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Original Contribution

SPECIALIZED MAPS AND REGISTERS – GENERAL APPROACHES TO THEIR CREATION

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ABSTRACT: *The article examines the main principles and approaches in the creation of specialized maps and registers. It highlights their role as tools for spatial analysis, planning, and management. The main stages of work are presented – from data collection and standardization to visualization and maintenance. Emphasis is placed on a systematic and standardized approach that ensures the accuracy, reliability, and interoperability of the data.*

KEY WORDS: *Specialized maps, Registers, Geographic information systems, Spatial data.*

1. Introduction

The development of information technologies and Geographic Information Systems (GIS) over the past decades has led to a significant expansion of the possibilities for collecting, processing, and analyzing spatial data. In addition to traditional topographic maps, specialized maps and registers have gained increasing importance, as they present specific information intended for targeted application in various fields – from urban planning and natural resource management to environmental protection and cultural heritage preservation.

The aim of this article is to present the general approaches and methodological principles applied in the creation of specialized maps and registers, with an emphasis on systematization, standardization, and ensuring data quality.

2. The nature and functions of specialized maps and registers

2.1. The nature of specialized maps

Specialized maps are thematic cartographic products whose main purpose is to visualize the spatial distribution and interrelations of specific natural, socio-economic, or technical phenomena. Unlike general geographic maps, which provide an overall characterization of the territory (relief, hydrography, settlements, etc.), specialized maps focus on a particular theme or aspect of spatial reality [1,2].

These maps are produced on the basis of specialized data – for example, geological, soil, climatic, demographic, ecological, or infrastructural. They have an analytical character and are often used for planning, forecasting, and managing various processes within a given territory.

Depending on their purpose, specialized maps can be classified as follows:

- Scientific maps – used in research to analyze spatial relationships (e.g., geomorphological or biogeographical maps).
- Production maps – intended for engineering, agricultural, mining, or forestry activities.
- Administrative and cadastral maps – used for regulatory, ownership, and management purposes.
- Educational and tourist maps – aimed at a broader audience for informational and cultural purposes.

In contemporary practice, specialized maps are most often created using Geographic Information Systems (GIS), which enable the integration of various types of data, their analysis, and dynamic visualization. This makes them a particularly valuable tool in the fields of spatial planning, ecology, transportation, and public administration.

2.2. The nature of registers

A register represents a systematized database or information system in which information about a specific category of objects or phenomena is stored, processed, and made accessible. Unlike a map, which visualizes spatial relationships, a register contains structured, attribute, and metadata information—such as a unique identifier, location, functional characteristics, and the legal status of the objects [2].

Registers are established on a normative or institutional basis and are often part of national or European information systems—for example:

- Cadastral register of real estate;
- Register of protected areas and sites (NATURA 2000);
- Register of road and technical infrastructure;
- Register of cultural heritage;
- Register of groundwater and water bodies.

Each register has a defined functional structure, including data for identification, spatial coordinates, description of the objects, and links to other registers or systems. In this way, registers provide a comprehensive informational framework that supports decision-making, administrative services, and applied scientific research.

2.3. Relationship between specialized maps and registers

Although they serve different functions, specialized maps and registers are closely interrelated.

The register provides structured and up-to-date data that can be spatially visualized through a specialized map. Conversely, the map serves as a graphical interface for accessing and analyzing the data contained in the register.

For example, a cadastral map visualizes data from the property register, while environmental maps reflect the contents of registers of protected areas or contaminated zones.

The integration of both types of sources within Geographic Information Systems (GIS) ensures a multidimensional approach to spatial management, allowing the simultaneous consideration of geographic, economic, and social aspects of a given territory.

2.4. Main functions and applications

The functions of specialized maps and registers can be summarized in several main directions:

- Informational function – they provide reliable and up-to-date information about spatial objects, processes, and phenomena.
- Analytical function – they enable spatial analyses, modeling, and trend forecasting.
- Planning function – they support decision-making in the fields of spatial planning, infrastructure development, and the management of natural resources and the environment.
- Control and monitoring function – they are used to observe temporal changes, assess the condition of specific objects, and track dynamic processes.
- Normative and legal function – in cases such as cadastre systems, registers have legal value and serve as official sources of information in administrative and judicial procedures.
- Educational and public function – through accessible visual means, they enhance public awareness and citizen participation in spatial governance.

2.5. Importance in the context of digital transformation

In the context of digitalization and e-governance, specialized maps and registers have become a key component of the national spatial data infrastructure. They support the development of integrated systems for territorial management, sustainable development, and electronic public services.

European initiatives, such as the INSPIRE Directive (2007/2/EC), encourage Member States to develop interconnected geoinformation platforms that provide access to standardized and harmonized spatial data.

Thus, specialized maps and registers not only perform traditional cartographic and administrative functions but also emerge as a crucial tool for knowledge management and spatial information governance in modern “smart” societies.

3. Main stages in the creation of specialized maps and registers

The process of creating specialized maps and registers is multi-stage and interdisciplinary, as it encompasses cartographic and geoinformation activities along with managerial, legal, and technological aspects. Each stage is interconnected with the others and plays a crucial role in ensuring the quality, reliability, and functionality of the final product.

