

# Review of methodological issues of application of geographic information systems in service maps and their compilation

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**Abstract.** This article considers the content of service maps and some methodological features of their creation, the experience gained in Uzbekistan in this field as one of the important areas of modern socio-economic cartography. At the same time, attention was paid to the role and place of modern geographic information systems in the creation of service maps, scientific and practical issues of their use. According to the cartographic criteria, thematic maps based on DemoGIS and geo-statistical analysis methods were developed and created in accordance with the research methodology. The results of the research on the use of GIS technology showed that a geographically innovative methodological approach solved theoretical and practical problems.

## 1 Introduction

Socio-economic cartography is one of the most diversified and rapidly evolving areas of modern cartography. The design and creation of service maps plays a special role, and service maps are of particular importance for their educational, scientific, and practical significance. In recent years, as the social demand for such maps has increased, so there is a need to print them. Clearly, service maps are one of the cartographic sources that reflect the size of the development of the service sector in a particular area, the type of system and the results of their activities. Therefore, service maps, which are the product of the method of cartographic research, play an important scientific and practical significance in the study of regional service systems of the region, in improving their regional structure and determining future prospects. Today, with the advent of geographic information systems, new opportunities for designing and creating service maps have emerged. These, in turn, have a positive effect on the enrichment of the content of service map, the expansion of their imaging capabilities, coverage and speed.

Before mapping the territorial composition of service industries and their institutions, it is important to have a clear idea of their content, location and laws of development. In fact,

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in daily lives or in existing scientific sources people often come across the concept of "service". In most cases, this concept can be directly understood in the sense of "service", and "service geography" as "geography of services (industries)". Consequently, one of the leading scholars in the field, M.A. Abramov understands "services" and "service" as synonymous, and this, of course, leaves no room for objection [1]. At the same time, researchers often come across a form of understanding services as a "social infrastructure". In particular, in many cases, the authors consider the whole health or education system as the basis of the concept of "social infrastructure". However, infrastructure, whether it is "production" or "social", is primarily a set of certain conditions that conditionally serve to ensure the normal flow of production (production infrastructure) or services to the population (social infrastructure).

The Republic of Uzbekistan developed the national economy based on market mechanisms during the period of independence, consequently, the share and importance of the services sector in its GDP was increased. In 1995, the share of services in the country's GDP was 39.8%, followed by 41.4% in 2005 and 49.5% or 118811.0 billion sums at the beginning of 2017 [9]. Currently, there are more than 16.5 thousand large organizations (including non-profit organizations providing market services) and more than 126 thousand small businesses in the service sector in the country [13]. In practice, when it comes to the composition of service maps, first, their content was formed as an alternative to the structure of the service sector. Noteworthy, service maps are among the core links of large-scale social cartography. Their main content depends on the type, volume of services provided to the population, the area of distribution (location). Such maps include:

- a) Network cards, that is, map that reflect the static location, specialization, size of institutions and enterprises belonging to a particular service area;
- b) Maps related to the level of activity and development of the service sector (i.e., provision of services to the population, ease of service, level, etc.).

In general, there are no complete service maps, which can cover all regions of the country. Obviously, the service sector, covering all segments of the population of any country, has an impact on almost all socio-economic aspects of life, which in turn shows how important this sector is. Therefore, this research was aimed at analyzing service maps and their importance, the experience of creating service maps in all sectors of Uzbekistan, highlighting some methodological issues of the use of geographic information systems in the creation of service maps. To achieve the research objective, the following tasks are needed to be solved:

- Analysis of the content and relationship of the terms "service", "service areas", "social infrastructure" and other related terms;
- To consider the general content, classification and features of the methodology of service maps;
- Analysis of the experience gained in Uzbekistan in the field of service cartography;
- Clarification of some methodological issues of the use of geographic information systems in the creation of service maps;
- Development of proposals for further development of service cartography in the country based on the analysis of existing experience.

## **2 Materials and methods**

In this research, methods of analysis of the experience of creating service cards in mapping the service areas and the regional structure of their institutions, the study of some methodological issues in the use of software belonging to the GIS family (ArcGIS, QGIS, MapInfo) in creating service maps were used. In addition, the analysis of the content of service maps, cartographic, aerospace, statistical, questionnaire, regional analysis,

geolocation methods were employed to reach research objective and accomplish research tasks.

