Development plan for the information system of the Real Estate Administration of Montenegro

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1 Introduction

Within the national IT strategy, the digital transformation of the Real Estate Administration represents one of the most important steps towards the modernization of public administration and improvement of spatial planning. The goal is to provide a more efficient, transparent and user-oriented real estate management system through modern technologies.

The Real Estate Administration of Montenegro is the central state institution in charge of managing spatial and property-legal data on real estate throughout the country. Its primary mission includes maintaining comprehensive cadastral records documenting ownership relationships, geographic characteristics of plots, construction facilities and all legal burdens related to real estate.

The institutional importance of the Administration stems from the fact that its data represent the basis for the functioning of numerous segments of social and economic life. The continuous and multiple use of this data makes the Administration a key factor in the legal system, public finance management, spatial development and realization of strategic projects of public interest, confirming its status as one of the most important informational and administrative points of the state administration of Montenegro. Considering the stated institutional importance of the Real Estate Administration, the analysis of the broader framework of digital management at the national level takes on special importance.

According to the report *"Competitiveness in Southeast Europe 2021",* in 2018, Montenegro did not have a list of fully digitized public services, which was also the case with 50% of the economies of the Western Balkans. Nevertheless, the report notes **the relative progress of Montenegro** in the field of digital governance since 2018, which confirms positive developments in the development of e-government. In addition, according to the latest assessment of the United Nations Development Program (UNDP), in May 2025, Montenegro presented its **first report on readiness for the implementation of artificial intelligence**

(AILA), which marks a significant step in preparation for AI-driven transformation of public administration.

With the aim of further improvement, the need has been emphasized for:

- **the development of high-quality, fully transactional e-services,**
- **ensuring adequate financial and institutional capacities** for the implementation of action plans,
- **the continuation of reforms** that position digital administration as a key instrument for increasing the efficiency, transparency and competitiveness of the public sector.

These findings confirm the strategic importance of the digital transformation of public administration as a foundation for sustainable economic development and integration into the European digital space.

According to the United Nations eGovernment Survey 2024, Montenegro ranks **81st** out of a total of 193 countries when it comes to the e-Government Development Index. Compared to the previous survey from 2022, **a drop of 10 places was recorded,** which indicates the need for more intensive reforms and strategic investments in digital governance, especially in the context of AI implementation and blockchain technologies that are becoming standard in European countries.

Year	2010	2012	2014	2016	2018	2020	2022	**2024**
Position	100	60	45	47	58	75	71	**81**

Table 1- Index of eGovernment development

These data indicate a **downward trend** in the international ranking of Montenegro when it comes to digital governance. In order to reverse this trend, it is necessary to:

- Speed up the implementation of digital services in public administration,
- Strengthen institutional coordination and responsibility for e-government,
- Invest in staff education and digital competence,

- Increase the availability and quality of e-services for citizens and the economy.

Managers in the public sector have a key role in this process — their proactivity, strategic planning and operational support are crucial to achieving digital transformation goals.

In the period from 2010 to 2020, Montenegro made some progress in the development of electronic administration, but the data show that this progress is insufficient compared to regional and global standards. According to the electronic services index, which measures the scope and quality of e-services on the national portal and the websites of key ministries, Montenegro recorded a result of **54.12%,** which is **below the average of southern** Europe and below the world average of 56.2%.

Of particular concern is the decline in **the electronic participation index,** where Montenegro fell from 83rd place in 2022 to **85th place in 2024.** This indicator reflects the level of citizens' involvement in digital administration processes, which directly affects transparency, efficiency and trust in institutions.

These data indicate that a strategic reorientation and active management of digital development is needed. It is up to managers to:

- Review existing digital services and identify areas for improvement,
- Accelerate the development and implementation of new e-services that are user-oriented and interoperable,
- Involve citizens and the economy in the process of designing digital solutions through participatory mechanisms,
- Set clear objectives and performance metrics for digital initiatives in their sectors and
- Ensure continuous education of employees and citizens in the field of digital administration and services.

The development plan of the information system of the Real Estate Administration of Montenegro also contains operational measures that will help in a certain segment in returning Montenegro to the map of digitally advanced countries. According to the Reform

Agenda 2024-2027, the key deadlines are: December 2025 for updating the land registers and ensuring the functionality of the e-cadastre, and June 2027 for achieving 100% accuracy and timeliness of the e-cadastre for all real estate.

The e-Government portal, with over 80,000 registered users, was implemented in 2011 and is the central point for electronic services of the state administration. Although the number of available services is increasing, the technological framework and user experience lag behind modern digital standards.

According to research by the Alternative Institute within the *WEBER project,* only a third of citizens are aware that government services are available in electronic format. Additionally, more than three quarters of citizens are not informed about e-services, while the majority have not used them in the previous two years. On the other hand, companies show a higher level of information - about 90% of entrepreneurs state that they are familiar with available e-services for the economy.

According to the latest data from **the European Report on Montenegro for 2024,** at the end of 2023 the number of e-government services was **389,** which represents **a decrease** compared to the previous year. Nevertheless, during the year 2024, **over 45 new electronic services** were created through the projects of UNDP and other partners, which indicates the renewal of the digital momentum, which also established the foundations for the implementation of AI solutions in public administration with a focus on OCR technologies, chatbot functionality and predictive analytics systems.

Additionally, Montenegro launched a national initiative to create a blockchain-digital economy worth **2 billion euros**[1], and **Agile Dynamics** was hired to evaluate the cooperation between state institutions, the private sector and regulators in order to create an interoperable framework for the application of blockchain technology. The initiative considers the use of blockchain components for various sectors: tokenization of capital

[1]Source: Consultancy.eu

markets, digital identity, interoperable platforms, financial services, and potentially other public systems such as registries.

Public administration reform strategy 2022 - 2026 demands that, through strategic goal 1 (Organization and work of public administration in function of citizens' needs) and strategic goal 2 (Citizens and the economy use high-quality services of public administration), paperless administration, full interoperability of information systems and an increase in the number of electronic services at a high level of sophistication, as well as introducing a central monitoring system for providing services, are recognized.

The Council of Foreign Investors has defined key recommendations for the improvement of digital business:

1. **Digital communication without intermediaries** - enable full electronic interaction with users via eID, including contracts, bills and service changes without physical presence.
2. **Electronic exchange of documents with public institutions** - through the e-Government portal, enable download of electronically signed documents for tenders and other administrative procedures.
3. **Exchange of data on the National Identification Number (NIB)** - improve the system integration with the Ministry of Interior for the purpose of automated user identification, while protecting personal data.
4. **Implementation of OCR** technologies for the digitization of old cadastral documents with an accuracy of 98%
5. **Establishing an AI** system for automatic recognition of missing fields in subjects.
6. **Integration of a computer vision algorithm** for the analysis of aerial photographs of parcels with an accuracy of 92-96%

These findings indicate the need for **a comprehensive reform of e-services**, which includes modernization of the technological infrastructure, strengthening of user awareness and legal-technical adaptations for the complete digitalization of public administration.

Montenegro's strategic goals in the field of information and communication technologies (ICT) are aligned with the Digital Agenda 2020 for Europe and the vision of the Gigabit Society by 2025. This compliance confirms the state's commitment to digital transformation, modernization of public administration and strengthening of competitiveness through innovative technological solutions.

The analysis identified key areas that require coordinated action:

- Organization and coordination,
- eServices and service design,
- eIdentification, electronic trust services and cyber security,
- Availability, interoperability and data management,
- Digital connectivity,
- Skills and education and
- ICT industry.

Based on the available and analyzed documentation, in recent years there has been visible progress in the establishment of basic information systems that represent the basis for the provision of quality e-services and their complete digitization. The Platform of the Unified Information System for Electronic Data Exchange (SISEDE) of the Government Service, also called the Unified System of Electronic Data Exchange (JSERP), was put into operation at the end of 2018. The primary goal of this system is to provide communication between existing systems and a faster exchange of information between citizens and the administration, enabling the provision of services electronically and the automated exchange and use of large amounts of data from state registers. The main function of a central, interoperable system is to provide institutions with a unique communication platform for safe and reliable data exchange, thus providing the basis for quality and fast delivery of services. The following registries are currently connected to JSERP:

- Central population register,
- Central Register of Taxpayers and Insureds (Register of Taxpayers and Register of Employees),
- Central Register of Business Entities,
- Register of Education of Montenegro,
- Register of beneficiaries of material benefits,
- Register of insured persons of the Health Fund
- Waste register,

While the registers under the jurisdiction of the Real Estate Administration are not currently connected to JSERP, but as part of the IS development plan, it is envisaged that all these systems will be integrated, as well as all other registers used as part of the Real Estate Administration's operations.

eDMS system (electronic document management system) has been established in 20 institutions (increase from 16 in 2021), and in 12 it is fully used without any auxiliary records (internal delivery books, order books, registers, etc.). Although the system supports the functionality of exchanging electronic documents between institutions, until now it has only been used for records and exchange within individual institutions. In April 2025, the Ministry of Public Administration confirmed the successful implementation of technologically advanced systems including eDMS, which indicates significant progress in the digitization of administrative processes. The system currently enables processing at a speed of 100-500 documents per hour with automatic recognition of key data

2 Business context

2.1 The reform agenda of Montenegro and the main objectives of the IS development plan

Within the framework of the Reform Agenda of Montenegro for the period 2024-2027, which was prepared by the Ministry of European Affairs, the need to improve the electronic cadastre

and spatial planning is especially highlighted. The intended steps for the Real Estate Administration include:

- Updating the land cadastre until December 2025,
- Establishing the functionality of the electronic cadastre by December 2025,
- Ensuring 100% accuracy of real estate data in the electronic system.

In addition to technical improvements, the reform requires continuous education and raising awareness in the field of spatial planning and cadastre, including new digital services, channels and services.

Through the "Digital Compass 2030", the European Union has defined key goals that guide the digital transformation of member states and candidate countries, including Montenegro. These goals include four fundamental areas: **skills, public administration, business and infrastructure**, and each of them recognizes specific standards to which national policies should be aligned by 2030.

In the area of skills, the Digital Compass predicts that at least 80% of the population has basic digital skills, while at the level of the Union, the goal is to create 20 million ICT experts, with a balanced gender representation.

When it comes to public administration, the goal is full digital availability of key public services, including 100% online public services, full digital availability of medical records through e-Health, as well as widespread use of digital identity, which would be used by at least 80% of citizens.

In the domain of the business sector, the EU strives to ensure that the majority of European companies use modern digital technologies by 2030, whereby the goal is for 75% of companies to apply cloud, big data and AI solutions, to accelerate the development and financing of innovators, and for over 90% of SMEs to reach at least a basic level of digital intensity.

Finally, in the area of infrastructure, the Digital Compass sets ambitious goals for building advanced digital capacities: gigabit connectivity for all, wide availability of 5G networks, as well as advances in computer technologies, including the first generation of quantum-accelerated computers.

2.2 Digital reforms of Montenegro in accordance with EU standards

Through the reform priorities defined within the EU Growth Plan for the Western Balkans, Montenegro established a clear digital transformation agenda aimed at modernizing public administration, strengthening digital capacities and improving key infrastructures. These reforms include:

2.2.1 Development of digital infrastructure

- Adoption of a national plan for the development and provision of broadband infrastructure for equal access to digital services in urban and rural areas and to encourage economic growth.
- Alignment with the European Code of Electronic Communications, which will enable faster construction of very high capacity networks and facilitate the introduction of gigabit networks.

2.2.2 Digital identity and electronic identification

- Establishment of the Digital Identity Wallet (Digital Identity Wallet), with the goal of full inclusion in the "EU Digital Identity Wallet" project by 2027.
- Full implementation of electronic identification (e-ID) by 2027, which will give citizens digital access to various public services, including tax, social and educational services.

2.2.3 Digitalization of public services

- Expansion and modernization of digital public services through the implementation of a special program (2025-2027) for complete transactional digitization at the state and local level.

- Improvement of the interoperability of registers and further development of the e-Government platform, in order to make digital services more accessible, efficient and easier to use.

2.2.4 Improving digital skills

- Implementation of the Education System Digitization Strategy (2022-2027), which foresees the accelerated development of digital education.
- Establishing a larger number of EdTech centers and ensuring that there is at least one technological device per 11 students in primary and secondary schools by 2027.
- Strengthening the digital literacy of the population and increasing the capacity of educational institutions in the domain of digital competences.

2.2.5 Cyber security and resilience

- Strengthening cyber resilience through full implementation of the EU 5G Cybersecurity Toolbox and alignment with the NIS2 Directive.
- Establishment of the Agency for Cyber Security and formation of an operational team for response to computer incidents (Computer Incident Response Team - CIRT).
- Strengthening the protection of key digital infrastructure and improving national capacities to respond to threats in cyberspace.

2.3 Positioning of Montenegro in relation to the region and the EU

Montenegro, along with Serbia and Albania, shares a leadership position in the Western Balkans region with the highest overall **DESI** (digital economy and society index) score, especially standing out in the field of digital technology integration.

2.3.1 Human capital

Digital skills and experts are the foundation of digital transformation. In Montenegro, the data show a solid base, with room for further development[2]:

- Internet access: 88.3% (EU: 90%, WB: 85%)
- Basic digital skills: 47% of citizens (EU: 56%, WB: 32%)
- Advanced digital skills: 10.6% of citizens (EU: 27%, GB: 9%)
- Skills for creating digital content: 87.4% of citizens (EU: 68%, GB: 57%)
- ICT experts: 4.1% of employees (EU: 5%, ZB: 3%)
- ICT graduates: 7.9% of all graduates (EU: 5%, ZB: 7%)

Montenegro stands out for the wide representation of basic skills and education in the field of information and communication technologies, but it is still necessary to increase the number of experts and develop more advanced skills.

2.3.2 Connectivity (network)

Availability of high-speed Internet and network coverage are key prerequisites for digitization[2] :

- Fixed broadband internet: 81.3% of households use it (EU: 93%, GB: 88%)
- Very High Capacity Fixed Network (VHCN) coverage: 79.2% (EU: 79%, WB: 68%)
- Coverage of fixed broadband subscriptions (>100 Mbps): 63.1% (EU: 66%, GB: 40%)
- Optical Internet coverage to the end user (FTTP): 74% (EU: 64%, ZB: 57%)
- Use of mobile broadband: 87.9% (EU: 90%, GB: 84%)
- 5G network coverage: 85.4% (EU: 89%, GB: 11%)

Montenegro leads the region, with significantly higher availability of advanced networks than the average of the Western Balkans and even the European Union, which clearly shows that the digital infrastructure is set on solid foundations. This result creates favorable conditions

[2]Source: Western Balkans Digital Economy and Society Index (WB DESI) 2024 Report

for the accelerated development of digital services, the faster adoption of modern technologies and the creation of an environment that can support the growth of innovation, the modernization of public and private services and the strengthening of the overall competitiveness of the digital economy in the coming years.

2.3.3 Digital public services

The development of electronic administration and digital services for citizens and the economy is an important part of the digital transformation of the state[3]:

- Users of e-government: 48.4% of internet users (EU: 75%, ZB: 43%)
- Number of e-services: >500 services from 50 institutions
- Digital services for citizens: 53/100 points (EU: 79, WB: 48)
- Digital services for the economy: 37/100 points (EU: 85, ZB: 60)
- Pre-filled forms: 24/100 points (EU: 71, ZB: 60)
- Customer support: 66/100 points (EU: 86, ZB: 54)
- Adaptability to mobile devices: 80/100 (EU: 95, ZB: 85)
- Access to electronic health records: 74/100 (EU: 79, ZB: 51)

By 2024, the e-Government portal included over 500 services provided by 50 state institutions, which makes it the central point for accessing public services in Montenegro. However, a significant part of these services, 349 of them have a predominantly informative function and serve as a guide through administrative procedures, without the possibility of fully electronic performance of work processes. Only 155 services are fully digitized, enabling citizens and businesses to complete processes online, without the need for physical visits and additional administrative steps. This structure indicates the existence of a solid foundation, but also a significant space for further expansion of the spectrum of transactional services and improvement of the real digital availability of public administration.

[3]Source: Western Balkans Digital Economy and Society Index (WB DESI) 2024 Report

2.3.4 Introduction of digital technologies in the economy

Small and medium-sized enterprises (SMEs) play a key role in the digital transformation of the economy. Montenegro shows significant progress in the digital transformation of the business sector[4]:

- SMEs with a basic level of digital intensity: 64% (EU: 58%, WB: 43%)
- Electronic exchange of information: used by 42.1% of companies (EU: 42%, ZB: 25%)
- Social networks: 39.2% of companies use them (EU: 31%, WB: 26%)
- Big data: used by 46% of companies (EU: 32%, ZB: 31%)
- Cloud computing: used by 28% of companies (EU: 38%, GB: 26%)
- Artificial intelligence: used by 5.6% of companies (EU: 7%, WB: 5%)
- Electronic invoices: 55.7% of companies use them (EU: 38%, WB: 41%)
- Turnover from e-commerce: 8.8% (EU: 12%, GB: 6%)

Montenegro is clearly positioned above the average of the Western Balkans in almost all aspects of the digital transformation of the business sector, showing stable progress and a greater willingness of companies to adopt modern digital technologies. In several segments, such as the use of advanced digital solutions, electronic services and digital communication, the results of Montenegro approach European standards, and in some areas even exceed them. This trend indicates that the Montenegrin economy is slowly but surely closing the gap with the EU and creating solid foundations for the further development of digital capacities, strengthening competitiveness and accelerated adoption of innovations in the coming years.

2.4 Business goals of the Real Estate Administration

The Real Estate Administration of Montenegro is one of the key institutions in the legal and economic system of the country, responsible for maintaining a unique cadastral record. As the custodian of data on ownership, real estate rights and spatial information, the Administration has a central role in ensuring the legal security of citizens, support for

[4]Source: Western Balkans Digital Economy and Society Index (WB DESI) 2024 Report

economic development and efficient functioning of the state administration. However, the current state of the information infrastructure, technological resources and personnel structure represents significant obstacles for fulfilling the increasingly complex demands placed on the institution by citizens, the economy and the processes of European integration.

Understanding the strategic importance of the Real Estate Administration's information system development plan requires an insight into the breadth and depth of the dependence of other institutions on the data that the Administration manages and maintains. Spatial and proprietary data represent the fundamental infrastructure on which the functioning of a large number of state and economic entities rests.

The Tax Administration of Montenegro uses cadastral data on a daily basis to calculate property taxes, determine the tax base and control the fulfillment of tax obligations. Without accurate data on real estate characteristics, ownership relationships and land categorization, the property taxation system cannot function effectively. **The court system** relies on data when resolving property disputes. Legal certainty in real estate transactions directly depends on the quality and availability of this information.

The Ministry of Spatial Planning, Urbanism and State Property depends on up-to-date spatial data for the preparation of planning documents, approval of construction and control of spatial development. **Local governments** use the Administration's data to determine utility fees, plan infrastructure and manage local development. **Security services** rely on ownership data in the investigation of criminal offenses and conducting preventive activities.

The financial sector, including banks, insurance companies, and investment funds, depend on reliable data on real estate that they use as collateral for loans, the basis for insurance or the subject of investments. **The business sector** uses cadastral data to identify locations for new investments, determine the legal status of land and verify ownership relationships before business transactions. **Citizens,** when buying or selling real estate, depend on the accuracy and availability of data maintained by the Administration.

The dependence of other entities on the data of the Real Estate Administration makes its role many times more important than it is usually perceived. The administration is not only an institution that provides services to a certain group of users, it is a critical infrastructural component whose functioning enables the operation of numerous other systems. The quality, accuracy and availability of data maintained by the Administration directly affect the efficiency of a large part of public administration and the economic sector.

The existing information systems of the Real Estate Administration are characterized by numerous weaknesses that directly affect the quality of services and operational efficiency of the institution. A small part of cadastral documentation and archival material still exists in analogue form. These materials, documented on paper, are subject to physical deterioration, making it difficult to quickly access relevant information and creating a serious risk of losing critical data. This situation not only makes it difficult to make reliable decisions, but also increases the possibility of errors in the work of the institution.

Users of services, citizens and business entities, are often faced with lengthy administrative procedures that require physical presence, loss of working time and often multiple visits to solve a single case. As the Reform Agenda requires the achievement of 100% accuracy and up-to-date e-cadastre by June 2027, the current capacities of the system are insufficient to achieve the goal. An additional problem is the insufficient connection of the Administration with other state registers. Although the Central Population Register, the Central Register of Business Entities and other key registers are connected to the Unified Electronic Data Exchange System (JSERP), the Cadastral Data Record is not yet integrated into this platform. Such disconnection creates the need to repeat the same procedures at different institutions, which additionally burdens users and slows down business processes.

A special and perhaps the most critical challenge is the personnel situation in the Real Estate Administration. The institution faces a significant shortage of professional staff, especially in the field of information technology, geoinformatics, spatial data management and modern geodetic technologies. The existing staff in the Information System Sector, as well as in other organizational units, often do not have the appropriate competencies for working with

modern digital tools, GIS technologies and complex databases. This situation directly complicates the implementation of new systems, maintenance of existing solutions and adaptation to international standards such as the INSPIRE directive.

The problem is further deepened by the fact that it is extremely difficult to attract young, promising experts to vacant positions in the Administration. Uncompetitive employment conditions in the public sector including salaries, benefits and professional development opportunities mean that the Administration cannot compete with private companies, international organizations and the IT sector that offer far more favorable conditions. This trend results in the aging of the personnel structure and the loss of access to newer knowledge and innovative approaches brought by young experts.

The Real Estate Administration's information system development plan is not an isolated technological initiative, it represents a strategic imperative arising from multiple interconnected pressures and obligations. First of all, the processes of European integration set clear and unambiguous requirements. Alignment with the directives of the European Union on Spatial Data Infrastructure (INSPIRE), ensuring the interoperability of public administration systems and the complete digitization of public services are not options but prerequisites for moving forward in the negotiation process. Without functional modernization of the information systems of the Real Estate Administration, Montenegro will not be able to demonstrate its readiness to meet the standards expected of member states.

The main objectives of the development plan for information systems of the Real Estate Administration of Montenegro are:

- Establishing a unified information system,
- Modernization and digitization of the cadastre (including digital processes) and related registers under the jurisdiction of the Real Estate Administration,
- Establishment of integrated electronic access to all spatial and proprietary data,
- Reducing the administrative burden on citizens and the economy through the integration of online services,

- Increasing transparency and legal certainty in real estate transactions.
- Improving data quality.

The key future activities of the Real Estate Administration are:

- Development of these systems, services and portals that include:
  - Establishing a new unified information system as the highest priority,
  - Cadastre of pipelines,
  - Real estate price register
  - Establishing a new system for creating topographic maps
  - Register of Geographical Names,
  - New rating system,
  - Creating a new geoportal of the Real Estate Administration,
  - Improvement of portals available to the public and institutions - Geoportal and GIS platform,
  - Development and implementation of a centralized information system for spatial and ownership data - a new system for cadastral records,
- Improvement and creation of existing systems, services and portals that include:
  - Digitization (eArchive) of existing analogue data (cadastral plans, records, archival material, documents),
  - Creation of a new eDMS system
  - Maintenance of existing registers
  - Improving data quality,
  - Integration with other state registers (register of citizens, central register of business entities, court registers),
  - Improvement of e-services: verification of ownership and tracking of item status online,
  - Automating the process of entering, checking and updating data,
  - Application of interoperable standards in accordance with the Law on Spatial Data Infrastructure.

The planned infrastructure and technology for the implementation of the initiatives envisages:

- Hybrid solutions (at the location of the Real Estate Administration and in the cloud) for reliable data storage and processing,
- Digital signature and user authentication through national identification solutions,
- Digital services for data exchange with other institutions.

The necessary organizational changes for the successful implementation of the development plan require:

- Filling the missing personnel in the Information System Sector,
- Education and training of staff to work in specific areas in the digital environment,
- Redefining internal processes in accordance with the principles of "digital by default",
- Establishing data management and information security teams.

The expected effects of the implementation of the information system development plan are:

- Faster and more efficient provision of services to citizens and the economy,
- Greater legal certainty in real estate transactions,
- Reduction of corruption risks thanks to transparent access to data,
- Compliance with European standards.

2.5 Audit recommendations as additional drivers of change

The general conclusion of the audit indicates that the Real Estate Administration in the field of information system management has largely established good practice in the functioning of the Geodetic-Cadastral Information System. However, the audit recommendations clearly emphasize the need to strengthen internal controls through their documentation, implementation and monitoring, in order to provide reasonable assurance that the management goals of this information system will be achieved.

Accordingly, the development plan of the information system of the Real Estate Administration is harmonized and directed towards the elimination of identified deficiencies through the following strategic directions of action:

2.5.1 Improvement of organizational structure and systematization

- Launching an initiative to revise and amend the Rulebook on internal organization and systematization, with the aim of clearly defining jobs and job descriptions that include all the needs of the Administration in the field of information technology
- Expected outcome: precise distribution of responsibilities and optimal directing of resources in accordance with the importance and complexity of the system

2.5.2 Filling of personnel capacities

- Planning and ensuring full occupancy of positions in the organizational unit responsible for managing the information system
- Expected outcome: sustainable and efficient functioning of the system, stable dynamics of development and realization of planned activities

2.5.3 Continuous training of employees

- Establishing a program of continuous professional development and training of employees in the field of information and communication technologies
- Introduction of individual professional development plans for each employee, in accordance with the needs of the workplace and the strategic goals of the institution
- Organizing thematic workshops, seminars and certification programs in the field of information and communication technologies, cyber security and digital transformation
- Encouraging internal knowledge exchange programs and mentoring support among employees
- Expected outcome: increase in employee motivation and reduction of personnel risks through targeted improvement of competencies. Harmonization of

professional knowledge with modern technological standards and best practices. Knowledge transfer within the organization, faster adaptation of new employees and strengthening of team cohesion. Strengthening professional capacities for daily activities, increasing the system's resilience and supporting its further development

2.5.4 Development of a strategic framework for the information system

- Initiation of the process of defining the strategic framework for the Geodetic-Cadastral Information System, including the elaboration of elements from earlier strategic documents
- Alignment with the methodology for drafting strategic documents in the public sector
- Expected outcome: a clear vision, goals and plan for the development of the information system in the medium and long term

2.5.5 Systematic management of IT risks

- Identification, classification and evaluation of IT risks in accordance with valid rules and regulations
- Creating an IT risk register that includes control activities, responsible persons and deadlines for implementation
- Special focus on information security risks and establishment of mechanisms for regular risk reporting
- Expected outcome: a comprehensive and up-to-date framework for proactive risk management

With respect to audit recommendations, the information system development plan clearly shows that it is not only developmentally oriented, but also correctively oriented, i.e. to actively integrate audit recommendations into its goals and plans.

2.6 ESG requirements

In the modern environment, based on the principles of sustainable development and European integration, the public administration of Montenegro must ensure that its activities are aligned with ESG (Environmental, Social, Governance) standards. These standards are not only an international obligation but also a basic framework for creating responsible, transparent and sustainable public administration.

In the field of environmental protection, public administration is expected to integrate the principles of sustainable resource management, including rational consumption of energy, water and paper, waste management and reduction of negative impact on the climate. Of particular importance is the application of the concept of "green public procurement" and the integration of ecological criteria into infrastructure and digital projects. In this way, the public administration directly contributes to the reduction of the ecological footprint and the achievement of the objectives of the climate policy of Montenegro.

In the social dimension, the key demands relate to the improvement of transparency and accountability of institutions towards citizens, as well as to the provision of equal opportunities and protection of human rights. The professionalization of public administration through the consistent application of the principles of employment, promotion and remuneration based exclusively on competences, knowledge, expertise and work results and continuous training of employees is the basis for quality provision of public services. In addition, it is necessary to develop mechanisms for the inclusion of citizens and the civil sector in decision-making processes, thereby strengthening trust in institutions and increasing the quality of policies and services.