Typically, this process includes the following main phases:

3.1. Defining objectives and scope

The first and one of the most important stages is the clear formulation of the project's objectives and tasks. The structure of the data, the methods of data collection and visualization, as well as the final form of the map or register, all depend on this stage.

When defining the objectives, the following aspects are determined:

- Purpose – whether the product will be used for scientific analysis, managerial decision-making, public access, or control activities.
- Thematic scope – which phenomena, processes, or objects will be represented (e.g., soils, forest areas, urbanized zones, water bodies, etc.).
- Spatial scope – the geographical boundaries of the study area (municipality, region, country, or transregional level).
- User groups – identification of the end users (research institutions, administration, investors, citizens), which influences the mode of presentation and the level of detail.

At this stage, a technical specification is also developed, including a description of the objectives, scope, expected results, data sources, and quality requirements. Proper planning at this point is crucial, as a poorly defined goal may lead to an inappropriate methodology and an inaccurate final product.

3.2. Data collection and preparation

The second stage involves the identification, acquisition, and preparation of primary data, which will serve as the foundation for the map or register.

Data sources can be diverse:

- Field surveys and measurements – employing GPS technologies, drones, total stations, sensors, and other instruments to collect precise information.
- Remote sensing – including satellite imagery, aerial photography, and laser scanning (LiDAR), which provide extensive coverage and up-to-date data.
- Existing cartographic and statistical sources – such as topographic maps, cadastral plans, registers, and geological or climatic databases.
- Institutional and regulatory sources – including national agencies (e.g., Cadastral Agency, Ministry of Environment and Water, National Statistical Institute) and international portals (e.g., Copernicus, Eurostat, INSPIRE Geoportal) [11,13].

At this stage, the accuracy, timeliness, compatibility, and reliability of the data are assessed. The datasets must comply with specific metadata and standardization requirements – for instance, those established by the INSPIRE Directive (2007/2/EC) for geospatial metadata.

If necessary, data are converted into a standardized format (e.g., Shapefile, GeoJSON, GML) to ensure interoperability.

3.3. Data processing and standardization

After data collection, the datasets undergo a process of processing, structuring, and standardization.

The main activities include:

- Harmonization of coordinate systems – converting all data into a uniform spatial projection (e.g., UTM, WGS84, or BGS2005).
- Geocoding – assigning coordinates to objects that were originally described only by address or textual description.
- Topological control – checking for geometric errors such as overlaps, gaps, and boundary mismatches.
- Attribute validation – verifying textual and numerical data (e.g., soil types, zone codes, ownership information).
- Data filtering and generalization – eliminating duplicate records and aggregating information when necessary.

The goal of this stage is to ensure the consistency and reliability of the database, which forms the basis for subsequent spatial analysis and cartographic visualization.

In modern GIS platforms (such as ArcGIS, QGIS, and GeoServer), automated quality-control scripts are applied to increase efficiency and reduce the likelihood of human error [12].

3.4. Mapping and visualization

Cartographic representation constitutes the essential stage of visually presenting spatial information. The goal is to create a map that is accurate, legible, and informative, tailored to the thematic requirements and the target audience.

The main activities include:

- Selection of projection and scale – according to the scope and purpose (e.g., 1:100,000 for national-level mapping; 1:5,000 for urban areas).
- Choice of symbols, colors, and legend – to clearly distinguish thematic elements, applying principles of visual hierarchy and color contrast.
- Creation of labels and explanatory elements – such as title, coordinate grid, scale bar, north arrow, and data sources.
- Spatial analysis and thematic visualization – when necessary, operations such as buffering, overlay, classification, and density calculation are performed.

Modern software tools (ArcGIS Pro, QGIS, MapInfo, GeoMedia) allow for both static and interactive mapping – for example, web-based solutions that enable dynamic zooming, filtering, and information retrieval [3].

Thus, the map becomes not only a graphic representation but also an interactive analytical instrument.

3.5. Building and maintaining registers

After the completion of cartographic representation, the next stage involves the structuring and organization of information within a registry system.

A register serves as an information database that contains both the spatial and descriptive characteristics of the objects.

The main principles in building registers include:

- Unique identification of objects – each object is assigned an individual code or identifier that distinguishes it within the system.
- Versioning and change history – tracking updates and maintaining a record of modifications over time.
- Access control and information security – defining different access levels for users (administrators, editors, observers).
- Interoperability – enabling data exchange with external systems such as the cadastral register, the registers of the Ministry of Environment and Water, and infrastructure databases.
- Maintenance and updating – regular review and revision of data to ensure its accuracy and reliability.

Modern registers are often built on relational or object-oriented database platforms (e.g., PostgreSQL/PostGIS, Oracle Spatial), providing high performance and flexibility in spatial queries.

Their integration with cartographic visualizations allows for the creation of web-based GIS portals, through which users can search, visualize, and analyze data in real time.

All the described stages form part of the overall life cycle of spatial data, in which quality and reliability are ensured through standardized processes.

Adhering to a methodical sequence in planning, data collection, processing, and visualization guarantees that specialized maps and registers meet the needs of society, business, and public administration.