### 3 Results and discussion

One of the first major cartographic works that played an important role in the development of cartography in the country, as well as service map, is a two-volume "Atlas of the Uzbek SSR" developed by the Department of Geography of the Academy of Sciences of Uzbekistan in the early 80s (Table 1) [3]. In essence, this work was a complex geographical reference atlas of Uzbekistan, which was also payed special attention to the social infrastructure related to the social life of the population. A total of 153 cards were given in this atlas and 27 of them were devoted to social spheres (issues) directly related to the daily living conditions of the population, which consist of the following three major sections:

1. Living conditions of the population.
2. Education, science, culture.
3. Physical training, sports, tourism.

**Table 1.** Structure and content of social cards issued in the second volume of the “Atlas of the Uzbek SSR”.

Sections	Map name	Scale	Main content of map
Living conditions of the population	Medical and preventive institutions	1:3500000	Number of hospital beds in rural areas, number of paramedic and obstetric points, number of sick beds per 10,000 population
	Provision of the population with medical personnel	1:3500000	Medical staff - doctors, the number of paramedics and their per 10,000 population
	Resorts, sanatoriums, holiday homes	1:3500000	Sanatorium, holiday fund, types and specialization of sanatoriums
	Domestic service	1:7500000	Number of consumer services, total volume of services, volume of services provided per capita
	Sales service, catering	1:7500000	Number of trade and catering establishments, retail turnover and total catering by regions and their per capita
	Utilities	1:5000000	Distribution of drinking water supply, sewerage, hotels, baths, laundry and hairdressing salons by regions and the results of their activities
Education, science, culture	Morning secondary schools	1:3500000	Number of schools in rural areas, number of students, number of classes, number of students per thousand population
	Evening (shift) secondary schools	1:3500000	Number of schools and students in rural areas, number of students per 1000 population

	Boarding schools	1:3500000	Number of boarding schools in rural areas, number of students, types of boarding schools
	Vocational schools	1:3500000	Number of educational institutions in rural areas, number of students, specialization of students in economic sectors
	Secondary special educational institutions	1:5000000	Types of secondary special educational institutions and number of students
	Higher educational institutions	1:7500000	Types of higher education institutions, number of students, number of students per 10 thousand population
	Level of education of the population	1:5000000	The number of population by level of education by region, the number of secondary and higher education per 10 thousand employed population
	Scientific insitutions	1:7500000	Number of research institutes and their distribution by disciplines, number of researchers
	Museums	1:7500000	Types of museums
	Theaters, club establishments	1:7500000	Number of theaters and clubs, types, population per institution
	Public library	1:5000000	Number of libraries by region, number of books and magazines, number of books and magazines per capita
	Cinematography	1:3500000	Number of movie theaters, the number of people per movie theater
	Newspaper printing	1:3500000	Types of newspapers, language of publication, number of one-time circulation, number of newspapers sold per thousand population
Physical education, sports, tourism	Physical education and sports	1:3500000	Number of sports facilities in rural areas and cities, number of physical educators, number of physical educators per 100 population
	Tourist organizations and institutions	1:5000000	Types of tourist organizations and institutions, the number of places in them
	Tourist map	1:2500000	Tourist routes and their numbers, levels, tourist facilities

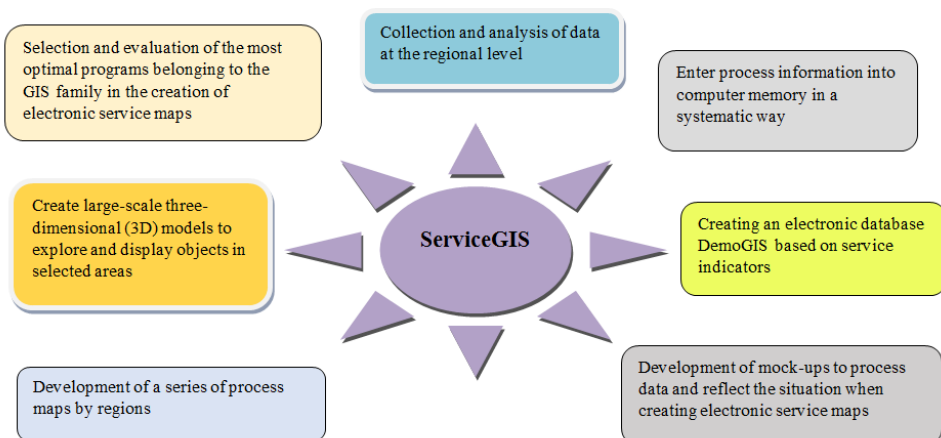
Table 1 clearly depicted that all the cards issued in the field of services were, in essence, "network cards", the content of which reflects the territorial structure of social infrastructure institutions and enterprises. Social maps were also reflected in the atlas of reference book "Atlas of the Uzbek SSR", which was developed and published in 1980-1981 by the Faculty of Geography of the former Tashkent State University and the Department of Geography of the Academy of Sciences of Uzbekistan [2]. In total, 35 maps were given in the atlas, 5 of which were directly ("secondary schools", "higher and secondary special educational institutions", "public libraries", "cinemas, theaters, clubs,