In the area of governance, ESG requirements direct public administration towards strengthening the system of internal control and supervision, increasing the responsibility of managers and employees, and improving the transparency of the work of institutions. This implies the consistent application of the principle of responsibility in decision-making, the establishment of mechanisms to prevent corruption and conflicts of interest, as well as the

ethical and legal behavior of public officials. Alignment with EU standards and methodologies is particularly important, as well as consistent reporting on work results and progress achieved.

This approach requires specific regulatory support through appropriate legal frameworks that are already in the process of implementation in Montenegro.

The rulebook on minimum requirements for the energy efficiency of buildings, adopted in May 2024 as part of harmonization with European standards, lays the foundations for energy-sustainable management of public buildings. This regulation obliges the real estate administration to establish a system of continuous monitoring of energy consumption of all public buildings, which enables precise measurement of the ecological footprint and planning of measures to reduce it. The implementation of this rulebook requires digitization of energy data and the integration of smart resource management systems.

The Law on the Use of Energy from Renewable Sources, which entered into force in August 2024, is a key instrument for the transformation of the public sector towards climate-neutral functioning. This law introduces incentive measures for the energy efficiency of public buildings and enables the integration of renewable energy sources into the public sector, thereby creating conditions for the creation of energy-independent public institutions. For the Real Estate Administration, this means the obligation to plan and implement solar panels, heat pumps and other renewable energy technologies on public buildings.

Amendments to the Law on Public Procurement, which are in the process of being finalized, introduce a revolutionary change in the way public administration functions through the implementation of "green criteria" in all public procurement. This regulation, aligned with the "EU Green Public Procurement" guidelines, obliges the real estate administration to include the supplier's ESG performance as a key decision factor when procuring IT equipment, software and services. This means that the procurement of technological solutions will have to include an assessment of the ecological footprint, social responsibility and ethics of the partner's business.

The Montenegrin Reform Agenda 2024-2027 specifies the obligations of public institutions in establishing systematic ESG reporting as an integral part of the European integration process. This agenda sets the framework for regular monitoring and public disclosure of data on energy efficiency, carbon dioxide emissions, social impact and management practices of public institutions. For the Real Estate Administration, this represents an obligation to establish digital platforms for collecting, analyzing and reporting on the ESG performance of all public real estate.

By integrating these ESG requirements, the development plan of the Information System of the Real Estate Administration of Montenegro acquires a clear developmental and corrective dimension. On the one hand, it enables the creation of digital solutions that contribute to the preservation of the environment, improvement of social capital and more efficient management, while on the other hand mechanisms of responsibility and transparency are strengthened, thus ensuring that the digital transformation of public administration is fully aligned with the principles of sustainable development and European values.

2.7 IT trends

This segment analyzes the key IT trends that shape the future of the public sector, provides a comprehensive overview of the current state of digitization in Montenegro and the European Union, and defines strategic recommendations for positioning the Real Estate Administration as one of the leaders in the digital transformation of public administration. In order to respond to the accelerated changes and expectations of citizens and the economy, IT development must be aligned with the business goals of the Administration, European obligations and the actual capacities of the organization. The Real Estate Administration of Montenegro is today faced with the imperative of modernization. Key challenges include the digitization of analog, archival existing data, the establishment of a modern IT infrastructure, the provision of backup and disaster recovery solutions, and the creation of conditions for the further introduction of advanced digital services.

Before introducing advanced trends, it is necessary to provide the basic elements of a modern IT system:

- Centralized database and centralized and integrated business-information system architecture,
- Backup and disaster recovery plan with clearly defined procedures and periodic testing,
- Cyber security through basic protection measures, user authentication and access control,
- Education of employees to work in a digital environment,
- Digitization of analogue data (cadastral plans and records).

Without these prerequisites, it is not possible to realize the long-term vision of an interoperable and advanced Real Estate Administration. The following are the trends and strategic directions that are key for the next cycle of modernization from establishing the foundations (digitalization, backup, backup IT center, security) to advanced solutions.

2.7.1 Adaptation to the new demands of citizens and the economy

Improve user experience through basic online services and multiple channels (web, mobile, counter support) with clear case statuses. First focus: mobile accessibility, overview of ownership and status, simple e-services without complicated procedures.

2.7.2 Fundamentals-based digital transformation

Integrated IT systems with unified IT architecture and processes, modern information systems, digitized analog cadastral plans, established centralized database, improved data quality, standardized records and consistent data quality control. Without reliable data, there is no automation, interoperability or analytics.

2.7.3 Two-way data flow

Provide external users (ministries, courts, notaries, banks and other users) with secure access to withdraw structured data (plot, ownership, encumbrances, case status and other data) and

fill the system through electronic submission of documents with a qualified e-signature and time stamp. Priority is MVP with "read-only" and pre-filling of forms, followed by full e-submission and SLA monitoring (status, notifications, availability). This significantly speeds up procedures, reduces errors and enables the principle of "once submitted data" which is the foundation of modern public administration in the EU.

2.7.4 Data-driven decision-making

A data-based approach enables management to identify bottlenecks in processes, optimize resource allocation, predict future needs and measure the effectiveness of implemented measures. This trend requires not only technical tools for analytics, but also an organizational culture that values facts over assumptions and makes decisions based on measurable indicators. Start with basic reports on timeliness and accuracy, then introduce simple indicators (eg processing time, percentage of digital items). At a later stage: predictive analytics and advanced demand segmentation.

2.7.5 Cloud and hybrid infrastructure

Establish backup and disaster recovery as a priority (offsite copies, test RPO/RTO), then transition to hybrid cloud for scalability and resilience. The hybrid approach allows public institutions to keep critical and sensitive data under complete control on the national infrastructure, while at the same time taking advantage of cloud technologies for scalability, resilience and reduction of initial investments. Gradually introduce DevOps practices as the fundamentals stabilize.

2.7.6 Operational efficiency and an agile workforce

Operational efficiency in public administration directly affects citizens' satisfaction and business costs. Digitization enables the automation of routine tasks, the elimination of paper documentation and the introduction of electronic case management, which frees up employees' time for more complex tasks that require human judgment and expertise. Standardize processes, fully integrate eDMS and basic workflows (reception, processing, control), and train employees to work in a digital environment. The introduction of agile work

methods, modern collaboration tools and clearly defined processes makes the organization more resistant to changes, faster in adaptation and more attractive to young experts.

2.7.7 Interoperability and API-first approach

Interoperability represents the ability of different IT systems to exchange data and function with each other without the need for manual interventions or custom integrations. This trend is fundamental for the realization of the concept of e-government, where citizens do not have to submit the same data to different institutions. Plan systems so that data exchange with other registers is a rule (tax and court registers, other registers). Introduce an API gateway and format standards, primarily for basic inquiries (ownership verification, case status).

2.7.8 Cyber security and digital trust

The Real Estate Administration manages extremely sensitive information, such as data on ownership, property values and personal data of citizens. In the context of accelerated digitization of public administration, cyber security is becoming a key prerequisite for preserving institutional trust, business continuity and acceptance of digital services by citizens and the economy. Cyber incidents, data leaks or unauthorized access can have long-term reputational, legal and financial consequences. In accordance with modern IT trends and international best practices, it is necessary to establish **a systematic approach to cyber security,** which includes a combination of technical, organizational and procedural measures. A special focus should be placed on the principle *of security by design* and *privacy by design,* where security requirements are incorporated already in the planning and development phase of information systems.

Key measures include:

- application of basic and advanced protection mechanisms, such as multi-factor authentication (MFA), identity and access management (IAM), system segmentation and keeping detailed activity records (audit logs);
- alignment with the relevant regulatory and strategic framework of the European Union, especially with GDPR and the NIS2 directive, as well as the application of risk

management principles in accordance with standards such as ISO/IEC 27001 and the NIST framework;

- establishment of a formal response plan to cyber incidents (Incident Response Plan), including clearly defined roles, escalation procedures and cooperation with national and international bodies;
- development of minimum capacities for monitoring and detection of threats through SOC/SIEM solutions, either through internal resources or using reliable external services (managed security services);
- continuous strengthening of employees' awareness and knowledge through training and simulations, given that the human factor remains one of the most common causes of security incidents.

2.7.9 Low-code solutions for acceleration

Use low-code/no-code for simple internal applications and forms (eg data correction request, appointment agreement), to quickly reduce time and relieve IT. This approach is particularly useful in public administration, where frequent changes in regulations require rapid adaptation of IT systems, and budgets for software development are limited.

2.7.10 Strategic use of spatial data

Contemporary trends in public administration shift the focus from the passive use of spatial data (cartographic representation and records) to their strategic and analytical use as a key resource for decision-making. In the initial phase, it is necessary to establish uniform standards for spatial data, including reference coordinate systems, transformation rules and minimum accuracy thresholds, adapted to different spatial zones (e.g. urban and rural areas), in accordance with INSPIRE principles and European spatial data management practices. In the following stages, the integration of the GIS platform with business applications enables the transition from descriptive to analytical and predictive use of spatial data, including:

- spatial analysis of the real estate market and identification of patterns and trends by location;

- support for the planning of infrastructural and urban projects through multi-criteria spatial analyses;
- connecting spatial and non-spatial data (legal status, values, purpose) in order to improve the decision-making process;
- laying the foundation for advanced applications, such as simulations of development scenarios and integration with "open" data.

2.7.11 AI integration — after stabilization of fundamentals

When data and processes are organized, introduce AI where it has a clear effect: OCR for old documentation, auxiliary chatbot functions for frequently asked questions, automatic recognition of missing fields in cases. The analysis of aerial photographs using computer vision technologies enables the automatic extraction of plot boundaries with 95% accuracy, recognition of illegal objects and monitoring of changes in land use, which reduces field work by 60% and automates 80% of routine controls. That is why it is crucial to plan AI integration strategically, but to implement it only after the stabilization of the basic systems.

3 Methodology for the implementation of the IS development plan

Through a carefully thought-out methodology, we have defined a clear roadmap for implementation in all relevant domains, thereby setting a structured direction towards the realization of the defined information system development plan.

Preparation of the implementation plan follows a methodological approach that connects and aligns business goals, requirements and priorities with the target IT operational model and target IT architecture. This approach prioritizes initiatives based on business and investment strategy, solves operational challenges in order to establish an efficient and effective system that brings value from the perspective of both IT and business, and takes into account system requirements from the perspective of IT architecture and operational IT security (hereinafter: IT security).

The methodological approach includes all relevant areas in order for the Real Estate Administration of Montenegro to ensure that the development of the information system is well thought out, feasible and can effectively bring value to the business.

The elements through which the development of the information system plan is defined include:

1. Regulatory requirements and standards
2. Business strategy and IT vision
3. IT strategic priorities and investments
4. IT operating model
    - IT management
    - IT organization
    - IT processes
5. IT architecture
    - Software architecture
    - Data architecture
    - IT infrastructure
6. IT security (passes through the layers of the IT operational model and IT architecture)

The overall result of this segment of the information system development plan is a list of initiatives that will determine the direction of information technology development and their role in the Real Estate Administration of Montenegro in the next **five years.** Defined initiatives will systematically influence the current state of IT and drive improvements from an IT and business line perspective.

The following illustration shows the methodology used to develop the Real Estate Administration Information System Development Plan.

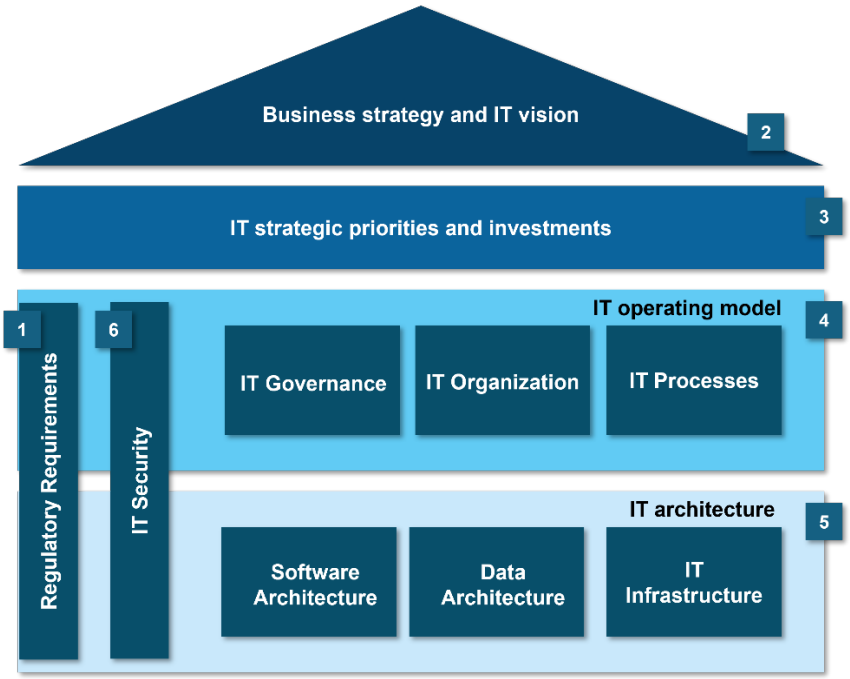


Figure 1- Methodology for the development of the IS development plan

Using **the presented methodological approach,** we created the target state for the Real Estate Administration of Montenegro from an IT perspective, specifically from the point of view of the target operating model, IT architecture adapted to the purpose of management and a high-level view of IT security, designed on the basis of business goals, requirements and priority initiatives. In the following segments of the IS development plan document, answers to the following five key strategic questions will be provided:

1. What role should IT play in achieving business success in the Real Estate Administration of Montenegro?
2. How should IT prioritize development activities and reallocate available investment resources?
3. How should information technology be managed to deliver the required values?
4. What does the new information technology architecture look like?
5. How is the distribution of duties in the field of IT security carried out?

4 Regulatory requirements and standards

4.1 Law on State Survey and Real Estate Cadastre

The Law on State Survey and Real Estate Cadastre regulates the system of state survey, real estate cadastre, land cadastre and registration of real and bond rights on real estate. The regulation defines that the survey and maintenance of the cadastre are activities of public interest and include the collection, processing and storage of spatial and legal data on land, objects and rights holders. This establishes a unique and credible public record that forms the basis for legal certainty in real estate transactions and space management.

The central component of the system is the geodetic-cadastral information system, which enables recording, exchange and access to real estate data for all authorized users, regardless of their location. The law emphasizes the obligation of up-to-date records and reliability of data, as well as the application of standardized technical and operational procedures in all phases of surveying and maintenance of the cadastre database.

In the procedures for creating and maintaining the cadastre, the rights to land and buildings are determined, including the right of ownership, co-ownership, joint ownership, condominium ownership and other real and obligational burdens. Enrollment of rights is carried out exclusively through an administrative procedure based on legally valid documents, and data from the cadastre have legal effect against third parties and are available to the public in the form of official documents such as the real estate list and the cadastral plan.

For the needs of digital transformation of public administration, the law represents a key basis for the development of interoperable services and advanced information solutions based on geospatial data. The role of a modern IT system is to enable reliable integration of the cadastre with other state registers and electronic services, which improves transparency, speeds up administrative procedures, reduces administrative burdens and increases the efficiency of space and property management.

4.2 Law on Spatial Data Infrastructure

The Law on Spatial Data Infrastructure is the foundation for the digital transformation of the spatial planning and data management sector. The aim of the law is to establish an integrated system that enables **efficient processing, exchange and use of spatial data** through modern technologies and standards.

Key elements of the law include:

- Geoportal as a central data access point, available 24/7,
- Metadata, network services and exchange methodologies,
- 34 thematic areas of spatial data (eg cadastre, addresses, traffic, energy, space protection).

Public institutions have the obligation to:

- Maintain data in electronic form,
- It provides interoperability and availability through network services and
- Designates persons responsible for updating and processing data.

Access to data is free among institutions, with the possibility of restrictions to protect the public interest. Supervision over implementation is carried out by the Ministry and the competent authority for e-Government, while funding is provided from the budget and other sources.

The aforementioned Law establishes a unique legal and technological basis for the collection, management, exchange and use of spatial data in Montenegro. This law defines the elements of spatial data infrastructure — metadata, network services and technologies, exchange methodology, conditions of use and Geoportal as a central access point. The regulation establishes the obligation of public institutions to form and maintain sets of spatial data in electronic form, establish network services, ensure interoperability in accordance with INSPIRE and other international standards, as well as continuous updating of metadata and spatial registers. This ensures transparency, availability and standardized management of

data related to reference systems, cadastre, infrastructure, environment, demography, energy, industry and a number of other thematic areas.

From the point of view of the development of digital administration, the law represents the foundation for the integrated management of geospatial information and enables the exchange of data between institutions, as well as the provision of e-services through the Geoportal, available to users 24/7. Its application encourages the interoperability of information systems, the automation of administrative processes, cooperation between state, local and private entities, as well as alignment with INSPIRE practices of the European Union. The law clearly directs public institutions towards digital business, standardized data exchange, web services for accessing, transforming and downloading data, with the protection of sensitive information and the application of information security principles. In this way, spatial data infrastructure becomes one of the key pillars of digitization, supporting more efficient decision-making in the areas of development, spatial planning, economic investments, environment, energy and risk management.

4.3 Rulebook on the creation and maintenance of the real estate cadastre

The rulebook on the creation and maintenance of the real estate cadastre represents the operational framework for the implementation of the Law on State Survey and the Real Estate Cadastre and defines technical norms, work methods and standards for collecting, processing, storing and updating real estate data. Special emphasis is placed on the establishment and maintenance of the real estate cadastre database, the exchange of data through standardized digital formats and the use of modern information technologies for the preparation of cadastral operations and the issuance of official records. This ensures the accuracy, reliability and transparency of geospatial data in accordance with the public interest.

In the context of the IT strategy, this regulation clearly directs the development of the geodetic-cadastral information system towards interoperable, automated and electronically accessible processes. The application of the rulebook implies digitization of cadastral data, modernization of field and office geodetic work, electronic exchange of data between

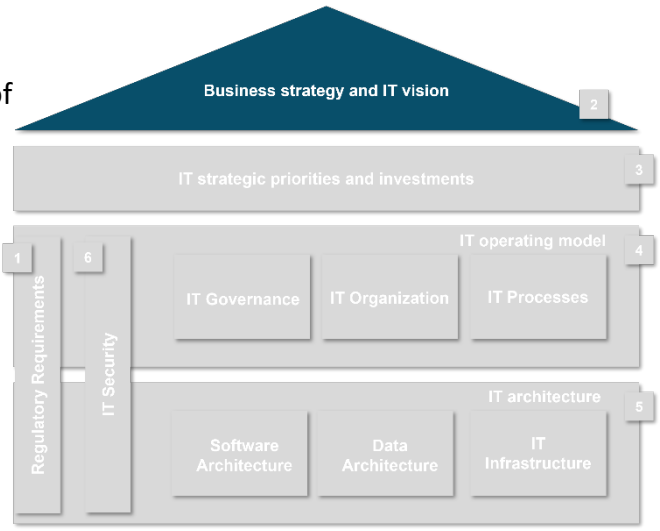
administrative bodies and licensed geodetic organizations, as well as opening of data through web services for the needs of citizens, institutions and the market. Thus, the rulebook directly contributes to the digital transformation of real estate management and represents the foundation for the development of modern e-services in the field of cadastre and property records.

4.4 Draft Rulebook on Geodetic-Cadastral Information System

The Draft Rulebook on the Geodetic-Cadastral Information System represents a normative framework for the establishment, formation and maintenance of GKIS as a central subsystem of the information system of state bodies for managing geospatial and cadastral data. This act regulates the structure of the system, the organization of databases and services, technical standards, data exchange, security requirements and management models, relying on international standards in the field of information technology and geoinformation, such as ISO/IEC, OGC and INSPIRE specifications. The system is based on modular architecture, web technologies, service-oriented architecture and standardized data exchange formats (XML, GML, ASCII, CSV, TIFF, LAS, etc.), which ensures interoperability, scalability and reliability in the exchange and use of cadastral data.

From the point of view of the IS Development Plan, this regulation confirms a clear orientation towards the development of a digital, secure and interoperable infrastructure for the management of real estate and geospatial information. The introduction of a standardized GKIS enables automation of the Administration's business processes, electronic issuance of documents, use of web services (WMS, WFS, WCS, CSW), availability of data to different types of users, as well as compliance with national and international policies of the information society. In addition, the rulebook emphasizes technical and organizational measures for information security, work process management, data protection and system development through continuous improvement of technological solutions. Thus, GKIS is recognized as a fundamental digital resource for the development of e-government, strengthening the transparency of property records and supporting investment planning, spatial development and economic development of the state.

5 Business strategy and IT vision



The Real Estate Administration of Montenegro is preparing for strategic digitization focused on harmonizing technology with the changing needs of the business environment.

The IS development plan is based on the basic question: "What does business need from IT?".

The next part of the document will provide an insight into the specific business needs from IT, relying on all available key sources, the priorities that have been set, as well as the feedback that has been received from the employees of the Real Estate Administration.

5.1 Compliance with business strategy

Within the IS Development Plan, the Real Estate Administration of Montenegro ensures that the IT vision, goals and priorities are aligned with the overall vision and strategic pillars defined in the business strategy. The final IS Development Plan will be harmonized with the mid-term work program prepared by the Real Estate Administration and will be adopted by the Government of Montenegro.

The IS development plan strongly emphasizes digitization, process optimization, automation and transition to paperless work. In addition, priority is given to operational resilience, reliable information and communication technology and cyber security, so that IS development is in line with broader business goals.

The management infrastructure of data on space and real estate is one of the key pillars of the digital transformation of public administration in Montenegro, as well as the foundation for efficient spatial planning, investments and development. In the next medium-term period, the priority of the Real Estate Administration will be the modernization, establishment and

maintenance of centralized registers and records: cadastre of lines, register of house numbers, streets and squares, register of spatial units and register of prices of traded real estate. These systems enable the creation of a complete, accurate, up-to-date and unique source of spatial information, which is available in electronic form to all users - institutions, investors, companies and citizens.

Digitization and interoperability form the basic vision of development. The establishment of new web applications, portals and services, improvement of existing solutions and integration with the e-Government platform will ensure the availability of data 24/7 and significantly reduce administrative procedures for the public and private sector. Special emphasis is placed on standardization and unified procedures, including implementation of international standards (INSPIRE, OGC, ISO), development of unique data models, application of web services for integration and information exchange, and creation of normative conditions for system sustainability. The establishment and modernization of registers has multiple economic and developmental significance - from strategic planning, infrastructure investments and risk management, to a stable tax and financial system.

The Real Estate Administration will implement activities in a planned and phased manner, through the 2026-2030 project dynamics. year, with full cooperation with state authorities, local self-government units, companies and other subjects of the public and private sector. At the same time, the modernization of the geodetic-cadastral information system and the digital archive is a key complementary component, which enables integrated access to all spatial and legal data, complete digitization of documents and the transition to the "paperless cadastre" concept. The results of these processes will strengthen the legal security of the real estate market, increase the transparency of public administration, improve the quality of services to citizens and the economy, and create a reliable information infrastructure for the development of Montenegro in the coming decades.

5.2 Comparative analysis of the organization of the Real Estate Administration of Montenegro with contemporary regional and European practices

Real Estate Administrations, ie Geodetic Institutions in the region and European countries are usually positioned as independent state bodies, directly under the Government of an individual state, in the form of an Agency for Real Estate Management or Geodetic Administration. Such a model enables a clearer definition of responsibilities, faster decision-making, stronger institutional autonomy and greater operational efficiency. Agencies have the primary function of providing reliable and digitally accessible services to citizens, the economy and other institutions, while ensuring transparent and safe disposal of property and legal data of strategic importance for the state.

The current service provision system in Montenegro is predominantly based on the principle of free availability, which significantly burdens the resources of the Real Estate Administration, and at the same time does not create a sustainable financial model for further technological and organizational development. The existing fee of 15 euros for registering in the register for natural persons is the same for investors and legal entities - including the procedures for registering capital buildings (e.g. hotels and office buildings), even though it is a job that in reality engages the capacity of the institution for up to two working days. This model does not reflect the actual costs of work, does not encourage the improvement of services and does not ensure the financial sustainability of the institution.

Models of Agencies/Geodetic Institutions in the region and Europe enable:

- billing system through differentiated and fair tariffs for individuals and legal entities,
- commercial services, especially for the economy and investments,
- direct investment of collected funds in digitization, technological infrastructure, cyber security and professional development of personnel,
- significant acceleration of procedures and increase in the quality of customer service.

According to the current laws in Montenegro, free access to services is provided to all state bodies and entities that have authority, and this practice should be preserved and modernized through standardized API integrations and secure access channels. This provides continuous access to key data for the implementation of administrative procedures, while simultaneously reducing manual communication and the administrative burden on employees.

In the case of the transformation of the Real Estate Administration into an Agency for Real Estate Management directly under the Government, they would get an optimal model aligned with modern European practices. Such a reorganization would enable the reduction of administrative barriers, acceleration of economic activities, better protection of the property and legal security of citizens and investors, as well as long-term sustainable financing of the development of digital registers and services.

An analysis of the organizational models of real estate management in Europe and the region shows that the most efficient systems function as independent agencies directly under the authority of the government:

- Croatia - State Geodetic Administration: an independent state body under the Government, with a developed model of billing for commercial services.
- Slovenia - Geodetic Administration of the Republic of Slovenia (GURS): independent administrative body responsible directly to the Government, financially sustainable through fees and digital services.
- Serbia - Republic Geodetic Institute: an independent organization with an expanded scope of activities and institutional autonomy.
- Austria - BEV (Bundesamt für Eich- und Vermessungswesen): operates as a federal agency under the Ministry of Finance, with a strong market approach to commercial services.
- Germany - Cadastral and land registry affairs organized through regional agencies (Landesämter) directly under the jurisdiction of the provincial governments.

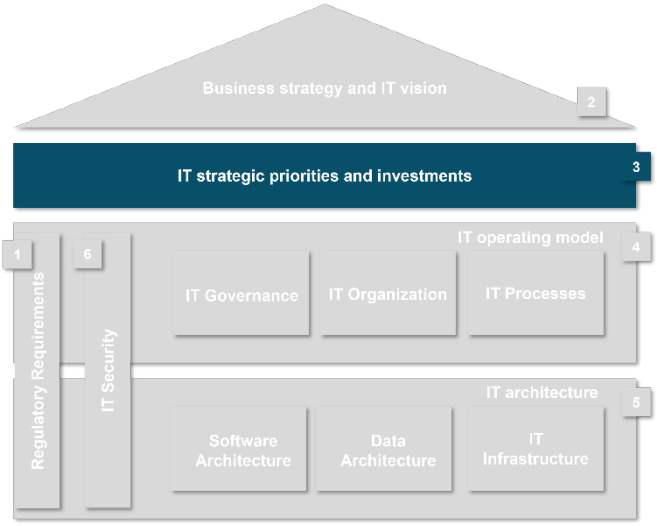
In all the listed systems, a common practice is clearly visible - the cadastre and land records are entrusted to specialized and organizationally autonomous bodies, which enables:

- greater operational flexibility,
- higher level of digitalization,
- financial self-sustainability,
- faster adaptation to business and technological requirements.

5.3 Strategic IT priorities and investments

5.3.1 Comparison of the current and desired state (IT Health Check)

The IT Health Check assessment represents a comprehensive tool for evaluating the IT department within the Real Estate Administration of Montenegro, with the aim of ensuring compliance of systems and processes with the strategic goals and tasks of the Administration.



This assessment covers the following dimensions:

- Business and IT alignment
- IT Value Management
- IT organization, IT management and IT processes
- IT applications
- IT infrastructure
- IT costs and procurement

Each dimension is evaluated on a scale of 1 to 5, according to the following stages:

- 1 - Initial phase: Processes are not documented, chaotic and reactive, leading to an unstable environment.

- 2 - Repeatability Phase: Some processes can be repeated, with potentially consistent results. However, discipline in implementing the process may be lacking.
- 3 - Defined phase: Processes are documented, there are standardized processes that can be improved over time.
- 4 - Quantitatively managed phase: Process metrics show effective achievement of goals under various operating conditions. Users demonstrate the ability to adapt the process to different situations.
- 5 - Optimized phase: The focus is on continuous improvement through incremental and innovative changes that improve process performance.

