of collective accommodation facilities in the Nizhny Novgorod region is the amount of revenue generated from hotels and other collective accommodations in the region. The data is shown in table 9.

Table 9. Quantitative indicators of the amount of income from collective accommodation facilities in the Nizhny Novgorod region for 2022-2023. (compiled by the authors)

Year	Amount of income from collective accommodation facilities in the Nizhny Novgorod region (million rubles)
2022	3,8
2023	5,1

When it comes to the revenue generated by collective accommodation facilities, the Nizhny Novgorod region is ranked first among the top three regions in the Volga District. Hostels and mini-hotels are also quite popular in the area, and more than 218 lodging options make up the structure of the Nizhny Novgorod accommodation industry (Snegireva). Due to sporting competitions, tourism festivals, and other events held in the Nizhny Novgorod region in 2022, the revenue increased by 1.3 million rubles in comparison to 2018. Figure 13 illustrates the revenue generated from tourism accommodations in the Nizhny Novgorod region.

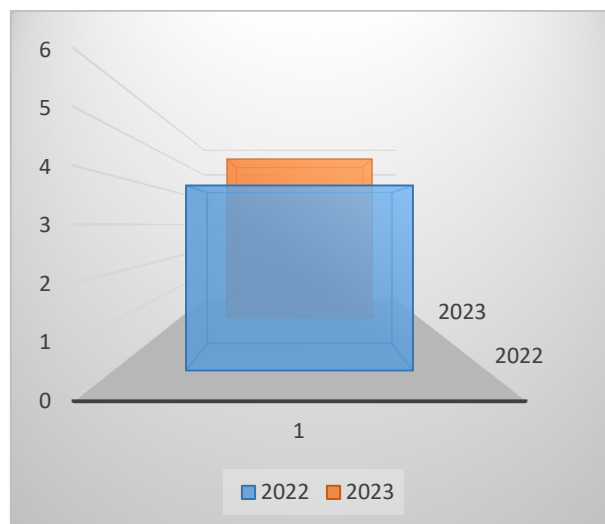


Figure 13. Quantitative indicators of the amount of income generated from tourist collective accommodation facilities in the Nizhny Novgorod region (compiled by the authors)

In conclusion, the following primary findings have been identified when analysing the Volga top regions in terms of local system development in the tourism sector: 1) in the Volga Federal District, the Republic of Tatarstan tops the lists for indicators like the number of foreign visitors, the amount of revenue received from collective lodging facilities, and quantitative measures of the amount of paid tourism services (Zakharov &

Ignatiev,2012). The region offers an extensive variety of resources, well-developed tourism infrastructure, government funding, and other favourable tourism-related incentives. In certain tourism metrics, the Republic of Tatarstan may compete with Moscow and St. Petersburg; 2) indicators of the development of local economic systems in the Volga Federal District's tourism industry position the Nizhny Novgorod region and the Republic of Bashkortostan in second and third place, respectively (Volkova,2016). In terms of the number of foreign visitors to the region, for instance, the Nizhny Novgorod region outperforms the Republic of Bashkortostan, but for 2022–2023, it demonstrates lower indicators in the amount of paid services provided in the tourism industry.

3.7 Analysis of indicators of tourist flow in the Volga Federal District and the number of tourist businesses.

The Volga Federal District's 2022–2023 tourism flow indicators were examined as part of the study (Figure 14).

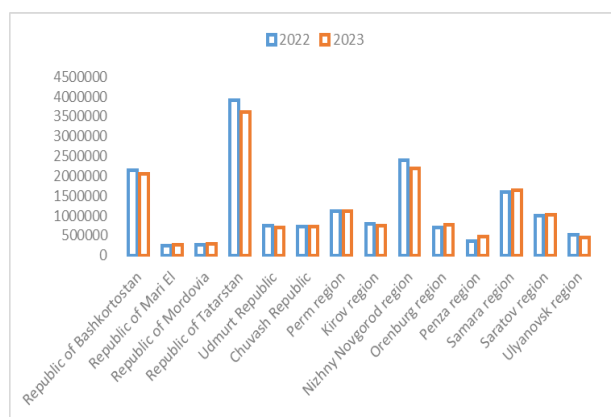


Figure 14. Assessment of the tourist flow in the Volga Federal District for 2022-2023. (compiled by the authors)

As a result, the Republic of Tatarstan emerged as the undisputed leader in terms of the amount of tourist flows in 2022 (3,908,170 trips). This region continued to rank high in 2023, despite a minor decline in comparison with the previous year (3,618,049 trips). The Nizhny Novgorod region took second place by the indicator of tourist trips in 2022 (2,397,809 trips), and in 2023 the figure reached 2,187,934 trips, which is 209,875 lower than in 2022. The Republic of Bashkortostan was ranked third in 2022 (2,136,314 tourist trips), which is 77,442 trips more than in 2023. The Samara region, with 1,599,350 tourist trips in 2022 and 1,651,890 in 2023, is ranked fourth among the Volga Federal District's regions if analyzed by this indicator. This region has demonstrated an increase in tourist flow in 2023 by 52,540 tourist trips.