4. General methodological principles

Regardless of their specific theme, purpose, or institutional context, the process of creating specialized maps and registers follows unified methodological principles that ensure their reliability, comparability, and applicability.

These principles stem from the accumulated international experience in the fields of cartography, geoinformation technologies, and spatial data management. They serve as a framework for the development of high-quality and sustainable geoinformation products [4,5].

4.1. Principle of systematicity and consistency

Systematicity implies that the creation of specialized maps and registers should be viewed as a single, interconnected process consisting of clearly defined stages—from planning and data collection to analysis, visualization, and maintenance.

Each stage has its own logical and functional relationship with the preceding and subsequent ones. For example, the quality of visualization depends on the precision of the collected and processed data, while the proper definition of objectives determines the approach to data standardization.

Applying a systematic approach ensures consistency and traceability of actions, reducing the likelihood of errors and data duplication [4,5].

4.2. Principle of standardization

Standardization is one of the most important principles in the creation of specialized maps and registers. It ensures the uniformity and interoperability of data, regardless of their origin or purpose.

International, European, and national standards are applied to regulate:

- Spatial data formats (e.g., GML, GeoJSON, Shapefile, KML);
- Coordinate systems and projections (e.g., WGS84, ETRS89, BGS2005);
- Classification systems – such as CORINE Land Cover for land use and NUTS for administrative units.

Within the context of the European Union, the INSPIRE Directive (2007/2/EC) plays a particularly significant role, as it establishes the framework for building a European Spatial Data Infrastructure (SDI). It ensures the harmonization of spatial data and enables their use and exchange among different countries and institutions.

Standardization not only enhances data quality but also ensures long-term sustainability—allowing data to be used, shared, and further developed in the future without loss of accuracy or relevance [4,5].

4.3. Principle of interoperability

Interoperability refers to the ability to exchange, integrate, and utilize data across different systems, institutions, and software platforms. This principle is of particular importance in the context of digitalization and e-governance, where spatial information must be accessible to a wide range of users and applications.

To achieve interoperability, it is necessary to:

- Use open standards and protocols, such as those of the Open Geospatial Consortium (OGC) – e.g., WMS, WFS, WCS;
- Develop interconnected web services for spatial data (Spatial Data Services);
- Provide metadata for clear identification and description of information resources;

- Implement national geoportals and data-sharing systems (e.g., the National Geoportal of Bulgaria, INSPIRE Geoportal).

Interoperability is a prerequisite for the creation of integrated geoinformation infrastructures, which combine data from diverse sources – cadastre, environment, transport, energy, and others. In this way, it enables the formation of a unified spatial knowledge base that supports strategic decision-making.

4.4. Principle of updating

The dynamic nature of the spatial environment requires the regular updating of the content of specialized maps and registers. Updating ensures data reliability and maintains the value of information over time.

It includes:

- Periodic incorporation of new data from field surveys and remote sensing;
- Integration of data from institutional sources (e.g., cadastral and statistical agencies);
- Automatic updates through sensors and monitoring systems (e.g., for atmospheric or hydrological parameters);
- Tracking and archiving of previous versions, ensuring historical traceability of changes.

The effective implementation of this principle requires the establishment of a quality-control and versioning mechanism, as well as a defined update frequency for different data layers.

A lack of updates may result in inaccurate analyses and faulty management decisions, which underscores the importance of this principle for the sustainable functioning of geoinformation systems.

4.5. Principle of accessibility and transparency

The principle of accessibility is directly related to the concept of Open Data and the democratization of access to information.

Its goal is to ensure that specialized maps and registers are accessible to a wide range of users — including government institutions, research organizations, business entities, and citizens.

This is achieved through:

- Developing web-based platforms and geoportals that allow data visualization, search, and download;
- Applying open data licenses (e.g., Creative Commons or Open Data Commons);
- Ensuring transparency and traceability of data sources, so that users can assess the reliability of the information;
- Creating adaptive interfaces that are accessible both to experts and to non-specialized users.

In this way, accessibility not only promotes the broader use of geographic information but also stimulates innovative applications — for example, in tourism, crisis management, environmental protection, and education.

The outlined methodological principles — systematicity, standardization, interoperability, updating, and accessibility — form the foundation for the sustainable development of specialized maps and registers.

Their application ensures that spatial data are:

- Accurate and verified;
- Compatible and usable across different systems;
- Up-to-date and easily accessible to diverse user groups.

In this way, an integrated information environment is created — one that supports scientific research, public administration, and the sustainable development of territories.

5. Conclusion

The process of creating specialized maps and registers represents a multilevel and interdisciplinary activity that integrates knowledge from the fields of cartography, geoinformation technologies, statistics, data management, and regulatory frameworks. It is of essential importance for the development of modern spatial data information systems, which provide scientific, administrative, and societal benefits.

The creation of specialized maps and registers progresses through a sequence of stages — from defining objectives and scope, through data collection, processing, and standardization, to visualization and the development of information systems. Each of these stages requires the application of unified methodological approaches, based on scientific validity, technical precision, and compliance with international standards. Adhering to this sequence ensures the high quality and reliability of the final product.

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