The IT Health Check assessment provides a deeper understanding of the IT department, including system analysis, identifying its strengths and areas for improvement. These insights enable informed decision-making in optimizing the IS development plan and better alignment with overall business goals.

The evaluation indicates the areas that need to be improved in all the mentioned dimensions, so that IT reaches the goal of becoming a proactive business catalyst within the duration of this IS development plan. The following illustration provides an overview of the current state of the Real Estate Administration and the targeted position in the next five years through the six previously mentioned dimensions.

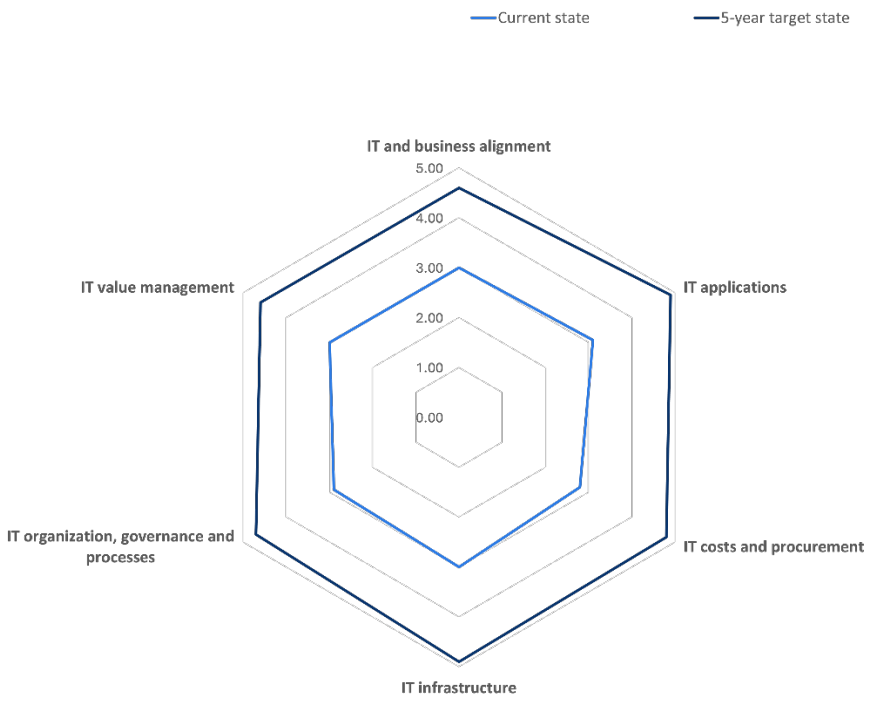


Illustration 1- An overview of the IT Health Check analysis, showing the current and target state for each dimension assessed.

A detailed analysis of the IT Health Check is shown in the following tables. It begins by reviewing summary guidelines for each dimension, and then more detailed tables address the individual subdimensions, providing guidance for each.

Illustration 2- IT Health Check Assessment - Summary of the analysis of all six dimensions

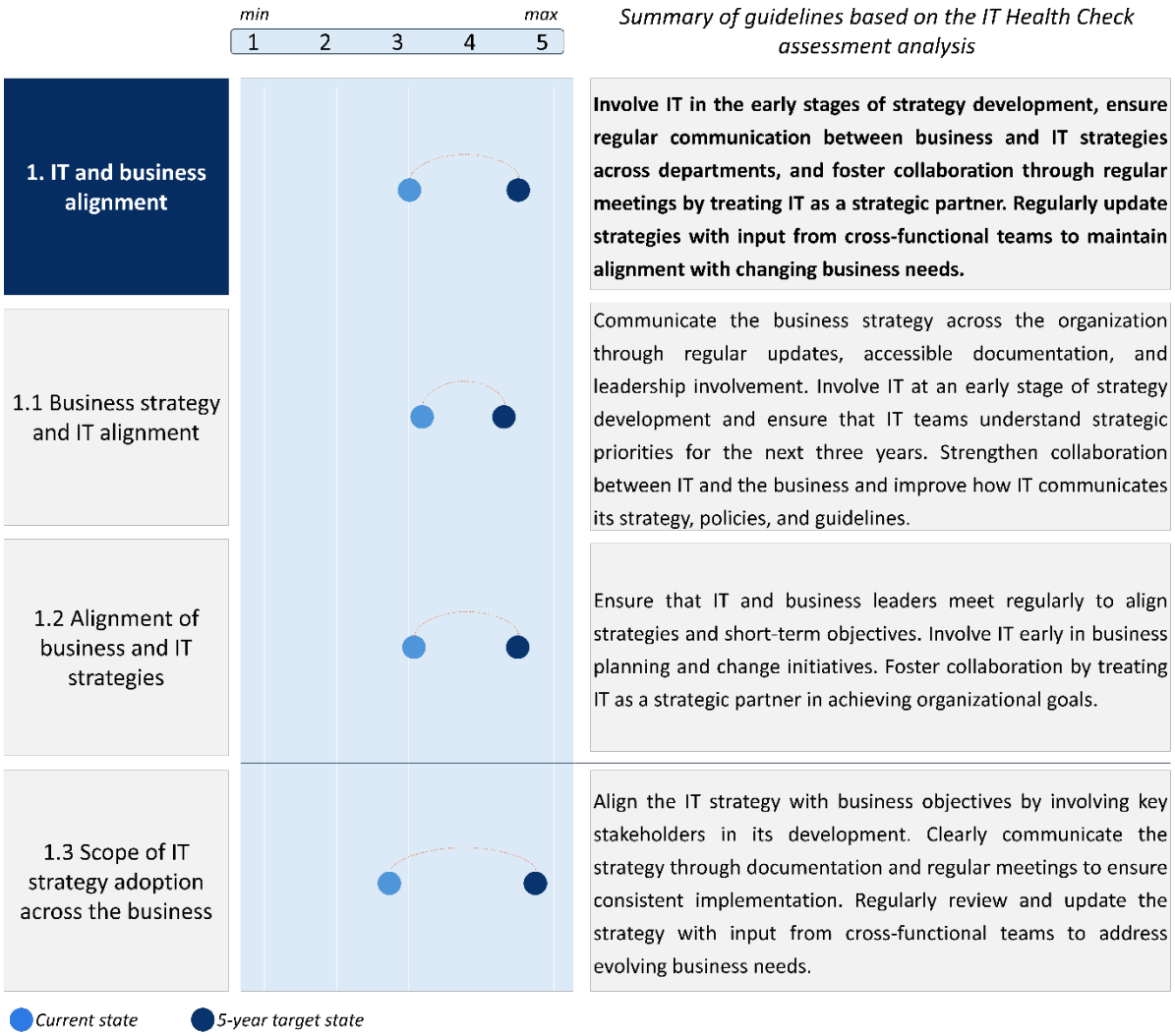


Illustration 3- IT Health Check Assessment - Dimension: Alignment of IT and Business

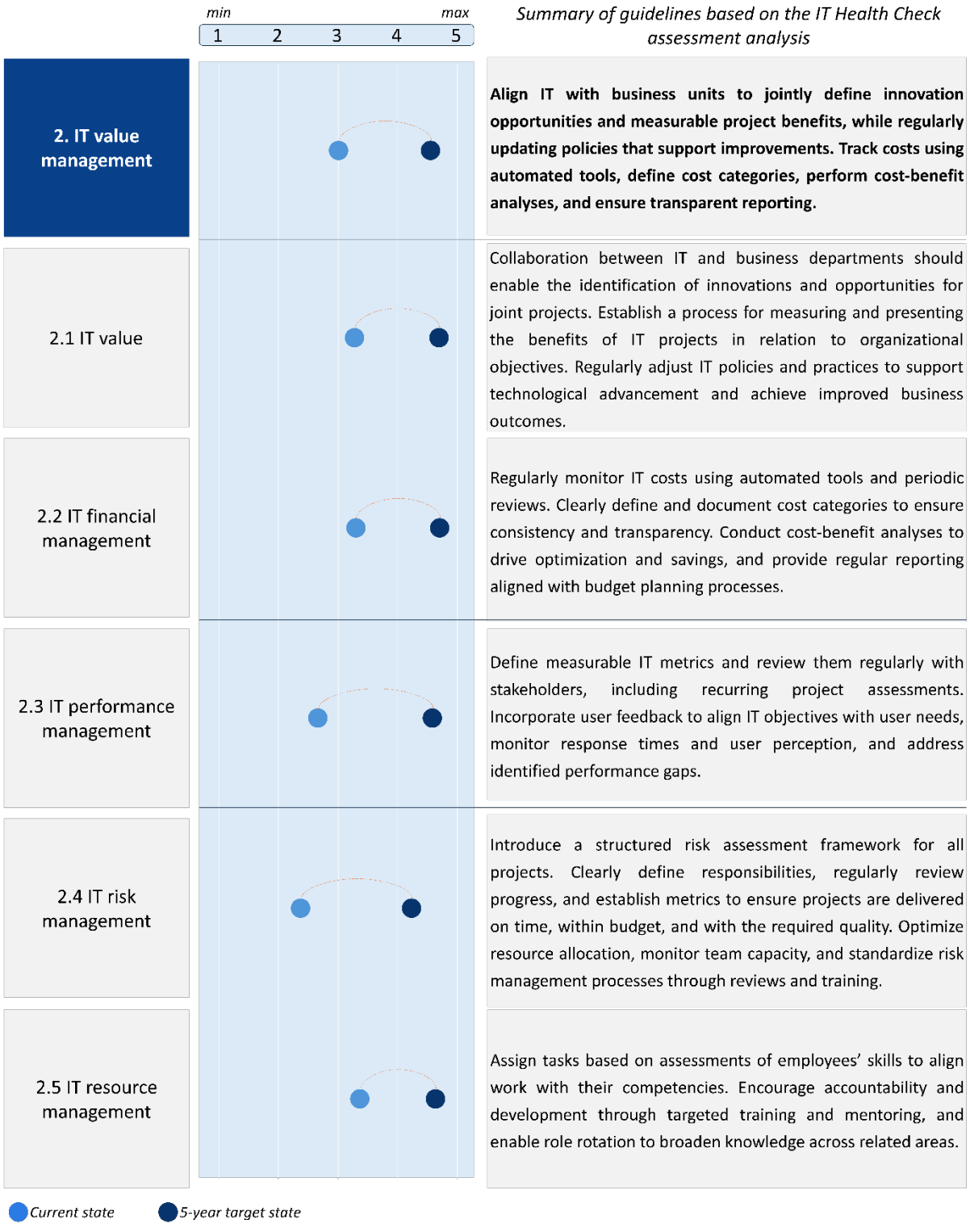


Illustration 4- IT Health Check Assessment - Dimension: IT Value Management

	Summary of guidelines based on the IT Health Check assessment analysis
3. IT organization, governance and processes	**Define and clearly communicate roles, responsibilities, and processes for IT and request-initiating units, using frameworks such as the RACI matrix and strengthening collaboration through knowledge sharing. Regularly review alignment, prioritize projects based on business value, apply agile practices, and align IT initiatives with objectives through continuous training, stakeholder engagement, and innovation tracking.**
3.1 IT organization structure and governance	Define and document clear competencies and responsibilities for IT and request-originating units, and communicate them regularly to business stakeholders. Establish and actively use formal knowledge-sharing networks between IT and the business to strengthen collaboration. Support interdisciplinary teams, teamwork, continuous learning, and participation in professional events to improve alignment and knowledge sharing.
3.2 Roles and responsibilities	Define and implement a RACI matrix for IT projects and governance processes to ensure that responsibilities are clearly defined and communicated. Regularly review and update roles to keep them aligned with business and IT needs. Ensure that all information is properly shared with relevant teams. Document IT products, services, and responsibilities so they are easily accessible and understandable across the organization.
3.3 Demand management and portfolio planning	Establish a consistent framework for classifying projects based on their business importance and prioritize them accordingly. Implement a request and incident management system with clear criteria and rigorous tracking. Introduce a formal demand management process, ensure business alignment, and link budget planning to a portfolio management process overseen by a dedicated governing body.
3.4 Complience	Conduct regular audits and controls to ensure IT compliance with legal requirements, internal policies, and project plans, while ensuring full alignment with applicable regulations and standards. Improve compliance documentation, training, and communication with stakeholders, while adhering to budget and timeline constraints.
3.5 Methodologies and tools	Provide targeted training and clear guidelines for IT methodologies and frameworks, standardize methods, and improve internal documentation to facilitate knowledge sharing and collaboration.
3.6 Proactivity and quality orientation	Establish a process in which IT proposes improvements and initiatives aligned with business objectives, with the support of business units. Regularly conduct IT user satisfaction surveys with clear action plans and follow-up to ensure changes deliver tangible impact. Involve business stakeholders in quality management and ensure the application of defined quality standards through appropriate tools and processes.

Illustration 5- IT Health Check Assessment - Dimension: IT Organization, Management and Processes (1/2)

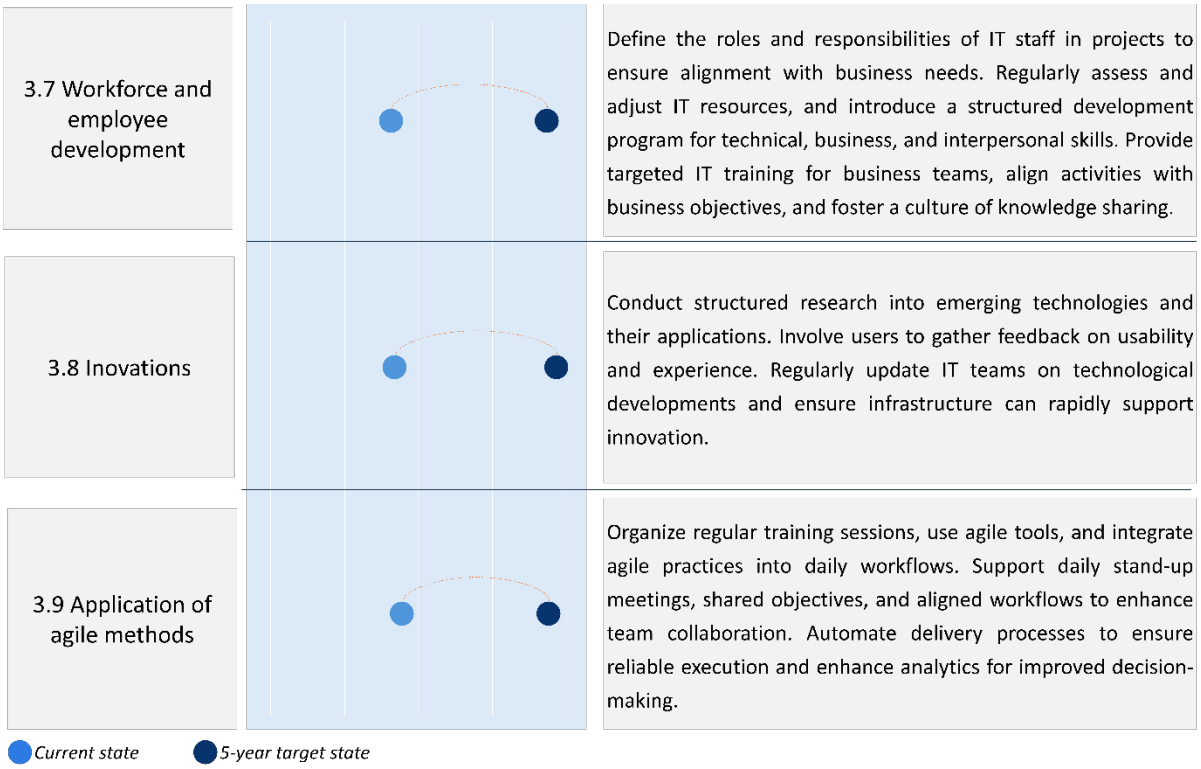


Illustration 6- IT Health Check Assessment - Dimension: IT Organization, Management and Processes (2/2)

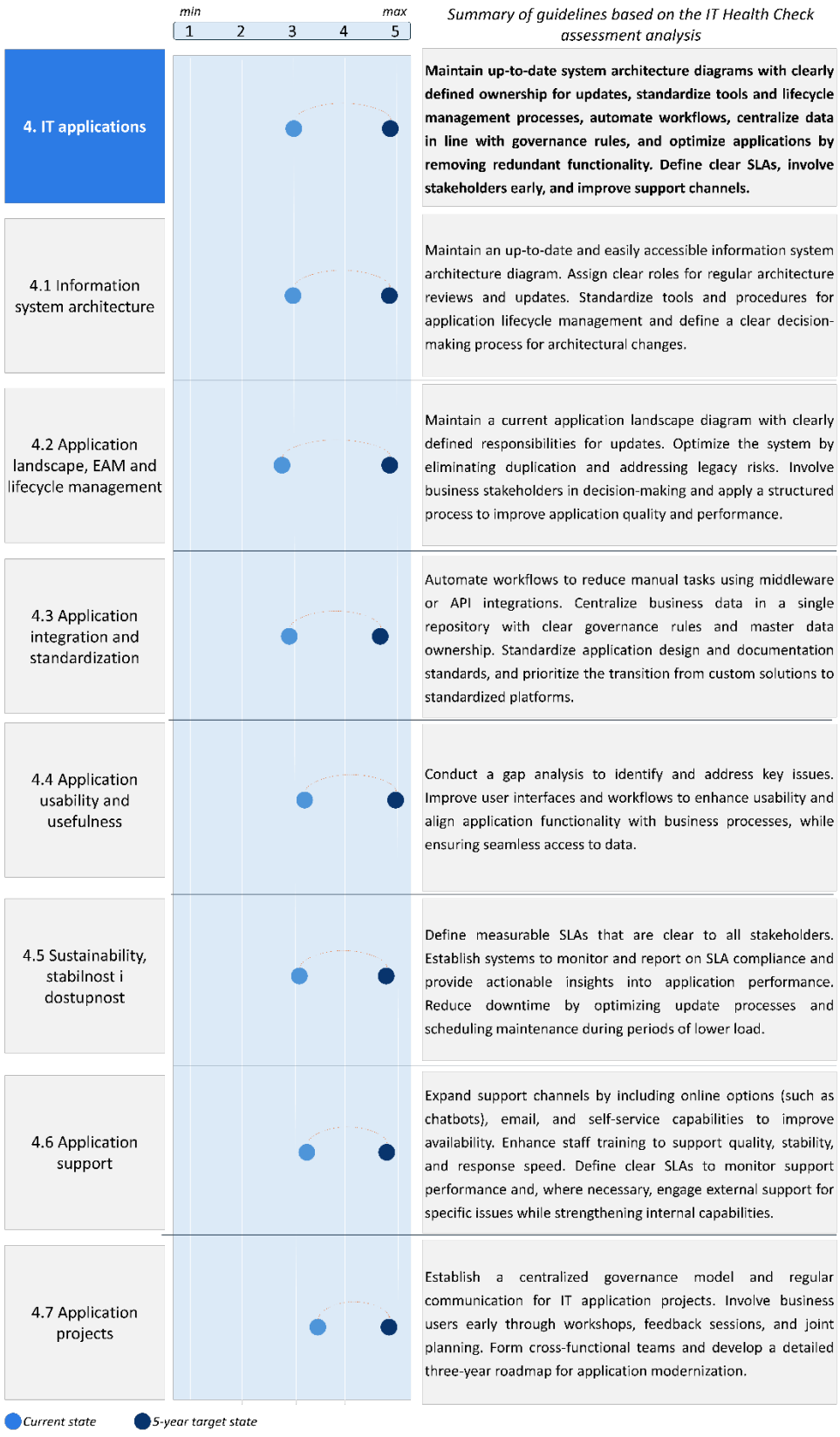


Illustration 7- IT Health Check Assessment - Dimension: IT Applications

	Summary of guidelines based on the IT Health Check assessment analysis
5. IT infrastructure	**Define governance roles and decision-making rules, maintain up-to-date infrastructure standards and the CMDB, replace obsolete systems, ensure scalability through modular design, implement security measures, and enhance support through training. Regularly review alignment with business objectives, monitor performance, and involve infrastructure teams in the early stages of projects.**
5.1 Infrastructure architecture	Define roles and competencies for technology decision-making, document them, and communicate them clearly. Centralize decision-making through a defined governance framework and approval processes. Regularly review infrastructure alignment with business needs, maintain up-to-date diagrams, and assign responsibility for keeping them current.
5.2 Infrastructure integration and standardization	Establish comprehensive, organization-wide standards for IT infrastructure and ensure they are accessible. Conduct regular audits and monitoring to ensure consistency and compliance across teams. Maintain a database for tracking and managing infrastructure components and integrate it consistently into operational processes.
5.3 Infrastructure reliability, availability, and security	Replace obsolete systems with modern, supported technologies to reduce vulnerabilities and increase reliability. Monitor uptime, stability, and incidents over the past year and define clear SLA standards. Conduct regular security testing and ensure compliance with defined security standards.
5.4 Infrastructure scalability	Design a modular infrastructure that can meet growing demands and regularly assess IT systems against business objectives to ensure scalability and reduce risks.
5.5 Infrastructure support	Maintain consistent IT support service quality through training and performance monitoring. Expand support channels to include phone, email, and online services to improve availability and ease of use. Implement clear SLAs to track support performance and involve infrastructure teams in application projects to identify needs early.

Illustration 8- IT Health Check Assessment - Dimension: IT Infrastructure

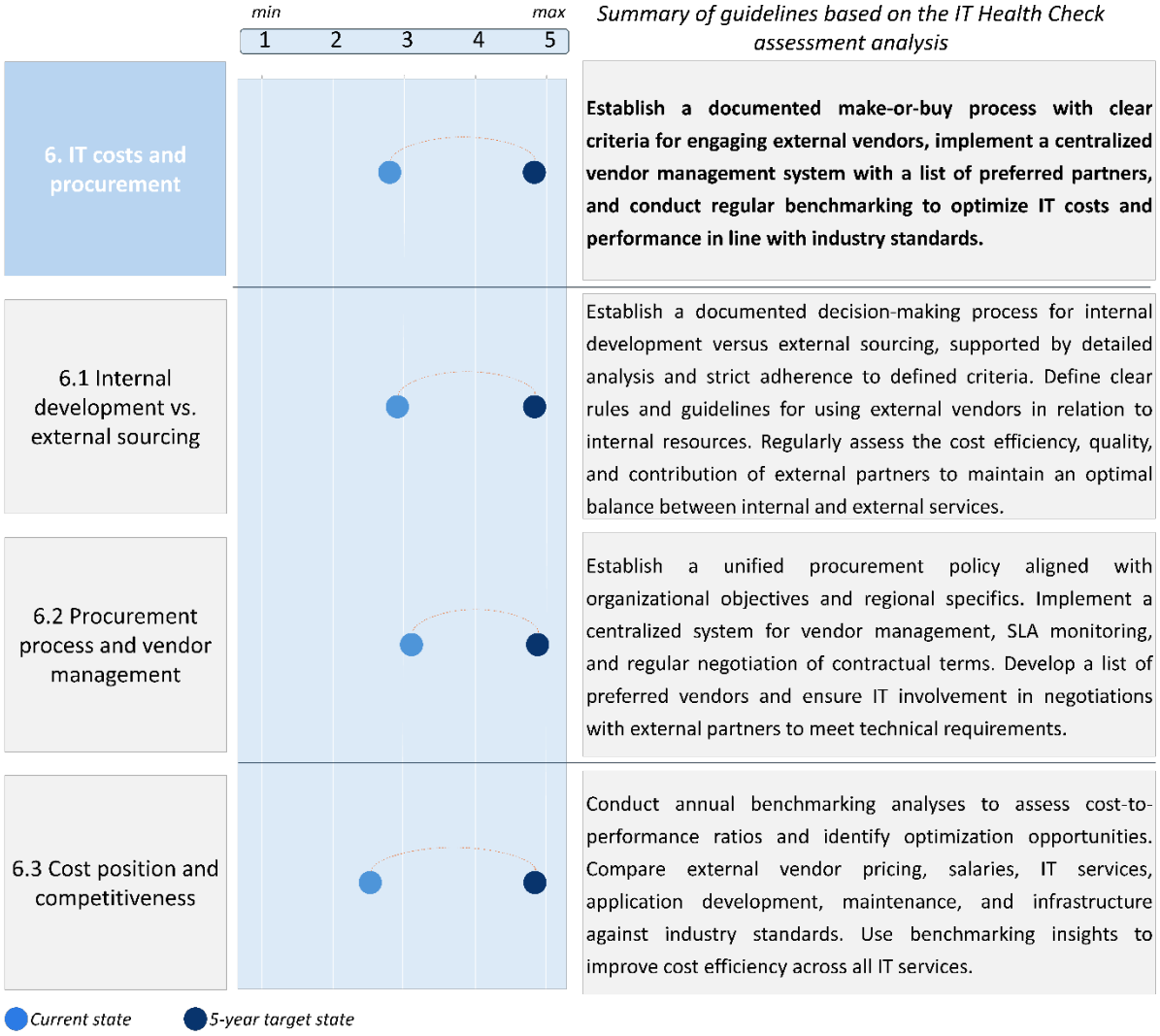


Illustration 9- IT Health Check Assessment - Dimension: IT Costs and Procurement

The maturity analysis of the Information System Sector of the Real Estate Administration of Montenegro was carried out based on the current state of the IT environment, and the recommendations were defined in accordance with the goals of the development of the information system until 2030. In order to ensure consistent monitoring of progress and regular alignment with the strategic tasks of the Administration, it is recommended that the IT Health Check and revision of the information system development plan be conducted once a year. This approach enables the monitoring of results over time and the formulation of updated recommendations in accordance with the level of development of the IT function.

The annual evaluation is also the basis for timely identification of priority activities, so that all planned initiatives are successfully implemented within the five-year cycle and the defined goals of the information system are achieved by 2030.

5.3.2 Investments

The initiatives in the current portfolio of requests for the current year include the entire set of priority needs and development activities of the Real Estate Administration. The budget planning process is fully integrated into the existing information system of the Administration, with the annual definition of the IT budget as an integral part of the overall budgeting process. In the domain of IT, this process is carried out through a formalized and defined change management process.

The development and investment plan for the current year is clearly defined, with an overview of the planned projects and the corresponding budget. When it comes to the period from 2026 to 2030, the IT budget planning approach is based on strategic alignment with the Administration's business goals and financial projections. In this sense, a combination of realistic top-down assessments is used, based on historical investments and key initiatives that will follow in the coming period.

The budgeting process itself is bottom-up, based on a portfolio of requests and the active participation of all relevant organizational units. This ensures transparency, clear traceability of budget items and the possibility of detailed monitoring of implementation. The plan is regularly updated twice a year, in order to reflect changes in priorities and business dynamics.

The assessment of development and investment needs for the time period until 2030 is part of the overall strategy of the Administration. Annual planning of amounts is an integral element of a strategic approach, with regular alignment with business needs and the needs of the information system.

Budget planning for the coming years is based on the defined strategic directions, implementation activities and the portfolio of requirements arising from the IS development plan of the Real Estate Administration of Montenegro.

Investments in projects are interdependent, which is why it is crucial to clearly define and confirm the budget, as well as investment priorities. In the proposed optimal scenario, the basis for the implementation of strategic projects and initiatives is the establishment of the planned hardware infrastructure. This implies the acquisition of system hardware and software that is adequate for installation, development and long-term maintenance of new systems, services and portals.

It has already been clearly defined that the highest priority is the development and introduction of a new system for cadastral records. A prerequisite for its successful implementation is the establishment of an appropriate information architecture, as well as reliable and scalable hardware platforms.

Even in the case of choosing a more conservative scenario, in which one of the existing platforms (eTerasoft or eSKatastar) would be upgraded and developed into an integrated system that combines the functionalities of both platforms, the investment in hardware remains necessary. Most of the existing equipment is older than ten years, is outside the manufacturer's support and does not meet the requirements for stable, safe and sustainable operation of modern information systems.