museums", "tourist card") had service characteristics. Evidently, these maps, by their nature, were more "network map", which partially reflected to the level of service.

The Geographical Atlas of Uzbekistan [12], which was prepared and published by the Faculty of Geography of Tashkent State University (now the National University of Uzbekistan) during the years of independence, also played an important role. It included 5 direct service maps ("Public Education", "Higher, secondary special, vocational education institutions", "Health", "Culture", "Tourist Map"). The content and main content of these cards were in line with the above source, and the content was limited by the number of relevant service facilities, their types, per 1,000, 10,000, 100,000 people. Geo-information mapping, spatial and cartographic modeling and visualization using modern cartographic methods and technologies in the creation of service maps play a special role in the development of the social sphere. Taking into account the advantages of geographic information systems and technologies in the study and mapping of the service sector, a special place in improving the mathematical, geodetic basis of these maps considering innovative methods and technologies are recommended (using ArcGIS, QGIS, and MapInfo).

When the service maps are based on GIS technologies, it can be easily seen the interdependence and harmonization of geo-informatics and cartography. Typically, these areas are interconnected in two ways. The geographic information support of cartography and the cartographic support of geo-informatics showed the relationship. The relationship between cartography and geo-informatics in the creation of service maps can be seen in the following stages [15]:

- Linking spatial data to a single coordinate system and using a topographic map in software belonging to the family of geographic information systems and technologies;
- Memorization of other information (statistical, analytical, etc.), such as software belonging to the family of geographic information systems and technologies, as well as remote sensing data;
- Vectorization of data in the form of digital maps to form a component of databases;
- Divide the thematic composition of spatial objects into layers.



**Fig. 1.** ServiceGIS structure in creating service maps.

When creating service map, it is vitally necessary to firstly collect all the statistical and other data and form a database in GIS programs. At the same time, the application of scientific ideas based on integrated, excellence-based geo-information research creates opportunities for systematic learning. Electronic service requires the creation of maps and scientific research based on innovative approaches. The following (ServiceGIS) [16]

systematized structure consisting of seven steps, which were developed in the creation of electronic service cards and situation analysis (Fig. 1).

This system of creating service cards speeds up the work process and at the same time increases the quality of the cards as well as the accuracy of the data. According to the cartographic criteria, thematic maps based on DemoGIS and geo-statistical analysis methods were developed and created in accordance with the research methodology. The results of the research on the use of GIS technology showed that a geographically innovative methodological approach solved theoretical and practical problems.

## 4 Conclusions

Today, the rapid changes and growth in social life and the service sector, in turn, are forcing to create complex maps that cover different service areas or different indicators of the development of a particular industry, or maps that assess the level of development of a service sector. At the same time, the creation of synthetic development maps that reflected the needs of the population in a wider range of services and the level of their satisfaction and territorial composition or within the trinity of "population needs-settlement systems-service level" was a scientifically and practically relevant issue. The research outputs depicted that preparing a "comprehensive service atlas of Uzbekistan" in the future, which will fully cover the service sector in Uzbekistan, obtains followings: 1) type of service institutions; 2) level of service; 3) the maps of complex service (or service potential) of the regions.

Furthermore, with the rapid introduction of new types of services in daily lives, such as financial, Internet, mobile services, the creation of thematic, analytical and especially forecast maps, which reflected their composition, level of development and the situation in the country and its individual regions, was one of the current issues of service (service sector) cartography.

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