When examining areas within the Volga Federal District that have low indications of visitor flow, the following

regions should be mentioned: 1) the Republic of Mari El (249,211 tourist trips in 2022 and 259,420 in 2023); 2) the Republic of Mordovia (267,066 tourist trips in 2022 and 298,207 tourist trips in 2023); 3) the Penza region (357,000 tourist trips in 2022, 471,969 tourist trips in 2023). The number of tourism-related businesses in the regions in 2022–2023 was another indicator of the development of cyber-physical local systems in the Volga Federal District of the Russian Federation's tourism and recreation industry (Figure 15).

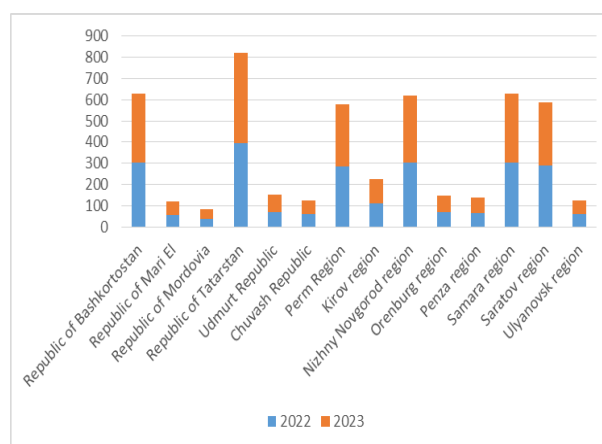


Figure 15. The number of tourist businesses in the Volga Federal District for 2022-2023 (compiled by the authors)

Based on the data, the Volga Federal District's Republic of Tatarstan leads all other regions in terms of the number of tourism-related businesses. The top five regions according to this indicator include the Republic of Bashkortostan in second place, the Samara region in third place—which surpassed the Nizhny Novgorod region in fourth place—and the Saratov region is ranked fifth. The Republic of Mari El, the Chuvash Republic, the Ulyanovsk region, and the Republic of Mordovia rank lowest in terms of the number of tourism-related businesses per region.

4. CONCLUSION

In summary, the local cyber-physical systems activities related to tourism and recreation in the Volga Federal District were examined for the years 2022–2023. It should be noted that during the period under study, the primary indicators of the efficiency of these systems were identified, showing the existence of regions that exhibited both leading positions in the District's tourism indicators (Perm Krai, Republic of Bashkortostan, Nizhny Novgorod region, Republic of Tatarstan) and those with significantly weaker indicators (the Republic of Mari El, Mordovia, Penza region, etc.).

Over the study period, the top regions for tourism and recreation have demonstrated a good practice of effective integration of archaeological and cultural heritage sites into the tourism industry. They have also showed an increase in the number of overnight

accommodations (Sycheva,2017). For example, in the Republic of Tatarstan, a policy on working with foreign tourists is being successfully implemented, certain actions are introduced in tourism businesses to comply with international standards, there is a steady increase in the indicators of cyber-physical systems in the tourism and recreation sphere, and information and communication technologies for tourism are being implemented, favourable conditions are created for international tourists (staff with the knowledge of foreign languages, information about facilities in different languages, etc.). Issues that need to be properly addressed at the administrative level exist in regions that have not demonstrated the highest indicators.

These problems include: 1) the lack of high-quality service in hotel and catering facilities, which negatively affects tourist work. Employers' reluctance to collaborate with workers and educational institutions (for additional training) as well as the region's poor or

nonexistent branding are the primary causes of this problem. The branding aspect of tourism development is often overlooked in the Volga Federal District, despite the fact that a territory's reputation plays a critical role in attracting tourists. Tourists will know the attractions to visit in each region of the Volga Federal District if the region's branding is done effectively. Collective accommodation facilities with outdated infrastructure found across the Volga Federal District need to be updated.

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