No.	Activity	2026 (€)	2027 (€)	2028 (€)	2029 (€)	2030 (€)	Total (€)
1	Maintenance and improvement of system software	59,000.00	87,750.00	92,137.50	96,743.12	101,579.39	437,210.01
2	Maintenance and improvement of application software	360,000.00	378,000.00	396,900.00	309,193.25	288,187.73	1,732,280.98
3	Development and maintenance of new systems	0.00	2,000,000.00	1,900,000.00	1,022,000.00	605,600.00	5,527,600.00
4	Improving data quality and developing new services	450,000.00	359,000.00	359,000.00	324,000.00	324,000.00	1,816,000.00
5	Consulting activities	230,000.00	210,000.00	105,000.00	110,250.00	115,762.50	771,012.50
6	Maintenance and improvement of hardware infrastructure	480,000.00	305,000.00	315,000.00	330,500.00	341,525.00	1,772,025.00
7	Maintenance and improvement of server and data storage infrastructure	0.00	1,000,000.00	550,000.00	350,000.00	200,000.00	2,100,000.00
	Total	**1,579,000.00**	**4,339,750.00**	**3,718,037.50**	**2,542,686.37**	**1,976,654.62**	**14,156,128.49**

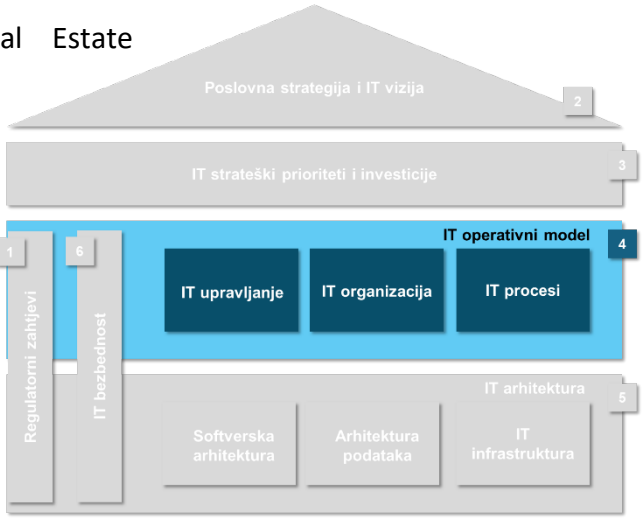
Table 2- Total amount of planned investments in strategic projects in the period from 2026 to 2030 (TCO5)

Component	Description	Quantity	Price / unit (EUR)	Total (EUR)
Compute servers (HCI cluster)	Rack, dual CPU (≥64 cores), 512 GB RAM, NVMe cache, 25/40GbE	10	30,000	300,000
All-flash NVMe storage – Primary	Petabyte-class, NVMe, HA, deduplication, encryption	1	500,000	500,000
All-flash NVMe storage – DR	Petabyte-class, NVMe, replication to primary	1	500,000	500,000
SD-WAN (central + 20 regional units)	Edge devices + 12-month. license (200Mb–1Gb, App-aware routing, SASE)	21	15,000	315,000
Network fabric (DC-core + ToR + optics)	Redundant 100GbE core, ToR switches, transceivers, cables	package	250,000	250,000
Backup/DR software + data protection	Backup platform + DD/immutable storage, automated test restore	package	100,000	100,000
Support & warranty (5 years)	OEM support for servers, storage, network, advanced SLA	package	135,000	135,000
DC racks, PDUs, power supplies	Rack cabinets, PDU, UPS upgrades, cabling	package	50,000	50,000
Additional costs	Unplanned costs / exchange rate differences / additional licenses	1	100,000	100,000
			Total amount	**2,100,000**

Table 3- Detailed description of the budget for server infrastructure and data storage

6 IT Operating Model

6.1 IT Management



The IT governance model in the Real Estate Administration of Montenegro is established to ensure stable maintenance of existing information systems, planned technological development, improvement of digital services and coordinated decision-making in the field of information technologies. The model provides an organizational and process structure for strategic IT management, operational service management, resource planning, risk management and compliance controls.

IT management functions through cross-functional bodies at the level of the Real Estate Administration, whose role is to:

- define the strategic direction of information technology development,
- set the priorities of IT projects and digital initiatives,
- approve budget and operational planning,
- monitor the implementation of IT projects and digital services and
- provide escalation points in case of technical and organizational challenges.

This framework complements the existing practice of forming commissions and working groups for specific projects, and introduces a systemic approach to the management of IT processes and responsibilities.

6.1.1 Establishment of the IT Steering Committee (ITSC) in the Real Estate Administration of Montenegro

In order to strengthen the management of information technologies, increase the efficiency of business processes, digitization and reduce operational risks, it is proposed to establish the Commission for IT Management as a central management body for the strategic management of the IT function in the Real Estate Administration of Montenegro.

The role and responsibilities of the Commission for IT Management would be as follows:

- Ensuring compliance of IT development with the strategic goals of the Real Estate Administration
- Monitoring and evaluating the effectiveness of IT processes, services and digital solutions
- Regular review of IT operations (personnel issues, incidents, problem management, development capacity, finance and budgets, key projects and services)
- Joint responsibility of members for prioritization of IT requirements and initiatives in accordance with available IT capacities
- Escalation body for all project, operational and organizational IT structures
- Monitoring the realization of the expected business benefits of digital projects and initiatives
- Approval of initiatives, architecture, standards, policies and other acts that define the work and development of the IT function
- Direction of managerial and development priorities of the IT sector and decision-making in areas of strategic interest
- Making decisions regarding the Development Portfolio and Demand Portfolio of IT

The establishment of the Commission for IT Management would enable:

- clear and transparent control over IT investments and priorities
- more stable and faster decision-making in the field of digitization

- greater responsibility and engagement of organizational units in the development of IT solutions
- reducing the risk of technical and organizational downtime
- increasing the quality and reliability of services to citizens, the economy and state institutions

The IT governance committee should consist of:

- Director of the Real Estate Administration (Chairman)
- Head of the IT sector (executive responsibility, currently the position is open)
- Managers of key organizational units
- Finance sector representative
- Representatives of strategic projects / digital initiatives (as needed)

The ITSC [5]would meet at least once every two months, either through a meeting or by correspondence, with the possibility of emergency sessions in case of escalation. The collection and classification of new business requests takes place continuously, with strictly defined deadlines and within the portfolio of requests for the corresponding year. New requests can be added to the request portfolio throughout the year, but if they exceed a certain threshold, an ITSC vote is necessary. The continuous process of collecting IT business requirements may lead to a backlog reset every six months, based on ITSC decisions.

[5]ITSC - Information Technology Steering Committee

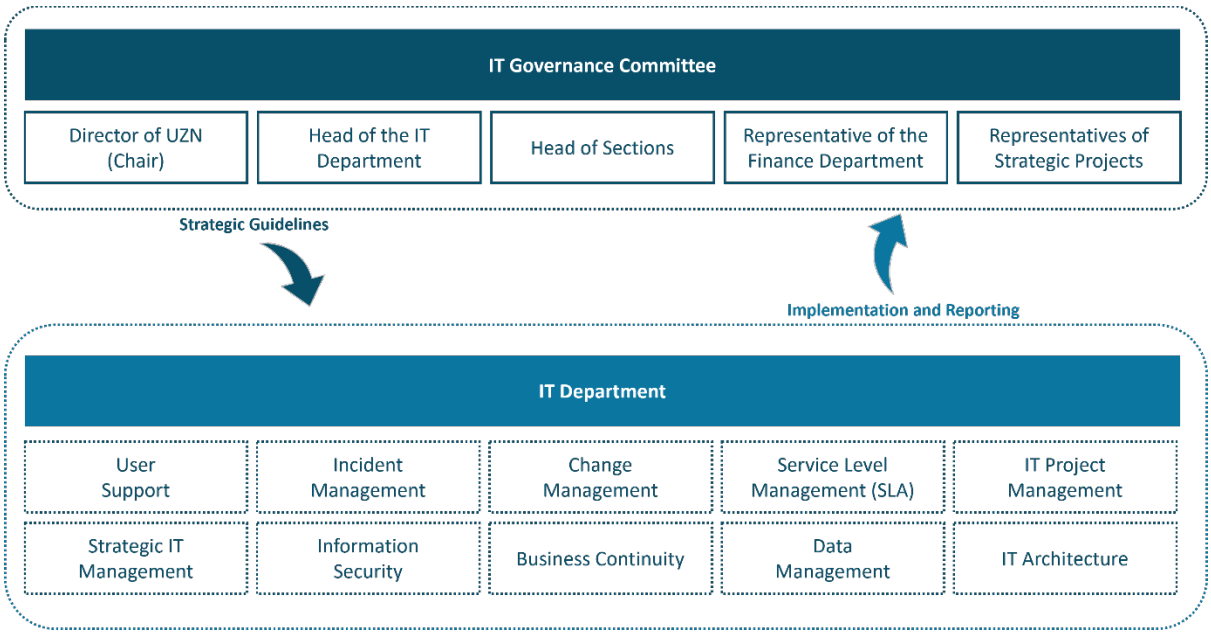


Figure 2- Operational management model within the Information Technology Sector

6.1.1.1 Reporting within the new model of information technology management

IT management at the level of the Real Estate Administration of Montenegro will continue to be improved through regular IT reporting according to the Commission for IT Management and the leadership of UZN. The set of basic reports is shown below, and reporting is carried out within the IT sector and the IT Management Committee.

Report name	Reporting Frequency	Function
Service Level Report	Quartarly	Service Level Management
Incident Management Report	Monthly	Information Security and Incident Management
Project Portfolio Progress Report	Monthly	IT Project Management
Budget Utilization Report	Monthly	IT Project Management
Security Incident Report	Monthly	Information Security and Incident Management
Individual Status Reports of Section Heads	Weekly	IT Section Heads

Table 4- Basic reports within the IT sector and the IT Management Commission

6.2 IT organization

In order to effectively achieve the business goals of the Real Estate Administration in conditions of intensive digital transformation of user operations, it is necessary to provide strong and comprehensive personnel support from the information technology side. This implies the implementation of powerful, stable and secure information systems, as well as the provision of a sufficient number of professional staff of various profiles, with a high level of competence.

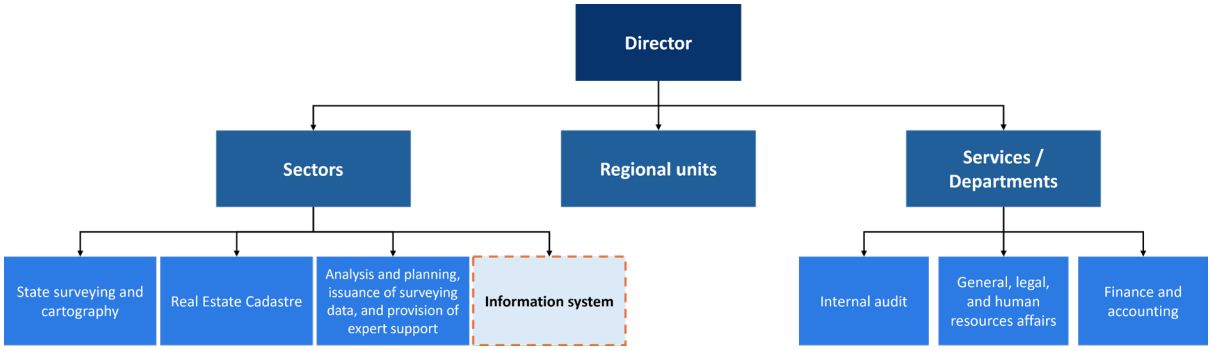


Illustration 10- Organizational structure of the Real Estate Administration

In order to successfully manage the complex and multiple requirements that are placed before the Information System Sector, functional responsibilities and competences are organized by thematic domains. The organization of the sector is vertically structured into specialized departments, adapted to address different domains.

This tactical organization of the Information System Sector into departments is based on the principle of functional separation, which enables each unit to operate focused within its area, without excessive overlap and redundancy. At the same time, the rules and guidelines that define the hierarchy and responsibilities within the organizational structure are aligned with the general rules and policies of the Real Estate Administration and the specific rules and policies of the Information System Sector.

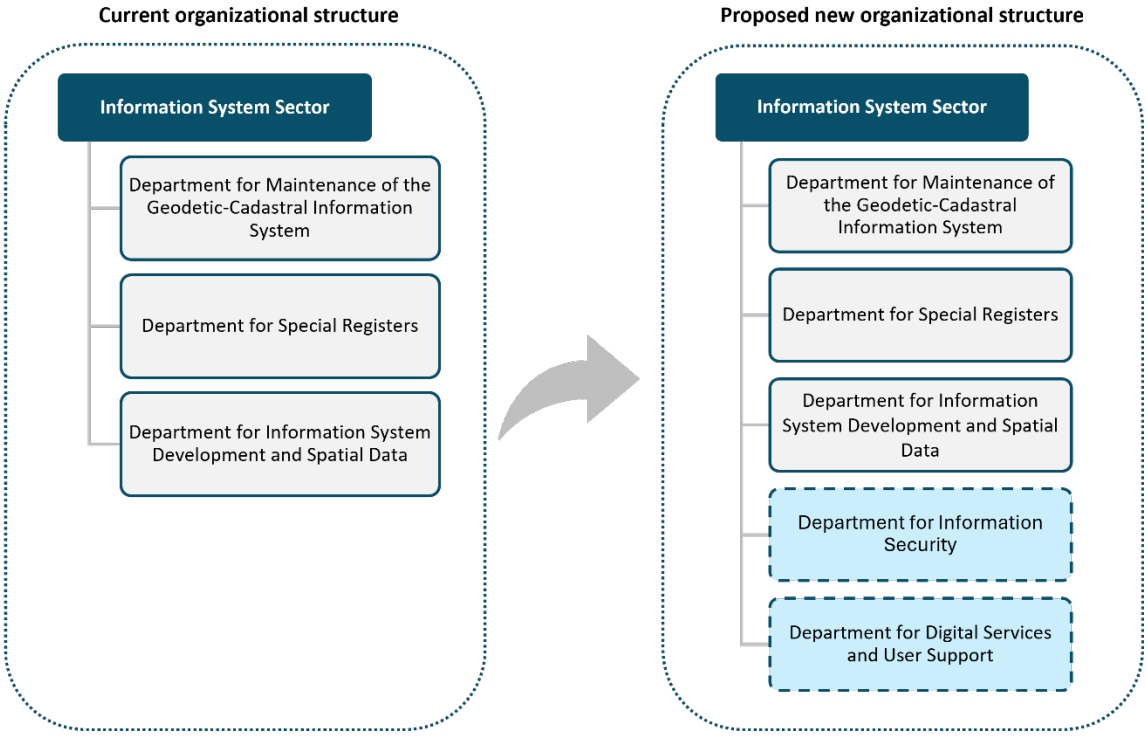


Figure 3- Existing and proposed organizational structure of the Information System Sector

A comparative analysis based on the practice of Cadastre and Geodetic Administrations in the EU and the region (e.g. Croatia - DGU, Serbia - RGZ, Slovenia - GURS, Sweden - Lantmäteriet, Austria - BEV) shows that administrations that advance faster in digitalization are almost always organized in such a way as to separate development and innovation from operational maintenance, separate GIS/IP data management from other IT functions and establish information security / cyber defense in particular.

The proposal is to improve the existing structure of the IT sector by establishing a department for information security and a department for digital services and user support. This would ensure more efficient protection of geodetic-cadastral information systems and improve the development and use of e-services, which is in line with the practice of modern cadastral administrations in the European Union.

The reason for the Information Security Department is the increased risks of cyber attacks on cadastral systems, GDPR / protection of personal data, as well as the need for detailed access

controls and audit records. All EU countries have a dedicated security team in their cadastres. This is not a luxury, but the protection of the country's key infrastructure.

The reason for the Department for Customer Support and Digital Services is the growth of e-services, web portals and API services, as well as the reduction of the workload of the first department (which now does both support and administration). In the Netherlands, Sweden and Slovenia, *the service for users of e-services is* mandatory and an integral part of cadastre services.

If it is not realistic and feasible to immediately add two new departments, then I recommend that a department for information security be formed first, and the department for digital services and user support be temporarily placed as a group within the Department for the maintenance of the geodetic-cadastral information system, which already largely performs user support services.

The general conclusion is that it is **necessary to strengthen the personnel of the Information System Sector in all areas and in all departments.** Estimates show that in public administrations, the ratio of the number of employees in information technology in relation to the total number of employees ranges from 1% to 8%, depending on the degree of digitization and development of the individual state. The member states of the European Union are closer to the upper limit of this range, while in the countries of the region that percentage ranges between 1% and 5%.

The European Commission has set the goal that by 2030 the number of employees in the information sector will increase to 20 million, which would represent about 10% of the total workforce in the EU.

The Real Estate Administration currently has approximately 4% of employees in the Information System Sector in relation to the total number of employees. In order to accelerate digitization, modernization and harmonization with European standards, this ratio must be increased and brought closer to the ratio of 8%, i.e. the level of the most advanced digital public administrations in the European Union.

In addition to increasing the number of employees, it is necessary to:

- **organize systematic professional development** of existing staff,
- **precisely define competences and responsibilities** in accordance with the tasks that employees perform,
- **establish a continuous training program** in the areas of digital infrastructure, data security, systems management and customer support.

These measures are crucial for the effective implementation of the information system development plan and ensuring the sustainable development of public administration digital services.

6.2.1 Department for Information System Development and Spatial Data Infrastructure

The department for information system development and spatial data infrastructure currently **does not have sufficient capacity for development activities,** it currently consists of **four employees,** some of whom are not from the IT profession. Due to limited resources, the department primarily deals with the development of business specifications for external development and support to other departments and sectors in business maintenance of the information system.

The specificity of the work of this department stems from European and domestic regulations related to spatial data, their creation, processing and exchange. These activities are technically and organizationally complex, and the Law on Spatial Data Infrastructure, harmonized at the state level, is used as the basic legal framework.

All systems and applications are developed through external contractors, which means that the department functions as **the technical owner of the product** and **coordinator of development projects,** but does not perform programming or internal development activities.

The current model, although rational in the context of current budget constraints, generates specific risks: dependence on the quality of specifications, the possibility of complete

dependence on suppliers, and the potential loss of institutional knowledge. Effective management of these risks requires **strengthening the department's analytical, project and human capacities.**

According to the ITIL methodology for the management of information services, the service of the Department for the development of the information system and spatial data infrastructure should include the following key areas:

1. **Management of development projects and external suppliers** - Given that the Directorate realizes all development projects through external contractors, this function represents a critical lever for quality assurance, cost control and deadline management through the following key activities:
   - Preparation of detailed business and technical specifications as a basis for tender documentation and contracts with suppliers,
   - Coordination of the implementation of development projects through defined management structures and continuous monitoring of the fulfillment of contractual obligations i
   - Defining and maintaining target system architecture and integration patterns.
2. **Spatial data infrastructure management** - Compliance with the Law on Spatial Data Infrastructure of Montenegro is a legal obligation and a prerequisite for the exchange of spatial data with domestic institutions:
   - Coordination of development and maintenance of Geoportal UZN i
   - Coordination of integration of different layers of data.
3. **Validation, testing and acceptance of the system** - Formal testing when receiving solutions from external suppliers to control the agreed criteria before putting them into production:
   - Organization of testing and confirmation of the success of the user test with key stakeholders from regional units and other sectors,
   - Verification of fulfillment of functional and non-functional requirements and formal acceptance of the system i

- Coordination of release activities in cooperation with other organizational units.

Considering the planned development and expected introduction of two new registers in the next 2-3 years, it is necessary:

- employment of at least four more professionals,
- strengthening of technical and analytical capacities,
- establishing a sustainable model for the development and maintenance of applications in accordance with legal obligations and strategic goals.

This measure is crucial for ensuring continuity in the development of digital services and spatial data infrastructure.

6.2.2 Department for maintaining the geodetic and cadastral information system

The department for maintaining the geodetic-cadastral information system has **9 employees** and is responsible for **maintaining over 450 workstations,** a dozen different applications and systems that are used every day, as well as providing continuous support for online services 24/7 throughout Montenegro. The specificity of the operational context of this department requires **a minimum tolerance for downtime** because any interruption in the operation of the system directly affects the operations of all 25 regional units and the ability to provide services to citizens

The following challenges were identified:

1. **Lack of human resources in the area of hardware infrastructure** - Analysis of the current situation shows a particularly critical lack in the area of network maintenance and a large number of workstations. For the entire hardware infrastructure of the Administration, only three people are currently engaged: one hardware engineer as a permanent employee, one employee under a work contract, and one technical associate who deals with basic repairs such as printer maintenance and solving simple malfunctions. When you consider that one IT worker supports over 50 workstations, it becomes clear that this capacity is far below recommended industry standards that

suggest a ratio of one technician to 30 to 35 workstations. An additional problem is the fact that most of the infrastructure and equipment is older than 10 years, which means that it requires more frequent interventions and repairs. Outdated equipment not only generates more incidents, but also makes it difficult to find spare parts, which further increases the time to solve the problem.

2. **Lack of capacity for application support** – In addition to the hardware infrastructure, a significant operational challenge is also the maintenance of the application part of the system. The current information systems used by the Administration are characterized by three fundamental problems: obsolescence, decentralization and insufficient synchronization. Decentralized architecture, inherited from the time when technological limitations imposed such solutions, today represents a significant obstacle to effective maintenance. The eKadastar and eTerrasoft systems function independently in each of the 25 regional units, which means that problems that arise in one location cannot be solved centrally, but require individual intervention. This architecture also generates data quality problems, as there is a lack of centralized input and validation control.

Considering the identified risks, it is necessary to implement the following steps:

- Transfer the operational part of the electronic archive from the IT sector to the business side, which would optimize resources in IT,
- Hire an additional 3 engineers to provide high-quality daily and operational support - if the current employee under the employment contract is hired permanently, additional personnel reinforcement with 2 more professionals is required. This staffing will enable the transition from the current reactive approach to a proactive maintenance model, with an expected reduction in the average time to solve hardware problems by 40 to 50 percent.
- In addition to hardware support, it is necessary to employ an additional 2 experts specializing in application support. The first of these positions is the position of Database Administrator who will be responsible for maintaining complex cadastral

databases. Another required position is an Application Support Coordinator who will be the central point of contact for coordinating with external application vendors.

- In addition to personnel interventions, it is necessary to formalize the support processes themselves in order to ensure the consistency and quality of services. This includes the implementation of a ticketing system that will enable the recording of all user requests, the monitoring of resolution times, the automatic escalation of problems that have not been resolved within the defined time, and the generation of support performance reports.

These measures are necessary to preserve the stability of the system, provide effective support to users and realize the strategic goals of digital transformation. The current capacity of nine employees, covering both hardware and application support for over 450 workstations and a dozen critical systems in 25 locations, is not a sustainable model for the long term.

6.2.3 Special Registers Department

The Department for Special Registers currently has only 2 full-time employees and one more contract employee, which makes it the smallest department within the Information System Sector. Despite the limited number of employees, this department has a key role in maintaining specialized registers that are the basis for numerous public services and data exchange with other state institutions.

The current situation where only two employees cover the maintenance of several specialized registers and coordination with numerous external institutions is not sustainable. The department must provide technical and operational support for all existing applications related to special registers, coordinate the exchange of data with local governments and other state institutions, ensure the quality and up-to-dateness of data in the registers, and provide support to end users who access that data. With only two employees, the approach is necessarily reactive, solving problems, while boasting resources for proactive activities such as data quality analysis, improving procedures or developing new functionalities.

The following risks have been identified:

1. **Critical lack of staff capacity to maintain existing registries -** The current ratio of two employees to maintain multiple different specialized registries and coordinate with dozens of external institutions is far below any recommended standard. Each of the registers has its own specificities, requiring continuous support for users, regular updating of data and coordination with relevant institutions. The register of house numbers, streets and squares, for example, requires constant cooperation with local governments when adding new streets or changing names.
2. **Planned new registers and expanding scope of work** - A special challenge is the fact that new registers are planned that will be under the jurisdiction of this department. The register of lines, as one of the highest priorities in the strategic goals of the Administration, will require significant resources not only during the development and implementation phase, but also in continuous maintenance after the release into production. This registry will require coordination with numerous line owners to collect initial data, continuous updating as the infrastructure of the lines changes, and support for users who will consult the registry when issuing building permits and planning works. With the current capacity of two employees, the realization of these projects is practically impossible without neglecting the maintenance of existing registers, which would jeopardize their functionality and reliability.
3. **Lack of specialized competences for managing the quality of spatial data -** The nature of the special registers that the department maintains requires specialized knowledge in the field of geographic information systems, spatial data and their exchange according to European and domestic standards. Currently, employees do not have enough time or resources to systematically check data quality, identify and eliminate inconsistencies, or proactively improve the structure and content of registers. This becomes especially critical in the context of obligations to exchange spatial data with other institutions under the Spatial Data Infrastructure Act, where data quality and standardization directly affect the possibility of interoperability.

Considering the planned development projects and the growing volume of work, it is necessary:

- O strengthen personnel capacities through the employment of at least 4 new employees, which will increase the department from the current two to six team members. This strengthening should take place gradually through **two phases :**
  - In the first phase, it is necessary to hire two experts who will focus on the most critical areas: an expert for spatial data and geographic information systems who will be necessary for the preparation and implementation of the Register of Lines, and a coordinator for data exchange and relations with institutions who will take over the growing volume of communication with local governments, utility companies and other external institutions.
  - In the second phase, it is necessary to employ two additional experts: a data quality analyst who will systematically monitor the accuracy and completeness of data in all special registers, and a technical administrator who will be responsible for the technical maintenance of all applications and databases used by the Department.
- Development of formal procedures and standards for managing register content, data validation and information exchange with external institutions
- Implementation of a system for tracking requests that will enable the recording of all problem reports, data access requests and user queries, which will enable better planning of resources and measurement of service quality

6.3 IT processes

IT processes represent a set of planning and operational activities, interconnected and standardized, which enable the IT sector to consistently and predictably support the institution's business goals. Well-defined IT processes:

- ensure control over the quality of delivery of IT services,
- reduce operational risk and dependence on individual employees,

- introduce clear performance measures (KPI) and accountability,
- increase the security, stability and scalability of the IT environment,
- enable transparent communication between the IT sector and organizational units of the Administration.

The introduction of the ITIL process model should be planned through a structured approach:

- Mapping of existing IT activities and analysis of current business processes, organization, competencies and available documentation,
- Defining target processes and responsibilities (RACI matrix) with a clear definition of activities, inputs and outputs of each process, roles, responsibilities and measurable points in the process,
- Creation of operational procedures and work instructions, as well as standardization of process steps and creation of unique documentation for application in practice,
- Defining KPI indicators and reporting mechanisms while measuring process efficiency for improvement and transparency,
- employee training and operational introduction of the process, followed by education of all involved organizational units and gradual implementation of the process,
- Continuous improvement of the service with periodic review of performance and adaptation of the process to the needs of the Real Estate Administration of Montenegro.

Within the operational management model, the information technology sector should function in accordance with the ITIL methodology, supporting business and IT processes, through properly defined basic work groups.

The goal of the combined model is to ensure the stability of existing systems with accelerated development of digital functionalities, interoperability and e-services.

6.3.1 Customer support

Customer support (Service Desk) represents the central and unique point of contact between the user and the IT organization. Its key role is to provide efficient management of user requests, incidents and problems, as well as to ensure a high level of user satisfaction and business continuity. The Service Desk acts as the "front line" of the IT organization and has clearly defined responsibilities, procedures and performance metrics.

6.3.1.1 Main Functions and Responsibilities of Customer Support

- Registration of requests and incidents: receiving and recording all reported events in the ticket system, regardless of the channel (phone, email, portal, chatbot, personal address).
- Classification and prioritization: categorization of requests according to type, determination of urgency and impact on business in order to assign adequate priority.
- First Level Resolution: resolution of incidents and requests that can be resolved without the involvement of other technical teams, according to pre-defined procedures and knowledge bases.
- Escalation: timely forwarding of requests to other technical or specialist teams in accordance with the rules of escalation (functional and hierarchical escalation), when the incident cannot be resolved at the first level of support.
- Monitoring and coordination: Overseeing the entire ticket lifecycle, including synchronizing activities between teams and notifying users of status.
- Communication with users: providing professional, clear and timely communication throughout the incident resolution process, with feedback after ticket closure.
- Continuous improvement: collecting data on frequent incidents and samples, proposing permanent corrective measures and contributing to the development of the knowledge base.

6.3.1.2 Areas covered by customer support

- Support for business applications and integrations
- Problems accessing user accounts
- Hardware support (computers, peripherals, mobile devices)
- Network, VPN and remote access issues
- Service and system failures (incidents)
- Standard user services (Service Requests) – software installation, license assignment, account creation, access rights changes, etc.

6.3.1.3 Main objectives of the process

- Ensure quick and efficient resolution of incidents to minimize impact on business.
- Ensure high availability of IT services and user satisfaction.
- Standardize and automate customer support processes where possible.
- Reduce the need for escalations through systematic knowledge building and education.

6.3.1.4 Typical metrics for measuring customer support performance

- Average response time and resolution time,
- Number of tickets resolved at the first level (First Call Resolution Rate),
- Number and frequency of escalations,
- SLA compliance (Incident Response / Resolution SLA),
- Customer Satisfaction Score (CSAT),
- Average waiting time in the phone line, chat or for a response to an email.

6.3.2 Incident management

Incident Management is used to quickly remove interruptions in the operation of IT services, conduct analyzes of the causes of recurring incidents, plan corrective actions and implement preventive measures to prevent the recurrence of technical problems.

Incident management represents one of the key operational processes of the IT sector and aims to quickly and efficiently remove interruptions or degradation of IT services, while minimizing the impact on the business processes of the Real Estate Administration. The process is based on ITIL principles and provides a standardized, transparent and controlled approach to incident resolution.

Incident management is inextricably linked with change management processes, problems, security and service levels, thus providing a comprehensive and stable IT operational management model.

6.3.2.1 Activities within the incident management function

- Reception, registration and categorization of incidents through the Service Desk as a central contact point for all users of the information system,
- Assessing the priority of the incident based on the impact on the business and the urgency of the required recovery,
- Quick and coordinated reaction of IT operational teams to restore normal service operation in the shortest possible time,
- Escalation of incidents to higher levels of support or vendors if the solution is not possible within the basic level of support,
- Informing users and management about the status of critical incidents and expected recovery time,
- Root cause analysis for incidents that are repeated or that have a significant business impact,
- Implementation of corrective and preventive measures in order to eliminate the causes and prevent the recurrence of incidents,
- Updating the knowledge base and recommendations for dealing with incidents of the same or similar type in the future

6.3.2.2 Objectives of the incident management process

- shortening the downtime of IT services,

- minimizing the impact of technical problems on the daily work of the Real Estate Administration,
- increasing the reliability and quality of IT services and
- improving user experience.

6.3.2.3 Monthly reports on incident and problem management

- review of critical and major incidents,
- duration of interruption and recovery time,
- initiated corrective and preventive measures,
- trends and frequency statistics by category,
- impact of incidents on key IT services.

6.3.3 Change management

Change Management is a structured and controlled process that enables safe, predictable and auditable implementation of all changes in the IT environment. The goal of this process is to minimize the risk of the negative impact of changes on business, while enabling the evolution and improvement of IT services in accordance with the needs of users and the strategic goals of the organization.

6.3.3.1 Key functions and responsibilities

- Notification and registration of changes - recording of all requests for change (RFC - Request for Change), including a description of the change, reasons, expected benefits and impact assessment.
- Assessment and classification of changes - categorization of changes by type (standard, urgent, normal), assessment of risk, complexity and impact on business processes and IT infrastructure.
- Change planning and authorization – detailed planning of change implementation, including defining steps, resources, timelines and rollback plans.

- Coordination and implementation - monitoring the implementation of the change through all phases, including testing, implementation, verification and documentation.
- Monitoring and version control – ensuring that all changes are recorded in the configuration management system, version tracking of software and hardware components, and compliance with standards and regulatory requirements.
- Escalation and management of incidents caused by change - timely response in case of unforeseen consequences of change and active involvement in the problem solving process.

6.3.3.2 Process goals

- Reducing the risk of interruption of IT services or negative impact on business due to changes.
- Standardization and transparency of the change process, with full auditability.
- Effective planning, monitoring and coordination of resources and time for implementing changes.
- Providing support for strategic initiatives and innovations through secure IT change management.

6.3.3.3 Typical performance monitoring metrics

- The number of approved and implemented changes in accordance with the plan,
- Time from request to implementation (Lead Time),
- The number of changes that caused incidents or problems,
- Percentage of changes implemented without negative impact (Successful Changes),
- SLA compliance and the number of urgent changes outside the standard process.

6.3.3.4 Benefits of effective change management

Effective change management increases the stability of the IT environment and reduces unplanned downtime. This results in greater control over the risks associated with technical

and business changes and better coordination between the IT sector, business units and external partners.

6.3.4 Service Level Management

Service level management is a key ITIL process that ensures that IT services meet business expectations and needs through defining, monitoring and optimizing service levels. The process focuses on contracting measurable SLAs (Service Level Agreements) for internal and external users, as well as continuous monitoring of IT service performance according to set standards.

6.3.4.1 Key functions and responsibilities

- Defining and negotiating SLAs - aligning service levels with business requirements and customer expectations, including availability, performance, response time and quality of support provided.
- Service catalog management – maintaining a current and accurate catalog of all IT services, including service description, SLA parameters, user instructions and responsible teams.
- Monitoring and reporting on service performance - periodic data collection, analysis of SLA achievement, preparation of monthly and quarterly reports on service quality, KPIs and trends.
- Deviation analysis and continuous improvement - identification of areas where IT services do not meet defined standards and initiation of corrective activities in cooperation with technical teams and business users.
- Management of escalations related to the level of service - timely response to cases of non-fulfillment of SLAs and coordination with relevant teams to ensure the achievement of agreed service levels.

6.3.4.2 Process goals

- Provide clear expectations and agreed standards for all IT services.

- Continuously monitor the performance of IT services and detect deviations from SLA in a timely manner.
- Support decision-making and resource allocation through measurable KPIs and service quality reports.
- Improve user satisfaction and trust in the IT organization.
- Support strategic initiatives and digital transformation through reliable and predictable IT services.

6.3.4.3 Typical metrics and KPI indicators

- Percentage of SLA fulfillment per service (SLA Compliance),
- Average resolution time of incidents and requests in relation to SLA,
- Number of SLA violations and emergency escalations,
- The trend of customer satisfaction (Customer Satisfaction - CSAT),
- Availability of critical IT services (% uptime),
- The number of incidents or problems per service in a given period.

6.3.4.4 The benefits of effective service level management

Effective service level management ensures clear communication between IT and users about obligations and expectations. This reduces business risk due to the unpredictability of IT services and increases support for capacity, resource and investment planning through objective data. Increasing the trust of business users in IT and raising the quality of internal and external services are the basis for continuous improvement of IT operations and process excellence.

6.3.5 IT project management

IT project management includes resource planning and allocation, project risk and budget management, monitoring progress and deadlines, coordination with business users and suppliers, project documentation management and ensuring project delivery within the approved scope, time and costs.

Project portfolio management, reporting and maintenance of project methodology in accordance with best practices, along with operational project management (Portfolio management) is part of future operational management within the Information Technology Sector.

6.3.5.1 Segments of project methodology and principles

- Criteria for project identification,
- The principle of working on projects,
- Organization of project work, appointment and roles of project participants,
- Phases and life cycle of the project,
- Key project documents and project documentation management,
- Identification, assessment and management of project risks,
- Incentives and rewarding project team members,
- Financial aspect.

6.3.6 Strategic IT management

Strategic IT management represents the highest level of information technology management and ensures that IT development is planned, financed and realized in accordance with the institution's long-term business goals. This process directs IT to create measurable value for the organization through IT portfolio optimization, smart investment management, and strategic digital transformation decision-making.

6.3.6.1 Key functions and responsibilities

- Formulation of IT vision and strategic direction - defining the role of IT in supporting business processes, digitization and efficiency of the institution's work.
- Management of IT investments and budget - evaluation and approval of IT projects, analysis of costs and benefits, prioritization of investments and monitoring of IT budget spending.

- Management of a portfolio of IT projects and initiatives - overview of all IT projects and programs, determination of priorities, coordination of resources and deadlines, and monitoring of the achievement of goals.
- Monitoring the realization of strategic benefits - evaluation of the success of IT initiatives through process improvements, reduction of operating costs, increase of transparency, availability and user satisfaction.
- Management of IT risks and compliance (compliance) - identification, assessment and control of risks that can affect the continuity and security of IT services, as well as the harmonization of work with legal and regulatory requirements (national and European).
- Management of relations with external partners and suppliers - definition of cooperation models, contractual obligations, performance monitoring of key suppliers and optimization of external services.

6.3.6.2 Process goals

- Provide long-term and sustainable IT development planning.
- Maximize the return on IT investments (ROI) and the benefits of digitization.
- Ensure that IT initiatives are implemented in accordance with business priorities and needs.
- Strengthen the organization's digital capacities and readiness for future development.
- Ensure a high degree of transparency and accountability in IT management.

6.3.6.3 Practical benefits for the institution

Strategic IT management includes the preparation of a long-term IT strategy and a plan for the development of information systems, as a preparation for digitization that is aligned with the real needs of citizens, the economy and state institutions. Strategic management ensures transparent and responsible management of public funds through clear investment criteria.

At the same time, work efficiency is increased while operational and administrative costs are reduced, and decision making based on data and strategic priorities is accelerated.

6.3.7 Information security

Information security ensures the protection of data, IT infrastructure, application systems and digital services from unauthorized access, misuse, loss and cyber threats, with continuous support for the safe and reliable operation of the institution.

This ITIL process defines policies, standards, control mechanisms and responsibilities that protect the confidentiality, integrity and availability of information, including the protection of business and personal data in accordance with legislation and regulatory requirements.

6.3.7.1 Key functions and responsibilities

- Defining and implementing security policies and standards in accordance with national and international practices (eg ISO/IEC 27001).
- Access control and identity management (IAM) — ensuring that only authorized users have access to data and systems in accordance with the principle of least privilege.
- Continuous monitoring of security events and recognition of potential cyber threats, anomalies and intrusions.
- Management of security incidents and coordination of activities on their detection, limitation, removal and return of the system to a stable state.
- Technical and organizational protection measures — network segmentation, data encryption, backup and disaster recovery, antivirus and antimalware solutions, system hardening and security tests.
- Risk management in the field of information security — identification of threats, assessment of vulnerability and definition of measures to minimize risk.
- Raising awareness and educating employees about security practices, recognizing phishing attacks and proper data handling.

6.3.7.2 Process goals

- Provide a secure, stable and resilient IT ecosystem, capable of protecting the institution from cyber risks and abuses.
- Protect the confidentiality, integrity and availability of data and digital services.
- Harmonize work with regulatory, legal and European data protection and cyber security standards.
- Increase the level of awareness and responsibility of users and employees for safe handling of information.

6.3.7.3 Practical benefits for the institution

By following ITIL standards in the field of information security, we achieve a reduced risk of cyber attacks, data leaks and system incidents, while at the same time increasing user confidence in digital services and electronic transactions. In this way, we protect the business continuity and reputation of the Real Estate Administration and enable faster recovery of the system and reduction of financial and reputational consequences in case of incidents.

6.3.8 Business continuity

Business continuity ensures that critical IT services remain available or recover quickly after an outage, incident or disaster, to minimize the impact on the institution's business. IT service continuity management is one of the key ITIL processes and ensures that IT infrastructure, data and applications can continue to work in extraordinary circumstances, with clearly defined plans, procedures and technical recovery measures.

6.3.8.1 Key functions and responsibilities

- **And** creating, maintaining and updating Disaster Recovery (DR) plans — including backup site strategies, data backup, application and infrastructure recovery.
- Defining and harmonizing RPO and RTO parameters in accordance with the criticality of business processes:

- RPO (Recovery Point Objective) – maximum acceptable data loss expressed in time.
- RTO (Recovery Time Objective) – maximum acceptable service recovery time.

- Business Impact Analysis (BIA) — identification of key services, dependencies and consequences of downtime to determine priorities and extent of protection.
- Regular testing of continuity plans and DR procedures — including technical tests, simulations, tabletop exercises and periodic documentation reviews.
- Monitoring and management of risks that threaten the continuity of work — identification of vulnerabilities, development of risk mitigation measures and coordination with information security processes.
- Document and train staff — clearly defined roles, contact lists, responsibilities and emergency procedures, along with training teams to effectively implement DR and business continuity.

6.3.8.2 Process goals

The goal of introducing and monitoring the business continuity process is to ensure the stability and resilience of the IT system even in catastrophic events (cyber incident, infrastructure failure, fire, flood, human error, etc.). The aim is to minimize interruptions in the provision of digital services and protect the continuity of business processes, align business and technical priorities through defined RPO and RTO values and ensure that the institution can continue operating without significant losses, reputational damage or regulatory consequences.

6.3.8.3 Practical benefits for the institution

By properly ensuring business continuity, financial losses in the event of interruptions are reduced, data and digital services are protected from permanent loss or damage. At the same time, this preserves the trust of citizens, partners and state institutions in e-services. Business

continuity is also important from the point of view of meeting the requirements of regulatory and legal regulations in the field of security and continuity.

6.3.9 Data management

Data management ensures that the data generated and used in the institution's information systems are accurate, complete, consistent, available and secure throughout the entire life cycle. This ITIL process establishes rules, roles and standards for working with data to enable operational efficiency, integration of registers, development of digital services and decision-making based on reliable information.

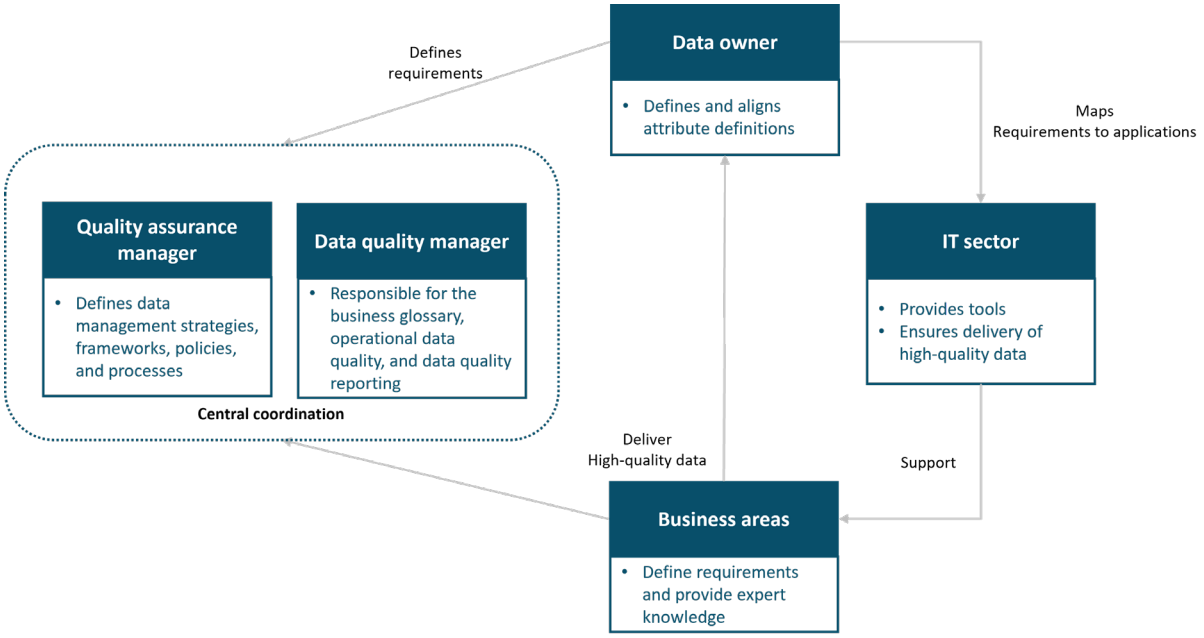


Figure 4 – Data quality management

6.3.9.1 Key functions and responsibilities

- Defining data ownership and responsibility and determining Data Owner, Data Steward and Data Custodian roles at the level of registries and business domains.
- Data Quality Management and detection, correction and prevention of errors, duplicates, missing and inconsistent data.

- Standardization of data and integrity control of registers as well as definition of unique identifiers, master data (MDM), structure and rules for entry and exchange.
- Managing metadata and documenting the structure, meaning and origin of data for greater transparency and standardization.
- control between systems and prevention of deviations during integrations, migrations and data exchange via services and API integrations.
- Support of interoperability between institutions and provision of format and semantic standards for data exchange with state systems and external users.
- Supporting business decision-making and enabling BI analytics, reporting and data-driven decision-making.
- Open data and selection of data intended for public use, anonymization of sensitive records and publication in accordance with regulatory regulations.

6.3.9.2 Process goals

- Improve the quality, availability and reliability of data in all information systems.
- Ensure consistency and integration of registers without duplication and contradictory information.
- Establish control over data as a strategic asset of the institution.
- Enable process automation, interoperability and data-driven digital services.
- Support the development of advanced analytics and reporting through reliable and standardized data sets.

6.3.9.3 Practical benefits for the institution

Proper implementation of data management reduces the number of operational errors and double work while increasing the efficiency and speed of processing requests. In addition, an improved end-user experience is obtained through accurate, up-to-date and mutually

harmonized registers. Data management must ensure easier and safer exchange of data with other institutions in accordance with legal and technological standards, strengthening transparency through the possibility of publishing open data and data of public importance, making decisions based on data (data-driven decision making) and developing BI analytics.

6.3.10 IT architecture

IT architecture represents a strategic function whose goal is to ensure that the technological environment of the institution is scalable, secure, interoperable and cost-effective. It includes the planning, design and management of the entire technological architecture, including the application, infrastructure, integration and security layers of IT.

6.3.10.1 IT architecture management responsibilities include

- Defining architectural standards and principles that guide the development and procurement of IT solutions in accordance with the organization's strategic goals.
- Application portfolio management through the identification, cataloging and rationalization of applications to reduce redundancies, functional overlaps and technical debt.
- Planning integrations between information systems through defining integration protocols, data standards and shared services, which enables interoperability and smooth data exchange.
- Architectural supervision of the development and procurement of IT solutions, including the mandatory technical evaluation of projects and changes to ensure that the solutions are compatible with the strategic technology map.
- Support for modernization and digital transformation, through the definition of target architectural models (target architecture), transitional phases and phased migration plans.

- Scalability and optimization of resources, through the selection of architectural models that support the growth of data, the number of users, services and integration while controlling costs and reducing technical and operational risks.

6.3.10.2 Expected results of an efficient IT architecture

An effective IT architecture provides a standardized and simplified IT environment, reduction of operating costs and technical debt, faster and safer implementation of new digital services, improved interoperability and data exchange between the institution's system and external partners, as well as strengthening the security of the IT system through controlled and consistent technological implementation.

6.3.11 Risk management

Risk Management is a key process of the IT sector that enables the identification, assessment and control of risks that may negatively affect the IT services and business processes of the Real Estate Administration. The goal of the process is to proactively reduce the probability and consequences of unwanted events, ensure business continuity and increase the resilience of the IT system. The process is in accordance with ITIL principles and integrates with incident, problem, change, security and service level management processes, thus providing a comprehensive and stable IT operational management model.

As a basis for risk management, a risk register should be defined, which usually contains the following attributes for each individual risk:

- Risk ID: unique code for easier tracking and referencing.
- Risk Name: Short, clear and specific name (eg "Primary Server Failure", "Phishing Cyber Attack").
- Risk description: A detailed description of what the risk is, including the cause (what triggers it) and the effect (what happens if it occurs).
- Risk category: risk classification (eg Technical, Operational, Security, Financial, Legal).
- Likelihood: an estimate of the likelihood that the risk will materialize (eg High, Medium, Low; or numerically 1-5).

- Impact: assessment of the consequences to the business/IT services if the risk materializes (eg High, Medium, Low; or numeric 1-5).
- Current risk level: derived from a combination of Probability and Impact (using a risk matrix). This is Gross Risk (before treatment) or Net Risk (after treatment).
- Risk owner: name and position of the person or sector responsible for risk monitoring and implementation of control measures.
- Risk response measures: specific actions planned for risk management (eg Avoidance, Reduction, Transfer, Acceptance).
- Status of risk measures: the current state of implementation of the measures (e.g. Planned, In Progress, Implemented).
- Residual risk: The level of risk that remains after treatment measures have been applied.
- Date of identification: the date when the risk was first registered.
- Date of last revision: the date when the risk was last reviewed, assessed and updated.
- Risk Status: Current risk status (eg Active, Controlled, Archived/Closed).
- Related IT service or asset: which specific IT services, systems or assets of the Real Estate Administration are affected by the risk.
- Related processes: which ITIL processes (Incident Management, Problem Management, Change Management) are involved in solving or controlling risks.
- Required resources: required budget, equipment or personnel to implement control measures.

The basis of the risk register is attached to the Information System Development Plan of the Real Estate Administration in the form of an excel file.

For effective risk management, it is necessary to define a risk matrix, which visually shows the probability of occurrence and the impact of individual risks on business processes and IT services. An example of a risk matrix is shown in the figure below, where three risks relevant to the Real Estate Administration are marked for illustration.

#	RISK DESCRIPTION	RISK MITIGATION PLAN
1	Catastrophic system outage at the primary location and unavailability of IT services of the Real Estate Authority	Establishment of a backup site that takes over services in case of a primary site outage
2	Insufficient number of employees to provide high-quality user support	Training of internal staff and hiring of additional required human resources
3	Services of the Real Estate Authority are not digitalized and automated, non-compliance with EU requirements	Implementation of a new IT architecture, applications, services, and portals, as well as process optimization

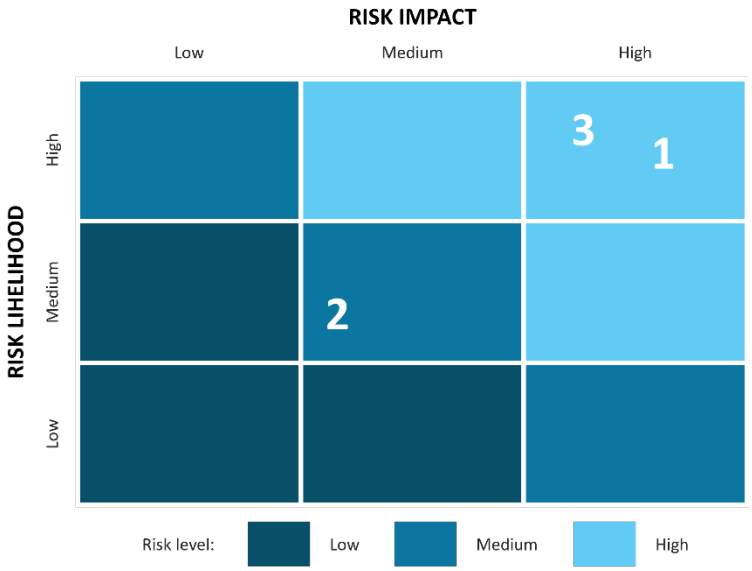


Figure 5- Risk matrix

The risk matrix allows:

- Prioritization of risks according to their severity,
- Faster identification of high-risk areas,
- Planning of adequate control and preventive measures.

It is important that the risk matrix is continuously maintained and updated during regular operational work, in order to reflect changes in the IT environment, new identified risks and the effectiveness of implemented mitigation measures.

6.3.11.1 Activities within the risk management function

- Identification of potential risks to IT systems, services and infrastructure, including technological, organizational and external factors,
- Assessment of the probability of risk occurrence and potential impact on business,
- Categorization and prioritization of risks according to severity and criticality for business processes,
- Planning and implementation of control and preventive measures to reduce risk,

- Monitoring and auditing of existing risks and controls, including updating records and risk databases,
- Escalation of high-risk scenarios to management or relevant teams,
- Informing relevant users and management about status and changes in risks,
- Analysis of incidents and problems to identify new or unrecognized risks and take corrective actions.

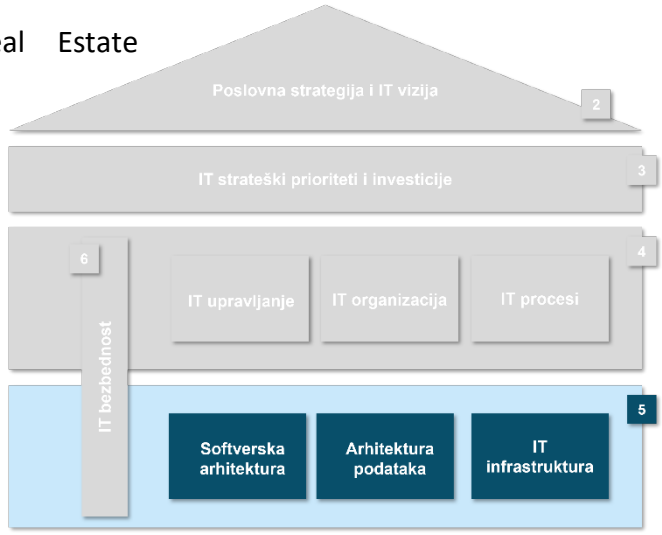
6.3.11.2 Objectives of the risk management process

- Proactive reduction of the probability and consequences of negative events for IT services,
- Ensuring business continuity and protection of critical IT resources,
- Increasing the resilience and reliability of IT systems and services,
- Improving risk awareness within the IT sector and among users,
- Support for strategic decision-making through records and risk analysis.

6.3.11.3 Monthly reports on risk management

- Overview of identified risks and changes in their status,
- Assessing the likelihood and potential impact for each key risk,
- Implemented preventive and control measures,
- Trends and statistics by risk categories,
- Impact of identified risks on key IT services and business processes,
- Recommendations for additional activities and improvement of the risk management process.

7 IT Architecture



The information system of the Real Estate Administration is a complex and multi-layered set of application and infrastructure components that support the establishment, maintenance, distribution and protection of cadastral data and accompanying registers of strategic importance for the state. The architecture is the result of several years of sequential development, in which new systems were implemented while maintaining existing solutions, which led to a heterogeneous technological structure, different integration approaches and a variable degree of interoperability between applications.

Overall, the existing architecture provides a high degree of functional coverage of key UZN processes, but at the same time shows limitations typical of systems built by iterative expansion: heterogeneity of technologies, integration based on partial approaches, absence of central architectural supervision, increased dependence on specific technical solutions and difficult scaling in the context of new digital services.

This architecture, although stable in the operational sense, represents a clear signal of the need for strategic consolidation, modernization and transition to a standardized, modular and service-oriented model that will enable complete digital transformation, inter-institutional interoperability and support for new state e-services.

7.1 Software architecture

7.1.1 Software (application) architecture - current "As-Is" state

The existing software architecture of the Real Estate Administration of Montenegro was built gradually, over a long period of time, and today represents a combination of modern web services and legacy application solutions. The combined model enables the functioning of key

business processes, but at the same time it is characterized by certain functional and integration limitations. As a result of evolutionary development, the information system has become heterogeneous, with multiple application modules and technologies that communicate with each other in a limited way or through partial integration mechanisms.

The primary goal of the current model is to ensure the stability and continuity of existing critical systems, with the simultaneous development of new digital functionalities, interoperability and e-services. However, current business processes and data flows are not fully optimized, which affects the speed of processing cases, employee productivity and the user experience of external users (citizens and notaries). As part of the implementation of strategic initiatives, it is necessary to optimize business and data processes in order to enable greater efficiency, end-to-end digitization and interoperability of systems.

When it comes to the system for establishing and maintaining cadastral records, we have three main units: eTerrasoft, eKatastar, and esKatastar.

eTerrasoft is a system intended for maintaining the alphanumeric part of cadastral records and has been in use in the Real Estate Administration since 2014, with certain improvements that are implemented through regular annual maintenance contracts. The system enables documentation management and office operations. eTerrasoft was implemented on the Java platform and the Oracle database management system. It was implemented as a distributed system with local servers in regional units of the Administration and a central server in the premises of the Administration in Podgorica with established data replication in real time. eTerrasoft, although a fully functional system, has several shortcomings: the platforms on which it operates are outdated and do not provide an efficient response to the increasing number of requests for new functionalities, the performance of the system represents a significant obstacle due to the daily increase in the amount of data, the administration of the system itself is complicated due to the distributed architecture, certain components of the system also represent security risks.

eKadastar is a portal through which access to alphanumeric data of cadastral records is provided to external users of the system. It directly accesses the central database of the

eTerrasoft system, data that is replicated in real time and enables multiple levels of access: public access to a limited set of data from cadastral records, extended access to a specific set of users who have statutory powers, as well as the possibility of downloading electronic documents - extracts, transcripts and certificates from cadastral records. Furthermore, services (SOAP and REST) have been developed for direct access to data used by various external users who have access rights to certain cadastral data sets. This system was also developed on relatively outdated platforms and libraries, which represents a significant limitation in further development and ensuring the security of the Administration's information system.

esKadastar is a system for establishing and maintaining digital cadastral plans, as well as for the purposes of displaying data for public inspection in the process of creating the real estate cadastre, and it is used in all regional units of the Real Estate Administration. This system represents a client-server platform where the client part is implemented as a module within AutoCAD applications, and the data is placed in MS SQL Server database management systems. The platforms are outdated, the possibilities of improving the system are limited, there are no services for the distribution and exchange of data with other parts of the information system. The main problem is the non-compliance and lack of direct connection of this system with the alphanumeric part of the cadastral records in eTerrasoft.

The Geoportal of the Real Estate Administration is a central place for the distribution of graphic data from the jurisdiction of the Real Estate Administration: digital cadastral plan, orthophotos, terrain models, cartographic products and others. The Geoportal consists of three main parts: a web browser of available data that has the option of including the display of available layers, a catalog of metadata and a service for distributing and downloading data (WMS, WFS, download). It was developed on the Hexagon platform and the main drawbacks are occasional downtime caused by a large number of users and insufficient system performance.

These systems, although functionally stable, rely on different technological standards and databases, with a mixture of centralized and decentralized models. This leads to a larger

number of separate databases, replication mechanisms, challenges in multi-user work and limited scaling possibilities, especially in the part of integration with external systems.

Support for the basic business process is provided by the e-Archive digital archive management system, which provides digitization, indexing, storage and search of millions of documents. Although it represents a key component for digital continuity and document processing efficiency, the system currently functions without a full integration framework with other applications, which limits the automation of document access through operational processes.

Spatial information and geoportal systems are another significant layer. The address register enables the editing and maintenance of data on house numbers, streets and squares with professional e-services, the register of spatial units includes the state hierarchy of spatial levels and represents a key reference point for inter-institutional exchange, the Geoportal and the Metadata Catalog provide a wide distribution of geospatial data through standardized services (WMS/WMTS), with differentiated access for internal use, professional users and, to a certain extent, the public. MontePOS enables precise geolocation based on a network of permanent satellite stations, and is a critical infrastructure for the geodetic and spatial sector.

Internal technical and security systems additionally support the functioning of the entire architecture. IT asset management software enables monitoring of hardware and software assets and licenses, while an antivirus program provides protection of workstations and server resources with managed access and monitoring of security events. The catalog of regulations functions as an internal system for the management of legal acts significant for sectoral operations and regulatory compliance.

A practical example of existing limitations is visible in the process of processing requests initiated by a notary. Although the notary obtains documentation electronically through the eKadastar portal, further processing of the request still involves physical submission of the contract at the counter and manual data entry into the eTerasoft desktop application. This

process generates duplication of entries, increased operational risk, costs and case processing time, and creates a burden for counter clerks.

Additionally, the digital cadastral plan (esCadastar) is synchronized between regional units and the central office once a day, which can lead to temporary deviations in the display of data and reduced timeliness in the event of an increased volume of requests. In the event of a system outage, restoring from digital archive copies requires data reconstruction and re-entry of scanned documents for a critical period, which represents an operational risk and increases the time for normalization of work.

In order to improve the digital infrastructure and increase trust in electronic transactions, Montenegro has already established a network of qualified providers of electronic trust services, which enable secure identification, electronic signing and data exchange in accordance with European standards. This capacity represents a significant foundation for the next phase of the Administration's digital transformation and the transition from partial digitization to end-to-end electronic processing, with improved integration of business applications and state registers.

The current software (application) architecture of the Real Estate Administration is shown in the figure below. All regional branches are connected to the central office with optical lines, except for a few locations, which do not have these possibilities. The contract for optical lines is under the jurisdiction of the Ministry of Public Administration.

The registration of real estate rights is synchronized between the regional units and the headquarters and is registered in real time through the eTerasoft system in the eKadastar system.

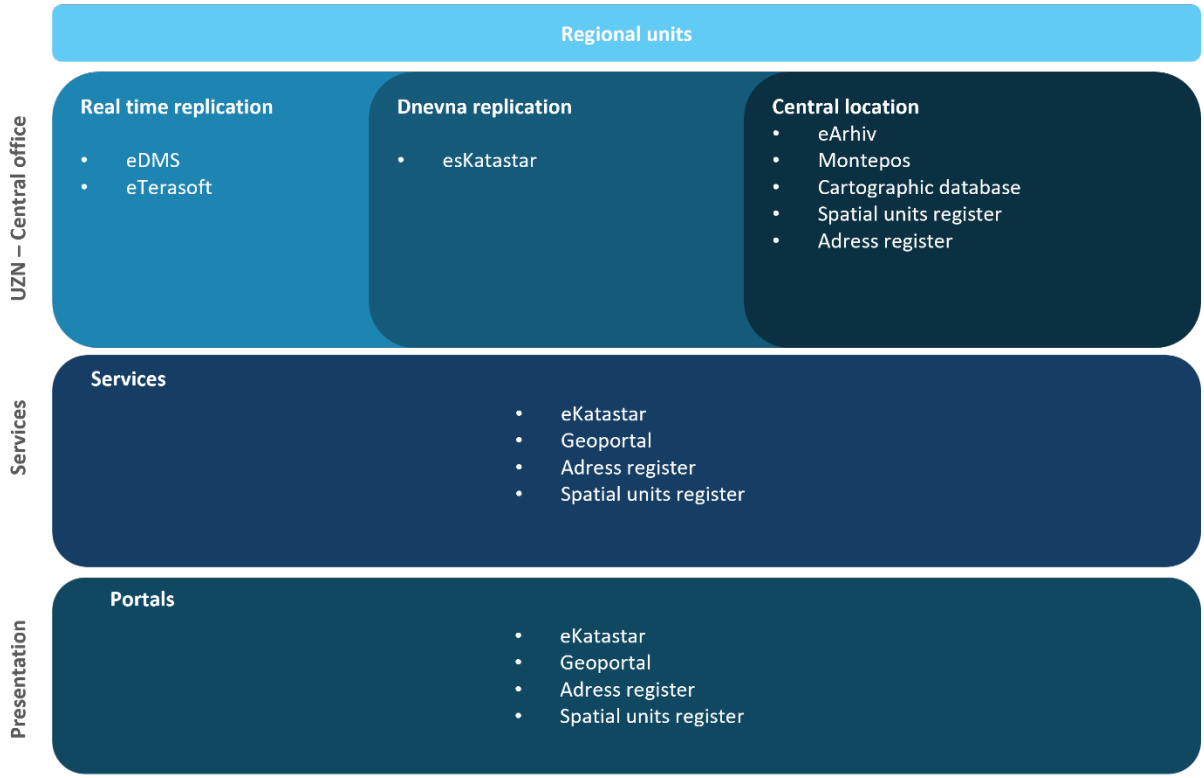


Figure 6- Application information architecture - current state

7.1.2 Application maturity analysis

Based on the conducted gap analysis, a detailed assessment of the maturity of 20 key applications of the Real Estate Administration through 17 architectural dimensions was made. The result is presented in the form of a "heat-map" diagram, which clearly shows the extent to which each application corresponds to modern industry standards. Green boxes indicate applications that comply with the latest standards and show high maturity. Yellow fields indicate partial deviations and the need to improve certain functionalities or technical characteristics. Red fields represent applications or dimensions that are significantly behind modern standards and require priority intervention and modernization. This approach enables the Administration to systematically identify critical weaknesses, as well as areas where there is potential for optimization. At the same time, the methodology provides a clear basis for planning the next steps in the development of the information system and establishing priority projects.

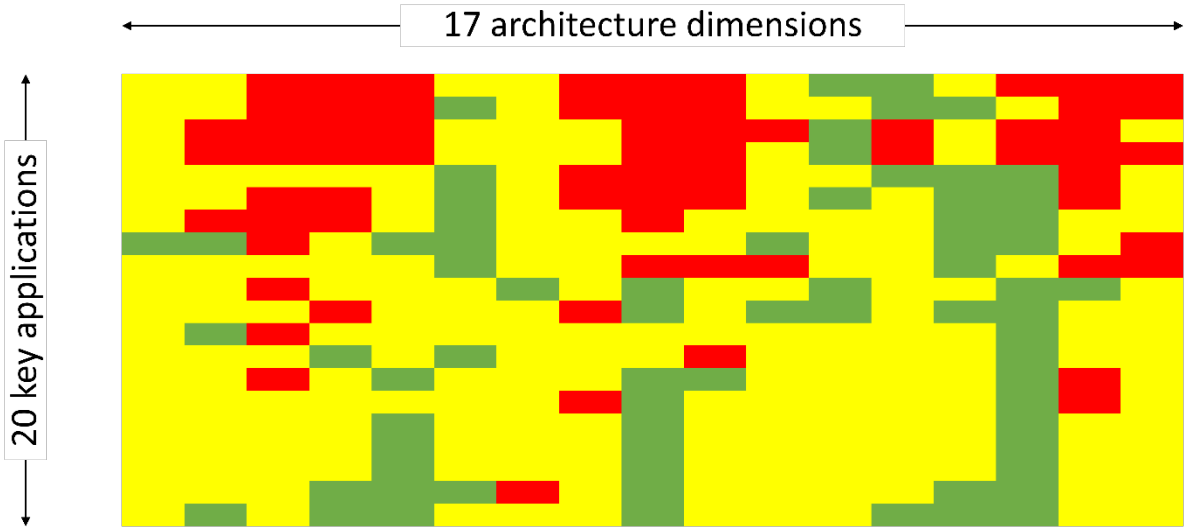


Illustration 11- Heat map of IT application portfolio

A detailed table showing the maturity analysis of the application is attached to the Development Plan of the Information System of the Real Estate Administration in the form of an excel file.

7.1.3 Positive aspects of the existing system

The current information system of the Real Estate Administration shows certain strengths that represent a solid basis for further development that is necessary in several segments. The radar chart clearly illustrates system performance across key dimensions of IT infrastructure and governance, noting areas where the system demonstrates stability and maturity.

The system shows the most pronounced strengths in the area of documentation, where there is a solid foundation in maintaining technical and user documentation, which enables easier maintenance and transfer of knowledge. This segment represents an important resource for training new users and administrators, as well as for the continuity of institutional knowledge. Also, a satisfactory level of ergonomics and user experience is evident, where application solutions demonstrate adaptation to the needs of end users, which facilitates daily use and increases employee productivity.

The quality of the multi-layer architecture of the system is particularly noteworthy, which represents a significant advantage from the aspect of organization and structuring of application solutions. This feature allows for better sustainability, flexibility and the possibility for future expansion of the system without the need for radical interventions in the existing infrastructure.

In addition to the above areas, the results indicate a solid level of maturity in the domains of application testing, process automation, performance monitoring and technical flexibility. These areas, although not at the level of the highest ratings, show stable performance and a certain degree of compliance with modern application management standards.

These positive elements represent the foundation on which a comprehensive modernization plan can be built, with the aim of further improving the efficiency, interoperability and security of the information system of the Real Estate Administration.

62	AUTO	Business process automatization level
55	TECH	Development technology
42	RES	Resource availability
51	FLEX	Flexibility
65	SUPLY	Supply capacity
76	TIER	Multi-layer
60	PERF	Performance
47	SCALE	Scalability
62	RELY	Reliability and availability
45	CTRL	Data security
60	IAM	Identity access management
72	AUDIT	User activity monitoring
64	INTEG	Integrability
78	ERGO	Ergonomy
84	DOCS	Quality of technical documentation
44	MONIT	Quality of application monitoring system
50	TEST	Regression testing support

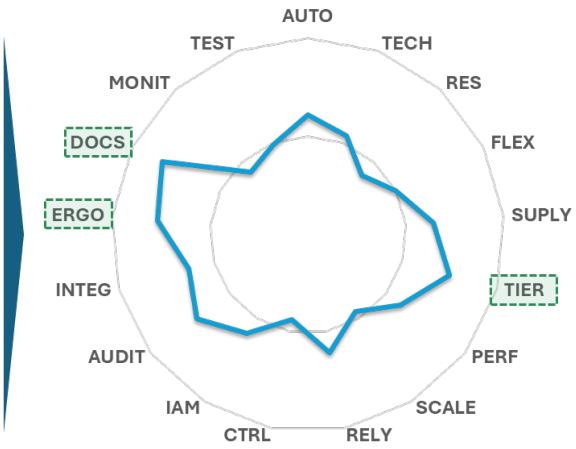


Illustration 12- Chart of AS IS evaluation of software architecture 1/2

7.1.4 Key challenges of the existing system

In addition to positive aspects, there are also significant challenges in the functioning of the application system of the Real Estate Administration, whereby **data security control** stands out as the most critical segment. The results show that data protection mechanisms, access

management and application of security policies are not at a level that provides complete protection of sensitive information resources. This result requires urgent improvement, especially in the area of standardization of security procedures and implementation of modern control mechanisms.

In addition to security, the system also faces challenges in several other areas. Resource availability and application environment flexibility are constraints that affect the system's ability to respond to new demands and support workload growth. A similar level of risk was observed in the scalability segment, where the possibilities of capacity increase and efficient management of a larger number of users and transactions are limited.

Additional challenges were identified in the area of technical support for the application life cycle. Application monitoring it is not at a level that enables timely recognition of anomalies and incident situations, while support for regression testing is not sufficiently developed to ensure a stable and controlled introduction of changes into the production environment. These weaknesses increase the risk of technical downtime and make it difficult to maintain system stability.

The overall assessment clearly shows that the improvement of security controls is a priority task, and at the same time it is necessary to strengthen resource capacities, flexibility, scalability and operational supervision. Only through these coordinated improvements will the system be fully prepared to support the future needs of the Real Estate Administration and provide a stable, secure and sustainable information environment.

62	AUTO	Business process automatization level
55	TECH	Development technology
42	RES	Resource availability
51	FLEX	Flexibility
65	SUPLY	Supply capacity
76	TIER	Multi-layer
60	PERF	Performance
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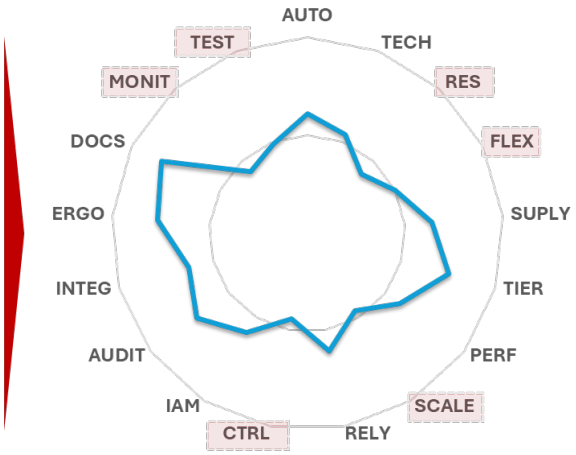


Illustration 13- Graph of AS IS score of software architecture 2/2

7.1.5 Software (application) architecture - future "To-Be" state

The goal of the future (To-Be) software (application) model of the Real Estate Administration and the biggest IT strategic priority is the establishment of a unique, centralized and integrated digital platform that enables efficient processing of cases in real time, interoperability with external systems and complete end-to-end digitization of business processes. In contrast to the current state of the System for managing cadastral records, where business functions depend on several separate application solutions and periodic data synchronization, the target solution implies the consolidation and modernization of key software components, based on modular architecture, service-oriented principles and a single central database.

Such an approach reduces the complexity of the system, eliminates the risks of data duplication and increases the speed of processing and availability of information, thereby creating the foundation for more advanced e-services and interoperability at the national level.

The eTerasoft and esKatastar systems, which currently function as partially separate solutions, according to their business logic, user scenarios and the nature of the data

necessarily belong to a single application entity. The target solution implies the development of an integrated Real Estate Cadastre System that includes:

- unified functionality of both systems through a unique web platform,
- a single central database,
- synchronization, i.e. in the "to-be" state, data entry between all regional units in the central database in real time,
- elimination of local bases and reduction of dependence on manual operations.

The proposed model provides a significant improvement in process efficiency and data quality, but at the same time opens the possibility for further digitization of communication with authorized external entities. It is planned to introduce a direct electronic connection for notaries, courts and other authorized institutions, which would enable the entry of active requests directly through the new portal, without physically submitting documents at the counter and without the need for subsequent manual entry into the system.

By eliminating local databases and switching to a fully centralized solution, the need for development and maintenance of complex data transfer mechanisms between headquarters and regional units is eliminated. This approach allows:

- current visibility of the status of all subjects,
- unique records of data without the risk of discrepancies,
- unified management of backups, archive and system recovery,
- more effective application of information security policies.

The targeted unified solution would be developed as a new core system, with a completely new data model based on best practices taken from existing systems. In this way, the transfer of outdated models and applications that have been upgraded over the years would be prevented, and at the same time, the modernization and greater transparency of the application architecture would be enabled, with the additional possibility of cleaning and consolidating data.

This approach, on the one hand, significantly reduces the risk in relation to the decision to change and integrate existing solutions. At the same time, it enables parallel and independent development without interfering with daily operations. On the other hand, the approach of building a completely new system may require somewhat larger initial financial investments compared to upgrading existing solutions. However, the actual cost ratio can be reliably determined only in the procurement process, when offers for the development or procurement of a new solution would be compared with the estimated costs of upgrading and integrating existing systems.

One of the key strategic priorities of the To-Be architecture is the establishment of a central Register of Lines. Currently, there is no digital platform that provides unified and centralized information about lines (eg electricity, water, telecom, gas and others), including rights, graphic displays, usage parameters, prices and values. Instead, the records are fragmented through local registers, while certain sectors (e.g. electricity lines) have separate records outside the state cadastre.

In accordance with its institutional competence, the Real Estate Administration in the targeted model becomes the only institution that guarantees ownership of lines and manages the central cadastre of lines for the whole of Montenegro.

The register of lines plans to develop in accordance with the principles of agile and modular architecture:

- the initial version contains the minimum functionalities needed to support basic business processes (MVP approach),
- the system is designed flexibly so that it can be gradually extended to advanced use cases and additional user requirements,
- architecture enables integration with GIS systems, national registries and external utility entities.

The strategic plan is to base all new systems on the same architecture, with the proposal to:

- development of a new system for cadastral records,

- development of the pipeline cadastre,
- development of the real estate price register,
- development of a new system for creating topographic maps,
- development of the register of geographical names,
- development of a new credit rating system,
- development of the new Geoportal of the Real Estate Administration

lead within one umbrella program initiative, which unites several projects, regardless of the fact that the systems are not necessarily connected to each other.

If from the perspective of the organization, available resources and time constraints it is not feasible to form a single, umbrella program initiative, it is recommended to approach an alternative option, independent procurement and implementation of individual projects. However, even in that model, it is necessary to centrally manage the compliance of architecture, data standards and mutual integration of all systems. In this way, it is ensured that individual projects, although implemented separately, function as a coherent and interoperable entire information ecosystem.

In this way, the systems would be maximally coordinated and placed on a common architecture, and budget planning and the use of planned financial resources would be transparent and easy to follow.

Access to the real estate register should be provided through digital channels to all institutions. The transition from manual work to digital processes should be carried out gradually, evolutionarily with constant awareness and information of employees in the Real Estate Administration.

In order to successfully digitize all processes, it will be necessary, in addition to upgrading existing and implementing new applications, to harmonize certain laws.

In the domain of electronic documentation systems, there are currently two such (eDMS) systems:

- eDMS within eTerasoft used for regular business,

- ThereFore eDMS is used for archival documents and archival data.

In the first phase of the migration, they would perform the following steps:

- Only eDMS from eTerasoft would be migrated to the new eDMS system,
- The entire paper business and processes would be covered,
- Dedicated eDMS ThereFore would not change at this stage.

Regarding digitization and eArchives, significant investments are needed in the digitization of paper documents. Digitization is realized partly internally, and partly through outsourcing to specialized companies.

The key question is whether the services of the Real Estate Administration will be provided directly through the internal information system and internal portals, or through a unified information system and portal at the state level. The strategic proposal is to implement a hybrid model, which will be a combination of both solutions.

We propose a modern, API-First integration strategy to real estate management, which redirects the architecture of IT systems from outdated centralized models to flexible, microservice principles. In this context, the strategic decision is the implementation of the Gateway API, which replaces the traditional Enterprise Service Bus (ESB).

ESB, dominant in the Service Oriented Architecture (SOA) era, today represents a significant architectural risk and obstacle to agility. Its fundamental weakness lies in its centralized, monolithic nature. ESB becomes a single point of failure and a potential performance bottleneck, as it contains all the routing and transformation logic. Any change in one service requires the modification of the entire central ESB, which drastically slows down development, increases the complexity of maintenance and makes it impossible to react quickly to changes. Also, ESB primarily focuses on older protocols, making it difficult to integrate with modern, REST/JSON-based systems and mobile applications.

The Gateway API is the foundation for a resilient, scalable and secure IT architecture. It is not a substitute for ESB in terms of data transformation and business logic (which remains in the

domains of microservices), but is focused on traffic management and execution of *Cross-Cutting* functionality.

The Gateway API serves as a single and secure entry point for all client applications and systems that access IT services of the Administration. Instead of applications having to know hundreds of internal addresses and protocols of individual microservices, they communicate exclusively with the Gateway. This greatly simplifies the development of client applications and allows internal microservices to be independently developed and updated without interrupting service to end users.

For an institution managing critical data, security is a priority. The Gateway API strategically takes on vital security tasks in one place, before requests reach internal systems:

- Authentication and Authorization: Gateway centrally verifies identity and access rights (through mechanisms such as tokenization and OAuth 2.0), ensuring that only authenticated entities can access data.
- Overload Protection: By implementing Rate Limiting and Throttling, Gateway protects internal services from an excessive number of requests, preventing potential DoS attacks and guaranteeing system stability.

In line with the need for rapid digitization, the Gateway API supports so-called loose coupling (Loose Coupling). The business logic remains within the independent microservices, while the Gateway exclusively routes requests. This decentralization allows teams to quickly and autonomously develop, test and release new functionalities (CI/CD) without the need for coordination and complex regression testing of the entire central bus.

The Gateway API improves overall system resiliency by implementing advanced fault-handling mechanisms, such as Circuit Breaker (which automatically terminates the connection to a failing service, giving it time to recover) and Retry Logic. In addition, it serves as an ideal point for collecting logs and performance metrics, providing management with a clear and real-time picture of the health and usage of all digital services.

The adoption of the Gateway API is a key component of the IT strategy that enables the transition to a modern, elastic and secure IT architecture, optimized for the Cloud environment and the high demands of digital business.

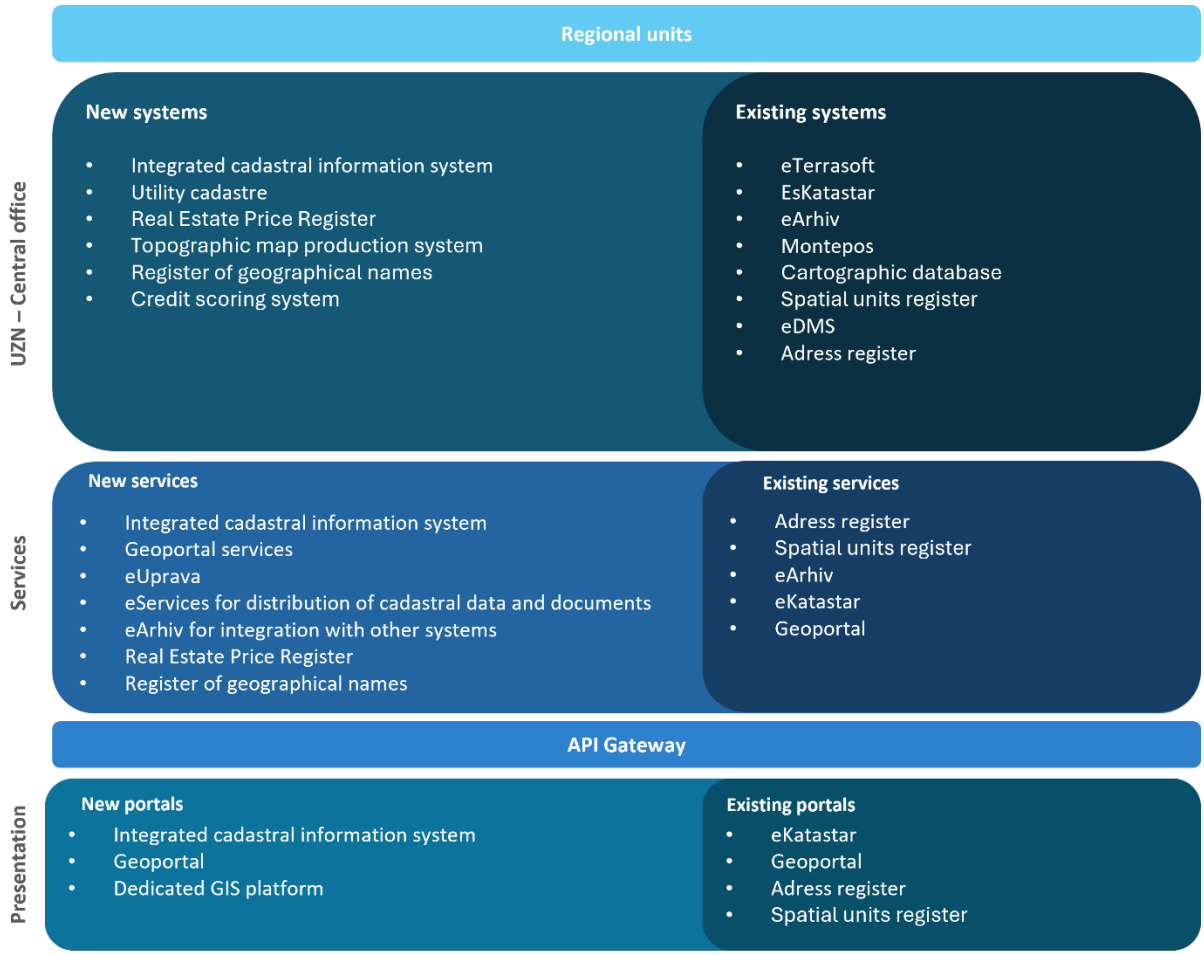


Figure 7- Application information architecture - proposed state

In order to take full advantage of the API and microservice architecture, it is necessary to establish a single, standardized data model for data exchange through a centralized API Gateway. This model represents a common basis for data exchange between all internal systems, external institutions and client applications.

A unified data model ensures that all systems exchange data in the same semantic and structural form, thus eliminating ad-hoc integrations, multiple transformations and

interpretation errors. The Gateway API in this context serves as a controlled point for data exposure and validation, while the actual processing and business logic is kept within the respective microservices.

In addition to the data model, it is necessary to define unique business models and standardized processes for:

- submitting a request for data through the service,
- data processing,
- returning response and processing status.

By standardizing business processes, consistent behavior of the system is ensured, regardless of which internal service is behind the specific request. In this way, all channels (internal systems, portals for citizens, systems of other institutions) use the same communication patterns, the same validations and the same business flows.

This approach allows:

- interoperability between existing and future systems,
- easier inclusion of new services and institutions,
- reducing the complexity of development and maintenance,
- better data quality control and audit trail,
- faster digitization of the process without disturbing the stability of the system.

Establishing a single central data and business model, combined with an API Gateway, is a key prerequisite for a long-term sustainable, scalable and manageable IT architecture of the Real Estate Administration.

Regarding the electronic signing of documents, the Real Estate Administration already has an electronic signature, which is partially used (e.g. for documents intended for notaries, executors, and users with the highest portal access level).

Internal electronic signing is currently not used, which opens up space for the introduction of electronically signed documents in business with legal entities and citizens.

Through the public administration portal and with the use of the new "digital" ID card, there is a possibility of integrating the Real Estate Administration process with other digital processes and enabling authorization in this way.

7.1.6 Connecting external institutions to future services and portals of the Real Estate Administration

Within the framework of the new application architecture, through modern portals and internet services, it will be possible to connect, exchange data and submit requests electronically between the Real Estate Administration and all relevant institutions in the country.

Institutions that will be able to interact digitally include:

- Ministries,
- Local governments,
- Government agencies,
- Legal and private entities,
- Geodetic companies,
- Appraisers,
- Court experts and
- all other organizations that need access to Real Estate Administration data.

The law stipulates that data exchange between institutions must be done through a single system, which means that the Real Estate Administration will provide data through a centralized platform, using predefined formats that enable interoperability and automated processing.

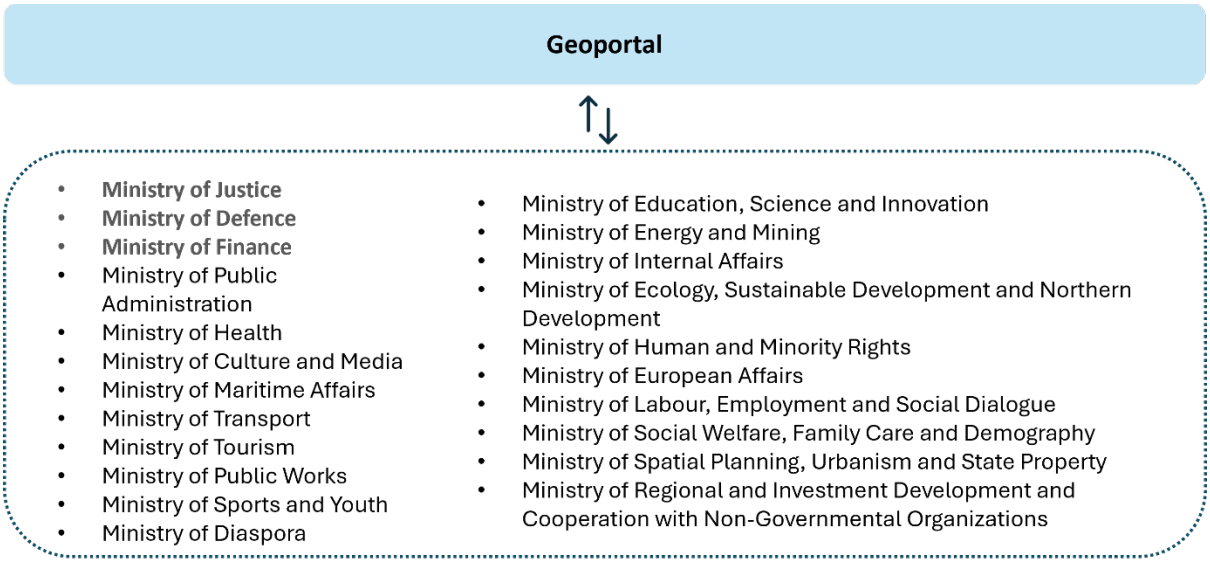


Figure 8- List of ministries that will be able to connect to the new UZN Geportal

7.2 Data architecture

One of the key challenges in the time of technological progress is the way of using personal data. The government needs to ensure that data protection laws match the intense pace of change, and that innovations created using personal data are ethical and responsible. The GDPR defines strict standards for the collection, processing, storage and protection of personal data, thus directly affecting the way an organization's data architecture is designed and implemented. In order to comply with the GDPR, the data architecture must provide the principles of data minimization, clearly defined purposes of processing, access control, monitoring of data flows, as well as the possibility of deletion, anonymization and portability of data at the user's request. In addition to technical measures, it also includes organizational mechanisms such as record keeping, privacy impact assessment (DPIA) and consent management. An aligned data architecture enables a company to reduce risks, meet regulatory obligations and build user trust, which is critical for all modern digital and AI systems. Legitimately collected and stored personal data could be knowingly or intentionally disclosed, risking the confidentiality of individuals, which is especially risky in the health care sectors where, in essence, the most sensitive personal data is.

The European Data Strategy defines a framework for cross-sectoral data management, access and use that aims to facilitate the use of data for innovative business. In November 2020, the European Commission adopted the European Data Management Act. This regulation aims to improve the availability of data in the EU by increasing the exchange of public data, strengthening trust in data intermediaries, and strengthening exchange mechanisms. Also, the act indicates that the interoperability and quality of data, as well as its structure, authenticity and integrity are key to harnessing the value of data, especially in the context of AI applications. In order to encourage the use of interoperability in the public sector and beyond, it is necessary to introduce a number of digital tools to make its application as simple as possible.

7.2.1 Data management

Data governance is one of the key pillars for the effective implementation of the development plan of the Information System of the Real Estate Administration. The constant growth in the volume, complexity and importance of data requires a comprehensive approach to ensure its protection, compliance with objectives and preservation of value.

Accordingly, the information system development plan includes both technical and logical aspects of data management, especially in relation to regulatory requirements.

A key overview of data management requirements includes the following aspects:

1. Data protection and privacy
    - Ensuring the security and privacy of client data in accordance with the data protection law and European regulation (EU) 2016/679 (GDPR).
    - Implementation of strict data protection (availability, confidentiality, integrity and authenticity) and privacy policies.
    - Regular implementation of data protection impact assessments (Data Protection Impact Assessment).
2. Data management framework

- Establishing a strong data management framework that is aligned with business goals.
- Defining roles and responsibilities, setting data quality standards, and implementing data management policies and procedures.

3. Data quality

- Focus on high data quality through the implementation of largely automated data validation processes.
- Ensuring traceability (lineage) and regular monitoring of data quality.

4. Data risk management

- Identifying, assessing and mitigating risks associated with data within the overall risk management system.

Data management within the Real Estate Administration cannot be established solely from an IT perspective. Comprehensive data management, which includes both technical and managerial aspects, is essential for the success of the implementation of the data-based information system development plan. By applying customized enterprise-level best practices in the areas of data architecture, data quality, data security and data analytics, as well as clearly separating responsibilities between the risk function, business functions and IT function, the Real Estate Administration will effectively manage and use its data to:

- Making decisions based on data analysis,
- improvement of risk management capabilities and
- fulfillment of strategic goals.

Continuous improvement and change management are key to maintaining a strong data management system that adapts to the evolving needs of the organization and regulatory environment. By implementing customized best practices at the company level, the highest level of data quality, security and compliance is ensured, which allows UZN to achieve additional value from its data.

Data quality management is mandatory and one of the most important components within data management. Working groups for data quality management should be formed, which includes IT representatives of the Real Estate Administration and represents a responsible body that acts within the framework of special guidelines that define basic principles, responsibilities, goals and tasks.

7.2.2 Artificial Intelligence (AI)

AI represents the application of algorithms and models of machine learning, natural language processing and other intelligent systems to automate decision-making and predict business trends. In Real Estate Management, AI will enable more accurate evaluation of real estate portfolios, risk identification and optimization of property management processes.

Key AI functionalities:

- Predictive analysis: algorithms predict future real estate market trends and property values.
- Anomaly detection: detection of potential irregularities in transactions or portfolio management.
- Process automation: speeds up routine operations, reduces errors and ensures consistency in data processing.

Implementation challenges and strategies:

- Defining an ethical framework and regulating the use of AI models to avoid bias and ensure transparency.
- Continuous monitoring and validation of models, including performance evaluation and adjustment of algorithms in accordance with changes in the business environment.
- Education of employees on the interpretation of AI results and the integration of recommendations into daily decision-making processes.

Strategic benefits:

- Faster and more accurate decision-making.
- Reducing operational risk and increasing efficiency.
- Increasing the Management's ability to anticipate market changes and adapt real estate management strategies.

Global trends in the development of artificial intelligence are moving towards the concept of **sovereign AI,** an infrastructure that enables fully controlled and secure management of data, algorithms and models within state or organizational frameworks. Such an approach reduces dependence on external cloud providers, while enabling compliance with regulations on data protection and security of critical infrastructure.

It is recommended to implement **on-premise AI servers** equipped with the latest high-performance GPU cards, capable of supporting modern AI models and big data analytics. Modern servers of this type are characterized by small physical dimensions, with exceptional processing power, which achieves optimal use of space and energy.

cooling is becoming a standard in modern AI centers, as it enables a significant reduction in electricity consumption, reduces heat emissions and meets ESG sustainability standards. Such systems enable efficient energy management and contribute to reducing the ecological footprint, which is of key importance in the public sector.

By establishing a sovereign AI infrastructure, the Real Estate Administration can achieve:

- Controlled, secure and audible data processing;
- Increased speed and efficiency of AI analytics and automation of business processes;
- Energy-efficient and sustainable use of resources, with minimal impact on the environment;
- Scalability and modularity of the system, which enables future expansion of AI capacity without the need for major infrastructure changes.

Such an approach positions the Real Estate Administration in line with global digitization trends, providing a high level of independence and flexibility in the development and application of AI solutions for state and public services.

7.2.3 Business Intelligence (BI)

Business Intelligence includes the systematic collection, processing and visualization of data to enable strategic and operational decision-making. BI platforms enable the consolidation of data from different sources, the standardization of reporting and the creation of dashboards that support transparency and efficient management of the real estate portfolio.

Key components:

- Data warehouses: unification of data from different business and IT systems.
- ETL processes: extraction, transformation and loading of data for their standardization and validation.
- Dashboards and reports: interactive tools for monitoring key performance, trends and business indicators (KPIs).

Application and benefits:

- Fast and informed data analysis.
- Consistency and standardization of reports reduces the time needed to prepare information.
- BI represents the foundation for further application of advanced analytics and AI, as it ensures quality and reliable data.

Strategic impact:

- It enables effective monitoring of the financial and operational situation.
- It increases the agility of the Administration in making decisions.
- It supports strategic planning through visualization of trends and identification of opportunities or risks.

7.2.4 Advanced Analytics

Advanced analytics involves the application of statistical methods, machine learning and other analytical techniques to extract deeper insights from data and predict future business situations. This component allows the Real Estate Administration to:

- optimizes the real estate portfolio,
- accurately assess risks and market opportunities,
- improve strategic planning and decision-making.

Types of analytics:

- Descriptive analytics: analysis of historical data to identify patterns and trends.
- Diagnostic analytics: determining the cause of certain results and events.
- Predictive analytics: using statistical and algorithmic models to predict future events, such as market movements or portfolio risks.
- Prescriptive analytics: generating recommendations and strategies for business optimization and risk reduction.

Implementation and strategy:

- Integration with BI platforms and AI models to improve accuracy and reliability of results.
- Setting clear data quality standards and analytical model validation processes.
- Staff training for interpretation of results and their implementation in everyday business decisions.

Strategic benefits:

- It enables better planning and risk management.
- It supports decision-making based on data instead of intuition.
- Increases the Management's ability to anticipate market changes and adapt real estate management strategies.

7.3 IT infrastructure

The Real Estate Administration of Montenegro is one of the key institutions in the country, bearing in mind that it is in charge of keeping and updating records of real estate rights, managing spatial, geodetic and property-legal data, as well as maintaining a series of registers important for legal security, the functioning of public administration and the implementation of development and infrastructure projects. Given the importance and scope of the work it performs, it is necessary to have a reliable, scalable and modern IT infrastructure, as well as an operational architecture that enables continuity of work, secure data storage and an effective disaster recovery plan (Disaster Recovery Plan).

The purpose of the As-Is analysis was to objectively assess the current state of the Administration's information system, identify potential critical points and propose concrete measures for improvement. The analysis is based on data collected during several workshops, interviews with relevant participants and through survey questionnaires.

7.3.1 Overview of the existing IT infrastructure

Central data center (Podgorica):

- 8 HP ProLiant 640c blade servers (generations 9 and 10)
- 4 units older than 10 years, no warranty, EoL
- Virtualized, hosted applications: eTerrasoft, eKadastar, Geoportal, Register of Spatial Units, Montepos

Regional units:

- 20 physical servers
- Most over 10 years old, no warranty, EoL, EoS, no maintenance contract
- Synchronization with the central in real time or daily
- Primary use: eTerrasoft and esKatastar

Storage system:

- Primary storage with secondary and tertiary backup repositories

- Located in the same room in Podgorica
- Age over 10 years, no warranty, EoL, EoS

Taking all these parameters into account during the As-Is analysis, an analysis of the submitted data was performed and a certain level of criticality was determined.

In the evaluation of the degree of criticality, the following parameters were used on the basis of which the weighting was done (this analysis was done only for servers):

- Warranty
- EOL
- EoS
- Duration of the maintenance contract
- Equipment integrity
- The number of applications the servers are responsible for

As a general conclusion of the As-Is analysis, the criticality in two key points of the threat of the complete or part of the IT infrastructure system is highlighted:

1. Criticality at the level of equipment obsolescence (warranty, EoL, EoS and maintenance contract)
2. Criticality at the level of non-existence of an off-line location (physical or cloud), which implies the absence of any disaster recovery plan.

7.3.2 Hardware infrastructure - the future "To-Be" state

In order to improve the overall reliability of the information system, reduce the risk of potential catastrophic events (whether caused by technical failures, natural disasters, human errors or malicious activities), as well as to increase the functionality and efficiency of the system, a comprehensive transformation of the existing IT infrastructure is proposed. This transformation aims to establish a modern, scalable and highly available technological environment that will serve as a foundation for the further development of digital services and processes.

The proposed solution is based on hyperconverged infrastructure (HCI) that integrates compute, storage and networking resources into a single platform, which provides flexibility, simplified management and the possibility of horizontal scaling. Alternatively, the option of SAN architecture in combination with SDS (Software Defined Storage), which enables dynamic storage capacity management and performance optimization, was considered.

Capacities and performance: It is planned to form a cluster of 8 nodes, where each node contains dual-socket processors with a total of 32 physical cores and a minimum of 256 GB of RAM. The total storage capacity is provided at the level of a petabyte-class SDS solution with NVMe drives for high performance. Expected performance includes a minimum of 100,000 IOPS per node and network throughput of 40 Gbps with a redundant fabric. These parameters are defined in order to provide optimal support for critical business applications and highly loaded transaction systems.

High availability requirements: The infrastructure must provide a high availability (HA) cluster with automatic failover mechanisms for the compute and storage layers, thus eliminating a single point of system failure.

All key services will be distributed across multiple nodes, with data synchronization and redundant network links. The Disaster Recovery center at a remote location ensures business continuity.

Criteria for backup and disaster recovery: In accordance with standards (eg NIST SP 800-34, ISO 22301), RPO ≤ 15 minutes and RTO ≤ 1 hour are defined for critical services. The backup strategy includes multi-level access (disk-to-disk-to-cloud), deduplication, data encryption at rest and in transit, as well as quarterly testing of recovery procedures. These measures are aligned with the "Critical Infrastructure Management Rules" in Montenegro, which ensures compliance with national standards for resilience and business continuity.

The infrastructure must be designed in accordance with the requirements of enterprise architecture, with the mandatory implementation of a layer for data exchange through services and an API Gateway, which will function as a virtual layer between new and existing

systems. This approach provides interoperability, security and access control, as well as flexibility for future integrations.

In order to ensure the stability and reliability of the network, the plan envisages the application of the highest standards that guarantee the continuity of work and the security of communication between all regional units and the headquarters. All regional units will be connected by optical connections that provide unlimited flow and guaranteed minimum speeds necessary for the smooth operation of services and applications. The network infrastructure must be designed to ensure redundancy and automatic switching to the secondary connection in the event of a primary connection failure, with physical separation of the primary and backup lines to reduce the risk of simultaneous failure. The stability and availability of the connection must be ensured 24/7, with clearly defined SLA parameters that guarantee business continuity. In the context of interoperability and future integration, the application of an API-first approach and the implementation of an API gateway are foreseen, which provides controlled access, security mechanisms and flexibility in connection with other systems. The backup link should be based on a reliable alternative technology, such as L3VPN or 5G wireless networks, with a prior analysis of availability and performance.

The network and security architecture must be designed to ensure traffic segmentation, protection of critical services and controlled access to external users. Within the framework of the future model, the implementation of a demilitarized zone (DMZ) that separates public services from the internal network is foreseen, with the application of a multi-layered firewall system. The edge firewall provides protection of the external perimeter and filtering of traffic towards the DMZ zone, while the internal firewall protects internal resources from potential threats that may originate from the DMZ. To connect regional branches with the central data center, the use of VPN tunnels with encryption and multi-factor authentication is recommended, along with the integration of SD-WAN technology to optimize traffic, dynamic redirection and ensure high availability. This topology enables centralized control, network segmentation and the implementation of advanced security policies, which reduces the risk of compromising critical infrastructure and ensures business continuity.

The infrastructure migration plan must be based on the principles of minimum risk and maximum efficiency, taking into account that most of the existing equipment is more than ten years old and is out of manufacturer support (EOS). This situation represents a high operational risk and justifies the need for a complete replacement of the equipment in the shortest possible time. The proposed approach implies a phased implementation that ensures business continuity and parallel operation of the old and new systems during the transition.

The first phase includes the establishment of a new central data center with hyperconverged infrastructure and the implementation of basic services in production mode. This is followed by the connection of regional units to the new platform via SD-WAN technology, with the gradual shutdown of outdated devices. The transitional regime envisages the parallel operation of old and new equipment for a period of several weeks, in order to ensure functionality verification and data migration without interruption of services. The final phase involves complete consolidation of the system, deactivation of old equipment and optimization of new resources in accordance with the goals of a single platform for the information system of the Real Estate Administration.

Such a migration plan not only minimizes the risk of downtime, but also provides a clear justification for high investment costs, as it provides a stable basis for the realization of a key digital transformation project and the establishment of a unique information system.

The given table provides a comparative overview of the advantages and disadvantages of the proposed technologies/platforms.

Technology	Option	Advantages	Disadvantages
Hypervisor technologies (virtualization)	VMware	Stability, advanced features	High costs
	Hyper-V	Integration, lower costs	Limited functionality
	Proxmox	Open source, flexibility	Less enterprise support
Cloud Options for Disaster Recovery	IaaS	Flexibility, control	More responsibility for safety

	Easter	Faster implementation, less maintenance	Limited control over the environment

For the needs of the critical infrastructure of Montenegro, a solution based on Hyper-V technology is proposed, because it provides high integration with the Windows environment, reliable support for virtualization and an optimal ratio of costs and functionality.

Also, the primary goal of this transformation was not aimed at changes in the internal architecture and interconnection of applications, but at strengthening security, providing redundancy through the proposal to build a disaster recovery center, as well as centralizing the system in terms of connecting regional units with the central infrastructure. The illustration below shows a schematic model of the proposed future infrastructure solution, with clearly highlighted changes in red that contribute to the improvement of the information system as a whole.

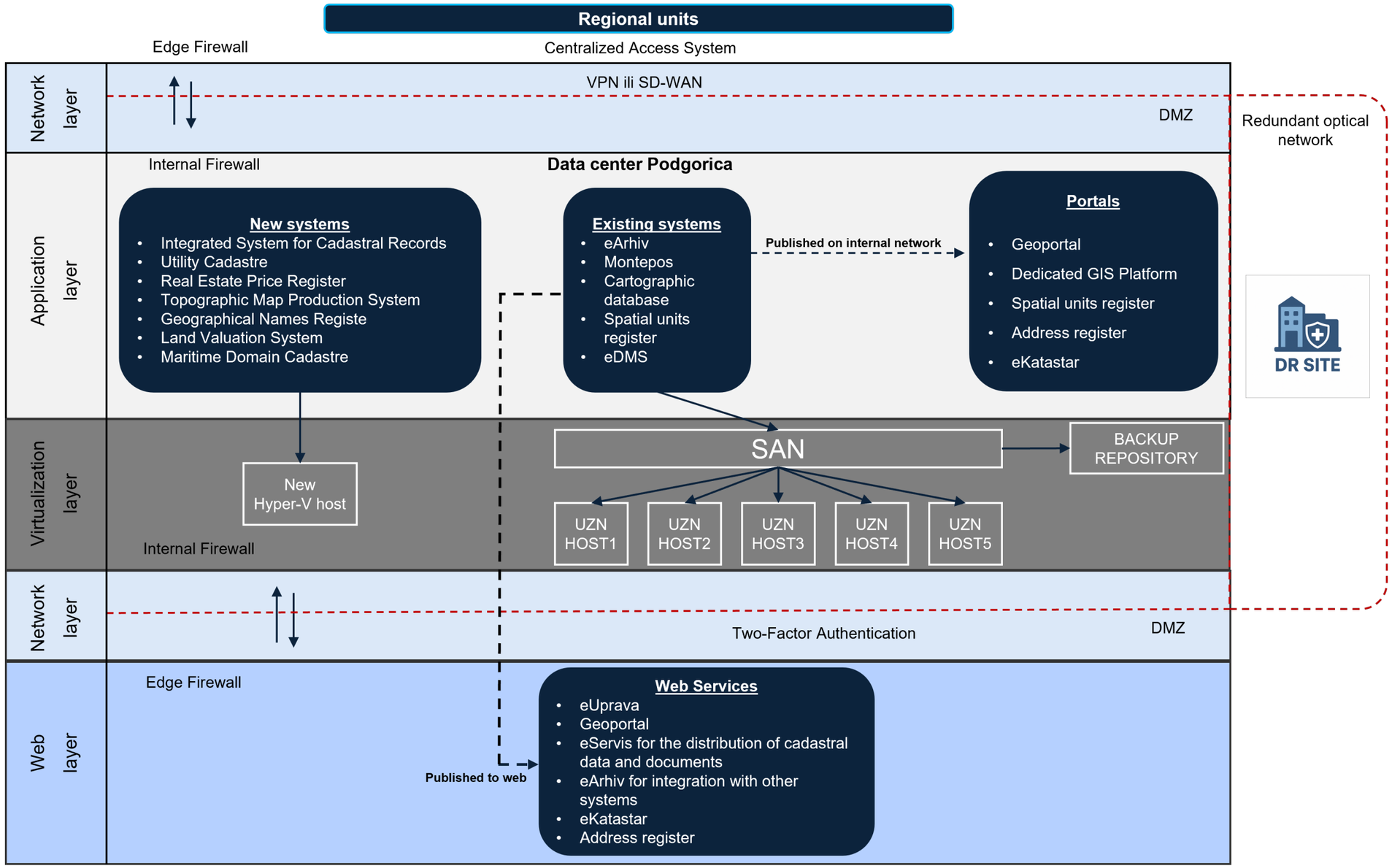


Illustration 14- Proposed model of future infrastructure

7.3.3 Key differences compared to the existing "As-Is" condition:

7.3.3.1 Centralization of the infrastructure through the main data center

The new model foresees the centralization of IT resources, whereby all regional units would be connected to the main data center located in Podgorica. The connection would be realized through secure VPN connections or alternatively using SD-WAN technology, which enables flexible, secure and efficient management of network traffic between locations. This approach enables:

- Unified control and management of resources.
- Easier implementation of security policies.
- Reduction of local infrastructure maintenance costs.
- Faster response in the event of an incident or need to scale.

7.3.3.2 Establishing a Disaster Recovery (DR) site

One of the most important elements of the proposed infrastructure is the construction and operational establishment of the Disaster Recovery Center, which would represent a complete replica of the primary data center in Podgorica. This location would serve as a backup should the primary center become unavailable due to emergency circumstances. Recommended DR Center Features:

- A geographical distance of at least 100 km from the primary location, in order to protect against localized disasters (eg earthquake, flood, fire).
- A redundant optical connection, ideally through a dedicated dark fiber connection, which provides high throughput and low latency.
- Automatic synchronization of data and services between the primary and DR locations.
- Ability to quickly switch operations (failover) in the event of an incident.

In considering the potential options for the primary and reserve (DR) location, various forms and models of implementation were analyzed, taking into account technical, security and investment aspects. A comparative analysis of the advantages and limitations of each

scenario is shown in the table below, which is the basis for making a decision on the optimal solution.

Scenario	Description	Advantages	Disadvantages
1 - State DC = Primary Location, Administration = Secondary (DR)	The new state data center becomes the primary, while the existing DC of the Administration serves as the DR location.	Centralization in state DC (Tier standard, better physical security); Management retains control over DR resources.	Required upgrade of existing DC for DR functionality; Risk if both DCs are in the same geographical area (need to check the distance).
2 - Administration = Primary Location, State DC = Secondary (DR)	The existing DC remains the primary, while the State DC serves as the DR.	Minimal changes in the existing environment; Fast integration with state DC as DR.	The primary DC may not meet the Tier III/IV standard; Optimization required for HA and failover.
3 - Active-active (Primary = State DC + Administration)	Workload is shared between both DCs (georundant), with near-sync replication.	The highest level of availability and resilience; Failover is virtually non-stop.	Highest costs (licensing, network, orchestration); Management complexity.

- The strategy must include risk assessment, Business Impact Analysis (BIA), definition of RPO (≤15 minutes) and RTO (≤1 hour) for critical services, as well as a test plan for failover procedures.
- It is recommended to create a Business Continuity Policy in accordance with ISO 22301 and NIST SP 800-34, as well as alignment with the "Critical Infrastructure Management Rules" in Montenegro. The policy should include: roles and responsibilities, communication protocols, testing program (quarterly failover, annual full recovery) and regular audit.

Choosing the right scenario is of key importance from the aspect of safety, efficiency, but also investment costs and maintenance costs. In the proposal, we provide 3 possible scenarios:

- building your own data center that would play the role of a disaster recovery center with all the features mentioned in the previous part of the text.
- establishing a disaster recovery center on one of the cloud solutions
- establishment of a disaster recovery center with third parties, ie one of the pioneers

At the moment when the Ministry of Public Administration implements a common state data center, this option can be considered in two ways:

- if the state data center is offered as a cloud solution, then it can be considered a free Disaster Recovery (DR) option in the cloud;
- if the state data center offers an on-premise solution, then it is a free DR option within the state data center, whereby the Real Estate Administration is obliged to provide funds for the purchase of servers and supporting equipment, which will be installed in the state data center.

The following table provides a detailed overview of the pros and cons for all three options.

Option	Advantages	Disadvantages
DR Own data center	- Full control over the infrastructure - Adapted to specific needs - Greater data security - Direct integration with systems	- High initial costs - Long time frame for construction - Need for constant maintenance - Risk of local disasters

DR Cloud solution	- Rapid deployment - Scalability - Pay per use - Geographic diversity - Automation and testing	- Dependence on internet connection - Potential security risks - Costs may rise - Regulatory restrictions
DR with third parties (provider)	- Fast infrastructure availability - Expertise of the provider - SLA guarantees of availability - Less burden for the internal IT team	- Less flexibility - Dependence on providers - Long-term high costs - Possible integration problems

Table 5- Presentation of advantages and disadvantages in DR implementation scenarios

7.3.3.3 Improvement of system security

Information system security is a priority in the new architecture. Proposed measures include:

- Implementation of secure VPN connections between all regional units and the central office, which ensures encrypted communication and protection against unauthorized access.
- Introducing a DMZ (Demilitarized Zone) between the web service and the internal network, using a double firewall system:
- Edge firewall – protects external access to the system.
- Internal firewall – protects the internal network from potential threats that may come from the DMZ zone.
- Two-factor authentication (2FA) for all users accessing the system, which significantly reduces the risk of compromising user accounts and cyber attacks.

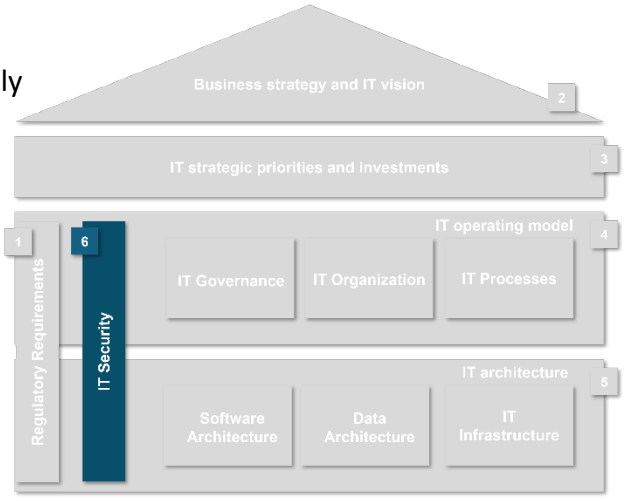
As part of the development of this To-Be model of the hardware infrastructure, the following controls from ISO/IEC 27001 were taken into account:

- A.6.1.2, A.8.2: Risk assessment and risk management.
- A.17: Business continuity and disaster recovery.
- A.9: Access control and user rights management.
- A.13: Network security policies and communication protection.
- A.12.3.1: Data backup and synchronization between locations.
- A.9.4.2: Two-factor authentication to protect user accounts.
- A.12.1.3: System capacity and performance planning.
- A.14: Security in the development and support of digital services.

The proposed "To-Be" model of hardware infrastructure represents a strategic step towards the modernization and digital resilience of the organization. Through centralization, the establishment of a DR location and the improvement of security mechanisms, a stable basis for future business needs, growth and innovation is provided. Also, the proposed infrastructure model is in accordance with the best practices and international information security standards. By implementing these measures, the Real Estate Administration of Montenegro increases the security, resilience and efficiency of the system, creating the basis for future growth, innovation and possible certification according to the ISO/IEC 27001 standard.

8 IT Security

The review of IT security is an extremely important component of the effective implementation of the IS development plan for the Real Estate Administration. In light of the constant growth in the volume, complexity and importance of data and its security in today's digital environment, adopting a comprehensive approach is key



to ensuring the integrity, confidentiality and availability of data, as well as proactively managing potential risks related to IT security.

The strategic goals of the Real Estate Administration in the field of IT security are based on a holistic approach, with the aim of establishing an appropriate level of information security.

The holistic approach is based on three basic pillars:

1. **People:**
   - People are both the strongest and the weakest element of any information system; incidents are caused by people and can be prevented by people.
2. **Processes:**
   - The general processes that support information security represent the basis for the implementation of specific tools and measures.
3. **Tools:**
   - Effective solutions and tools are necessary to support security functions (as defined, for example, in the NIST Cybersecurity Framework).

From these three basic pillars: **People, Processes and Tools** - the Real Estate Administration defines goals in the following areas **:**

1. **People development** - Developing awareness, responsibility, obligation, knowledge and skills of employees.
2. **Building a security environment** - Defining, implementing and continuously improving effective and consistent information security as a basis for the application of concrete measures and tools.
3. **Information Protection** - Implementation of effective solutions using appropriate tools to prevent and detect unwanted security events, as well as to facilitate response to such events and recovery after incidents.

IT security in the Real Estate Administration would be treated on two levels:

1. **The first level of IT security** - within IT governance (IT Governance)
2. **Strategic and political level** - within risk management (Risk Management)

Activities in the field of IT security are carried out within the Plan-Do-Check-Act (PDCA) cycle, which represents a robust and adaptable approach with a focus on continuous improvement and refinement of the organization's security practices. By adopting this cyclical methodological approach, the Real Estate Administration will systematically address security challenges, develop a proactive security culture, and adapt strategies in accordance with new threats and changes in the technological environment.

Plan	• Define objectives and select the appropriate scope of implementation • Define risk assessment methods • Prepare an inventory of information assets that need to be protected, rank assets according to risk classification • Develop a project plan, timeline and roadmap
Do	• Carry out the implementation of activities that are within the scope of the project (including design, engineering, procurement, operations, testing, auditing, etc.) • Manage risks and create a risk treatment plan • Establish policies and procedures for risk control • Allocate resources and train employees
Check	• Monitor the implementation of activities that are included in the scope of the project • Monitor and report on progress (e.g. measure and analyze specific key success indicators – KPIs)

Act	• Prepare for reassessments and certification audits • Conduct reassessment audits (current status review) • Review the criteria and methods used • Review project and process requirements • Identify corrective and preventive measures • Implement continuous improvement activities

Table 6- IT security activities within the PDCA cycle

Risk management in the area of IT security in the Real Estate Administration would be implemented through the PDCA framework, which includes the identification, mitigation and monitoring of risks:

1. Determining the scope of the risk assessment and the team:

- Based on law and safety standards (eg ISO), identify the preliminary scope of the assessment
- Identify and analyze IT and information resources for risk assessment (purpose, functionality, data sensitivity, user, location, owner, criticality)
- Determine the appropriate team with the necessary expertise

2. Risk identification (threat and vulnerability assessment):

- Identify and assess threats such as:
  - Cyber security threats
  - Natural disasters (floods, earthquakes, etc.)
  - Environmental threats (water damage, power outages, etc.)
  - Human factors (intentional or unintentional actions)
- Identify and assess vulnerabilities such as:
  - Employees
  - Facilities
  - Operating systems
  - Applications etc.

- Develop a list of threats and vulnerabilities (TV list)
- Assess gaps and existing protection mechanisms

3. Risk assessment (impact of threats and probability):

- Determine the probability of occurrence of threats and vulnerabilities (from very likely to least likely)
- Determine the severity of the impact based on:
  - Confidentiality
  - Integrity
  - Availability
  - etc.
- Perform a qualitative risk assessment using a 2x2 matrix:
  - Probability
  - Seriousness
- Determine possible monetary loss (quantitative assessment)

4. Communication and determination of risk tolerance:

- Summarize assessment reports and share them with key stakeholders
- Determine risk tolerance in accordance with company priorities and available budget
- Identify priorities and decide on an approach for each risk:
  - To mitigate
  - Accept (operate with known risks)
  - Ignore
  - Reduce
  - Transferred (e.g. by outsourcing)

5. Determination of the activity plan:

- Based on the assessment report and risk tolerance, prioritize activities

- Define the implementation plan (schedule, roles and responsibilities)
- Define KPIs and targets to track progress
- Establish a Plan-Do-Check-Act (PDCA) cycle for continuous risk mitigation

6. Implementation and monitoring:

- Follow the PDCA cycle:
  - Implement initiatives, monitor progress and evaluate activities against KPIs
  - Monitor ignored and mitigated risks
  - Identify new risks
  - Reassess existing risks (as needed)

8.1 An IT security architecture perspective

IT security architecture plays a key role in protecting against potential security threats and includes several interrelated dimensions that together form a comprehensive framework for preserving the security of information systems. This architecture is seen not only as a technical aspect, but as a strategic approach that integrates management, technology and operational activities.

Governance:

Security management involves establishing clear policies, procedures and responsibilities that define how security is implemented, monitored and improved. It includes monitoring access to information, conducting audits and ensuring compliance with relevant standards such as ISO 27001 and NIST. Effective management enables the organization to clearly define safety objectives, identify risks and establish control mechanisms that ensure consistent application of safety measures. To achieve this, security management includes several key components:

- **Strategy** - Setting a long-term vision and security goals, defining data protection policies and compliance with laws and standards.
- **Organization** - Clearly defining roles and responsibilities within the organization, including IT and security teams, to ensure coordination and efficiency.

- **Processes** – Creating and implementing procedures for access control, incident management, conducting audits and monitoring compliance.
- **People** - Educating employees on policies and procedures, raising risk awareness and ensuring that all participants understand their role in protecting information.
- **Technology** - Implementation of technology solutions that support security processes, such as systems for event monitoring (SIEM), identity management tools and control automation.

Applications:

Application security includes their proper configuration, regular updates and protection against known vulnerabilities. Application access control must be precisely defined, applying the principle of least privilege. In addition, applications must be subject to regular security testing, including penetration tests and code analysis, to identify potential weaknesses before they are exploited. To provide complete protection, this layer includes the following key components:

- **Application traffic protection** - Ensures the security of communication between applications and users, most often by using encryption and secure protocols.
- **Application Integrity Protection** – Prevents unauthorized changes to applications, keeping their source code and configuration from being compromised.
- **Application Security Testing** - Regular testing of applications for vulnerabilities, including penetration tests and static/dynamic code analysis, to detect weaknesses before attackers exploit them.

Data:

Data protection is a central element of IT security. Data must be encrypted both at rest and during transmission, using modern cryptographic algorithms. The classification of data according to sensitivity enables the application of appropriate access controls, while the monitoring of data activities enables the timely detection of unauthorized access or manipulation attempts. Special attention is paid to the protection of personal data in

accordance with legislation and regulations. To provide complete protection, this layer includes the following key components:

- **Protection of data at rest** - Ensures the security of data that is stored on disks, databases or other media, usually using encryption and access control.
- **Protect data in motion** – Protects data in transit through the network, using security protocols such as TLS or VPN, to prevent interception and manipulation.
- **Data integrity protection** - Guarantees the accuracy and consistency of data, preventing unauthorized changes and corruption of information.

Infrastructure:

Infrastructure security includes a series of technical and organizational measures that together ensure the system's resistance to threats. This layer of protection includes network and host components, ensuring that the underlying architecture of the IT system remains reliable and resistant to attack. The goal is to prevent unauthorized access, compromise of communication and abuse of resources, with the application of controls that cover all levels of the infrastructure. To provide complete protection, this layer includes the following key components:

- **Network security**
  - **WAN/Perimeter Protection** – Protects the boundaries of the broadband network from external attacks, using firewalls, IDS/IPS systems and other controls.
  - **VPN protection** – Using a VPN enables secure access to internal resources from remote locations, with traffic authentication and encryption. The application of multi-factor authentication (MFA) is recommended, as is the segmentation of access according to user roles and needs.
  - **Perimeter protection** – Prevents unauthorized access to the network through entry point control and segmentation.
  - **LAN Protection** – Protects the local network from internal compromise and unauthorized devices.

- **Internal Perimeter Protection** – Segments the network to limit the spread of attacks within the organization.
- **Protection of internal traffic** - Ensures the security of communication within the network, using encryption and monitoring.

- **Host security**
  - **Host Traffic Protection** – Protects communications between individual computers or servers, preventing interception and manipulation.
  - **Secure host configuration** – Application of security configurations (hardening) to reduce vulnerabilities and remove unnecessary services.
  - **Host data protection** - Protect data on the host through antivirus, encryption and access control

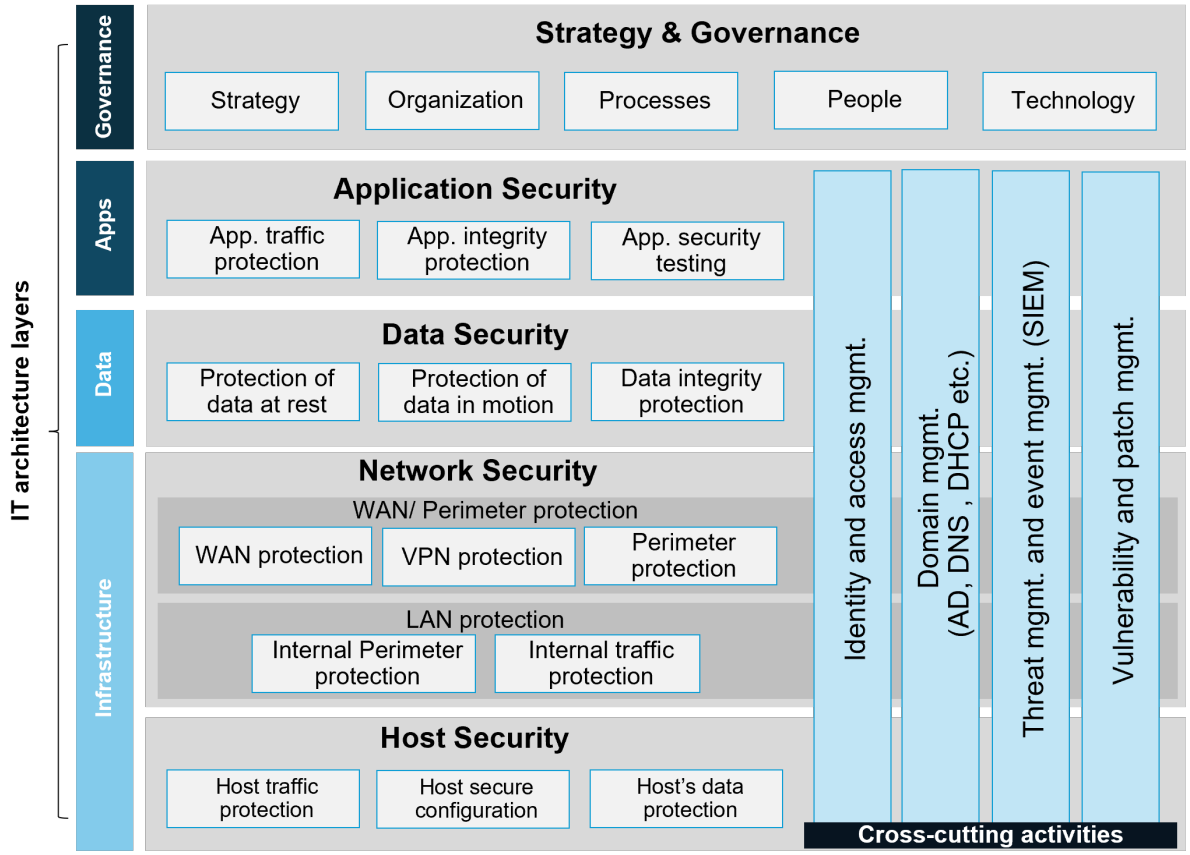
Activities that overlap across multiple areas:

Bezb unified functions must be integrated through all layers of the system - from user access, through applications, to infrastructure. Examples of such activities include the implementation of SIEM systems for centralized collection and analysis of security events, identity and access management (IAM), as well as continuous system monitoring for timely detection of anomalies and threats. These functions provide coordinated protection and enable the organization to respond to threats in real time. The key components of this layer are:

- **Identity and access management** - Management of user identities and control of access to resources, applying the principle of least privilege and multifactor authentication.
- **Domain Management (DNS)** - Ensuring the security of DNS services to prevent attacks such as DNS spoofing and traffic redirection.
- **Active Directory** - Manage users, groups and resources through Active Directory or similar directory services.

- **Threat and Event Management (SIEM)** – Centralized collection, correlation and analysis of security events for anomaly and threat detection. Identification, analysis and response to security incidents, including automated response tools.
- **Vulnerability and patch management** - Monitoring vulnerabilities and applying patches to reduce the risk of system compromise.

The following image shows a visual perspective of the IT security architecture, which enables an easier view of all layers and their interconnections within the unique concept of a safe and reliable architecture that the organization should strive for.



WAN = Wide access network, LAN = Local area network, VPN = Virtual Private Network, DMZ = Demilitarized zone, SIEM = Security Information and event management, AD = Active Directory, DNS= Domain name service, DHCP= Dynamic Host Configuration Protocol

Figure 9- IT security architecture

Compliance with the standards of the Authority for Technical Data Protection in relation to IT security:

The implementation of security measures must be harmonized with domestic legislation and standards prescribed by the Authority for Technical Data Protection (OTP), that is, the Directorate for the Protection of Secret Data of Montenegro, which is the competent authority for the protection of classified information. This compliance implies the application of clearly defined procedures for issuing, extending and withdrawing permissions to access confidential and secret data, as well as establishing a unified framework for managing those permissions.

The Directorate has a key role in classifying information, determining the level of secrecy and monitoring the application of the Law on Data Secrecy. In this context, it defines criteria for categorizing data (eg confidential, secret, top secret), taking into account potential risks to national security, economic stability and public interest. In addition, it carries out the accreditation of communication and information systems that process secret data, supervising the implementation of security solutions and controls by state authorities and service providers.

The compliance system also includes continuous education of civil servants - the Directorate, in cooperation with competent institutions, regularly organizes trainings in the field of safe handling of classified information. Also, regular internal and external audits are conducted to verify compliance with regulations, OTP standards and international frameworks such as ISO 27001, NIST and NATO requirements.

At the international level, the OTP in Montenegro actively cooperates with organizations such as NATO and the European Union, exchanging best practices and jointly developing security policies. This approach not only ensures legal and technical compliance, but also strengthens the trust of citizens and international partners through the transparent management of confidential information and the resistance of state systems to security challenges.

9 Implementation plan

As part of the implementation of the Real Estate Administration's IT strategy, the implementation of a series of interconnected initiatives aimed at the modernization, consolidation and digital transformation of key cadastral records, registers and supporting IT infrastructure is planned. The plan includes the development and improvement of information systems, the strengthening of architectural and security foundations, as well as the development of organizational and personnel capacities necessary for the long-term sustainable functioning of the system.

The key initiatives that depend on the implementation of all other initiatives are:

- improvement of server infrastructure and data storage infrastructure i
- implementation and introduction of a new integral system for cadastral records.

These two key projects represent the basis of the future IT architecture and, in the planned financial budget, carry the largest part of the total load.

In parallel with the improvement of the server infrastructure and the implementation of a new integral system for cadastral records, a new layer of the system, the so-called API Gateway, with a universal data model and structure. This layer would provide the basis for the future exchange of information, both internally between different applications in the Real Estate Administration, and externally, through portals and services intended for external users.

In the event that funds are not provided for the implementation of key initiatives, it would be necessary to take a strategic turn in the modernization of the application and hardware infrastructure, in such a way that the existing applications are upgraded and the system continues to be used in the current way. In that case, a new analysis would have to be done and a new strategic orientation defined in relation to the priorities of implementing new solutions and upgrading existing applications.

However, when it comes to hardware infrastructure, this option is not recommended, considering that the existing equipment is outdated, that the Disaster Recovery (DR) center does not exist, and that the current situation is not in accordance with recommendations, professional standards and good practice.

The main objectives of the implementation of the planned initiatives are:

- Increasing the availability, reliability and quality of data for internal and external users,
- Improvement of integration and interoperability between different registers and information systems,
- Provision of scalable, stable and secure IT architecture in accordance with modern standards and valid national and European regulations
- Support for the development of digital services for citizens and the economy, including electronic services, geoportals and advanced digital channels

The implementation plan includes projects for the development and improvement of key registers and systems, including a new integral system for cadastral records, cadastre of lines, register of real estate prices, register of geographical names, credit rating system and new Geoportal of the Real Estate Administration, as well as initiatives related to digitization of business processes, system integration, modernization of infrastructure, improvement of IT architecture and strengthening of the information security framework. Each of these initiatives foresees a new system development phase, implementation and annual maintenance, in order to ensure long-term operational reliability and compliance with the strategic goals of the Administration.

The implementation of new information systems would be realized as a set of individual projects within the main program initiative, in accordance with the approach defined in the Information System Development Plan. Each project, shown in the project plan, would go through a standardized life cycle that includes the following stages:

1. Project planning,

2. Resource preparation,
3. Prototype development,
4. Prototype testing,
5. Implementation of solutions,
6. Quality control and
7. Completion and handover of the project.

The next part of the document shows a tentative project plan with a timetable for the implementation of initiatives by year, along with a presentation of their prioritization based on an assessment of the level of impact, the degree of urgency and the implementation effort index, which enables a clear overview of key activities, priorities and required capacities for the successful implementation of the proposed initiatives.

For certain initiatives, the start is planned for 2026 and 2027, considering that in that period the phase of detailed analysis and consulting activities related to defining the scope, implementation model and required resources is being carried out. The operational implementation of these initiatives will begin in the following year, after the analysis and strategic planning phase is completed.

		2026	2027	2028	2029	2030	In[6]	H	IN
1.	Maintenance and improvement of system software								
2.	Maintenance and improvement of application software								
3.1	New system for cadastral records								
3.2	Cadastre of utilities								
3.3	Real estate price register								

[6]U – Impact; H- Urgency: IN- effort index

		2026	2027	2028	2029	2030	In[6]	H	IN
3.4	A new system for creating topographic maps								
3.5	Register of Geographical Names								
3.6	New rating system								
3.7	New geoportal of the Real Estate Administration								
3.8	Unique IS UZN platform								
4.1	Improving data quality								
4.2	Development of new services for the needs of citizens e-Government portal								
4.3	Improvement of eServices for the distribution of cadastral data								
4.4	Development of services for integration of eArchive with other systems								
4.5	Implementation of dedicated GIS modules								
H1	Maintenance and improvement of HW infrastructure								
H2	Improvement of server infrastructure								
5.	Recruitment of personnel to cover missing competencies								
6.	Competence development and people management through training								
7.	Digitization of archives								

		2026	2027	2028	2029	2030	In[6]	H	IN
8.	Integration of the UZN system on JSERP								
9.	Implementation of the API Gateway platform								
10.	Establishing a Disaster Recovery Center								
11.	Centralization of the infrastructure through the main Data Center								
12.	Establishment and certification in accordance with the ISO 27001 standard								
13.	Design and implementation of IT security management processes								
14.	Establishing, revising and improving the target IT architecture								
15.	Establishing an IT Governance Committee (ITSC)								
16.	Continuous implementation of identity and access management (IAM) systems								
17.	Implementation of the Zero Trust security model								
18.	Compliance with NIS2 and national cyber regulations								
19.	Application of AI/ML projects								

Illustration 15- Framework project plan for the implementation of new initiatives

The proposed multi-year digital transformation plan is based on gradual modernization of infrastructure, improvement of key information systems, improvement of data quality, development of digital services and strengthening of cyber security. Initiatives are grouped

and phased, taking into account their business impact, urgency of implementation and estimated effort index.

The plan is structured so that in the early stages a stable technical foundation is provided, while in the later years the focus shifts to advanced digital services, integrations and the application of AI technologies.

The first phase is focused on stabilizing the existing IT environment and establishing the foundation for further modernization.

Key activities include:

- continuous maintenance and improvement of system and application software,
- improvement of hardware and server infrastructure (H1, H2),
- hiring deficient IT profiles and covering critical competencies,
- starting a training program and development of internal capacities,
- initiation of digitization of archival material,
- establishment of the IT Management Commission (ITSC) in order to formalize the decision-making process and project portfolio management,
- the beginning of the establishment of the central Data Center and the Disaster Recovery Center.

This phase is the basis for all subsequent activities. Without a stable infrastructure, qualified staff and a clear management model, the implementation of more complex digital initiatives would not be sustainable. Centralized infrastructure and DR center enable high system availability and business continuity.

In the second phase, intensive modernization of the basic business systems of the Administration begins. The focus is primarily on:

- to the development of new systems for cadastral records,

- development of land cadastre, register of real estate prices and credit rating,
- improving the geoportal and developing a unique IS UZN platform,
- implementation of the API Gateway platform in order to standardize integrations,
- system integration with the state JSERP environment,
- further digitization of the archive and improvement of data quality.

These initiatives are strongly interconnected. A single platform and API Gateway represent the basis for interoperability, while data quality directly affects the reliability of new services and registries.

The third phase is aimed at raising the level of digital services for citizens, the economy and other institutions.

The key objectives are:

- development of new e-services for the e-Government portal,
- improvement of services for the distribution of cadastral data,
- implementation of specialized GIS modules,
- development of integration services with eArchive and other state systems.

In this phase, the full business value of previous technological investments is realized. Interoperability increases the efficiency of data exchange between institutions.

The fourth phase is focused on strengthening the security and governance framework.

Activities include:

- system certification according to the ISO 27001 standard,
- implementation of the IT security management process,
- continuous implementation of the IAM system,

- introduction of the Zero Trust security unified model,
- alignment with the NIS2 directive and national cyber regulations,
- revision and improvement of the target IT architecture.

This phase ensures long-term system resilience, cyber risk mitigation and regulatory compliance, which is especially important for systems of critical state importance.

The final phase is focused on innovation and advanced technologies.

Planned activities include:

- full operational stabilization of new platforms,
- application of AI/ML projects for data analytics, process automation and decision support,
- optimization of existing services based on user behavior and business metrics.

The application of artificial intelligence is planned after data is consolidated, systems are integrated and security standards are established, thereby minimizing risks and maximizing business value.

The plan is designed with clearly defined dependencies:

- Infrastructure initiatives (H1, H2, Data center, DR center) are a prerequisite for stable operation of applications and services.
- A unique IS platform, API Gateway and, first of all, a new system for cadastral records are the basis for the development of digital services and integration with external systems.
- Data quality directly affects the success of e-services and AI projects.
- IAM and Zero Trust models are a technical prerequisite for meeting ISO 27001 and NIS2 requirements.

- AI/ML initiatives depend on previously consolidated infrastructure and standardized data.

10 Summary

The proposed development plan for the Information Technology of the Real Estate Administration is a multi-year program of modernization, consolidation and digital transformation of key applications, business processes and IT infrastructure. The goal of the strategy is to build a stable, secure and scalable information platform that will enable reliable digital services for citizens, the economy and state institutions, while at the same time improving the operational efficiency of the Administration.

The transformation is based on three key initiatives:

- improvement of the server infrastructure, including the establishment of a central Data Center and a Disaster Recovery (DR) Center,
- implementation of a new integral system for cadastral records and other business applications in accordance with the plan, with the establishment of a unique, modern and centralized application architecture, as well as a universal API layer, with parallel strengthening of information security in accordance with regulatory requirements and modern trends and
- improvement of information technology management, including the establishment of organizational bodies for the coordination and management of IT system modernization projects, as well as the strengthening of personnel capacities in order to ensure the successful implementation of planned activities.

The strategy is structured in phases. The initial phase is aimed at stabilizing the existing IT environment, strengthening the infrastructure, hiring deficient IT profiles and establishing a management framework through the formation of the IT Management Commission (ITSC) as a central body for strategic management of the IT function. ITSC ensures alignment of IT investments with the business priorities of the Real Estate Administration, transparent management of the project portfolio, more efficient decision-making, clear allocation of

responsibilities, as well as reduction of operational and organizational risks. The committee represents a mechanism that connects business management, the IT sector and financial functions in a unified management framework.

In the following phases, modernization of basic business systems, development of digital services, strengthening of cyber security and regulatory compliance are foreseen, while the final phase focuses on the application of advanced analytical and AI solutions.

The implementation of the strategy implies significant changes in the way the Administration works. Transformation of business processes, transition to digital workflows, greater degree of automation and more intensive use of centralized information systems are expected. At the same time, the strategy requires changes in the personnel structure, including the strengthening of IT capacities, employment of specialized profiles, continuous training of employees and development of internal competencies for managing complex digital platforms.

The risk analysis identified several critical factors that can affect the success of the strategy implementation. The most significant risks include:

- failure to provide budget funds within the planned deadlines, which may lead to delays in key infrastructural and application projects,
- the lack of professional staff and the outflow of existing employees, which can threaten the implementation and long-term sustainability of the system,
- outdated infrastructure and the absence of a DR center, which represents a high operational and security risk for business continuity,
- employee resistance to changes and new systems, which can slow down the adoption of digital solutions and reduce the expected benefits.

Management of the mentioned risks requires a strong management structure, phased implementation, active change management, continuous training of employees and stable financial planning.

In conclusion, the proposed IS Development Plan represents a realistic and sustainable framework for the digital transformation of the Real Estate Administration. Its successful implementation depends on the timely construction of the technical base, strengthening of personnel capacities, stable financing, as well as the establishment of a functional ITSC management model, which will ensure long-term sustainability and maximum business value of the planned investments.