Methodology of decision support systems for digital public governance

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ABSTRACT

The research argues that digital operations centers (DOC) serve as the core digital infrastructure for data-driven decision-making in public governance. Digital public governance is a multilayer concept that includes the hardware/software, the management system, and the data processing. The key issue for digital public governance is the capacity to connect all layers and exchange data across to take data-driven decisions, which are adjusted for the needs of each particular citizen in order to make public governance fully effective and efficient, i.e. smart. The concept of digital data-driven decision making in public governance has been fundamentally elaborated by Forrester, Winter and Marcuse. Tailor-made governance decisions correspond to the concept of mass customization, which derives from the Fourth Industrial Revolution theory and practice. The hypothesis suggests that DOC serve as a platform that unites core digital technologies (such as AI and data mining) and the physical infrastructure in the interest of public governance thus becoming a genuine decision support system. The omni-channel data collection and processing create the transition of reactive management patterns to predictive analytics and smart decision-making in public governance. The research leads to identification of relevant Russian experience in implementing and developing DOC in public governance at the regional level, as well as studying international experience to provide a set of recommendations for practitioners. Methodology of the research includes general scientific methods of cognition of processes and phenomena: an analytical approach, qualitative and comparative analysis, and synthesis.

POINTS FOR PRACTITIONERS

We are referring to our empirical research of the market for AI solutions designed for public governance. Our conclusions will help AI tech providers to better understand the requirements of public governance and offer needed thought-through systems to local and regional governments. The governments may also learn the diversity and scope of functionality designs of AI-related DOC that we see in the public governance.

Key words: public governance, AI, decision-support systems, digital operation centers.

INTRODUCTION

Ubiquitous digital transformation is an integral part of modern life. First of all, it implies that traditional management and decision-making mechanisms are becoming obsolete and are being replaced by new ones: based on the large-scale use of digital services and technologies. In such conditions, data becomes highly valuable. Governments and corporations around the world are reshaping management mechanisms to work with data i.e. becoming data-driven. As the researchers state, the ability to collect, analyze and share information today has great potential to transform and even reinvigorate the governance [1].

According to the World Economic Forum Report [2], around 2.5 quintillion bytes of data are created every single day. On the one hand, the use of modern technologies and management mechanisms simplifies traditional processes, and on the other, due to the openness of most processes, raises the problem of security and protection of personal data. The problem of “data exhaust” is one of the most important challenges of digital public governance [3]. Accordingly, the effectiveness of modern public governance largely depends on the ability to collect, analyze, filter and process data for an objective assessment of the situation and making appropriate management decisions. To this end, the majority of public authorities introduce the so-called decision-making support systems (DMSS).

Practice shows a high variability of DMSS (from advanced information and analytical systems to dashboards with predictive analytics modules). Originally, such systems developed in the form of security operations center as a means of responding to incidents (extraordinary events) and a means of ensuring security [4,5]. However, at present, they have been transformed into systems that can objectively assess the situation and form recommendations for making management decisions, as well as to model the development of certain areas through predictive analytics mechanisms and technologies. The most comprehensive form of such systems is Digital Operations Centers (DOC).

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The paper focuses on the most effective and impactful cases of implementing DOCs in digital public governance in order to form recommendations for practitioners in this sphere.

The hypothesis of the study suggests that DOC will evolve in two phases. The first phase: DOC as interface between digital infrastructure and offline decision-making systems. The second phase: DOC virtualize decision-making in public governance and develop as online public administrations.

METHODOLOGY

Our research in founded on three theoretical concepts that enforce the practical level of public governance: evolutionary theory (Winter), systems dynamics (J.Forrester) and cities landscapes (German socio-architect school, Marcuse). We synthesize our current concept of high-tech public governance and evidence-based decision-making systems. Subsequently we induce the core principles into existing governance systems to derive the spheres of future improvement.

The research focuses on studying the Russian and international practice of implementing DOC as a key functional element that combines the infrastructure of digital public governance, as well as forming recommendations for practitioners on the development and application of a strategy for using such big data and AI-based technologies in conjunction with the objectives of digital transformation of public governance.

THEORETICAL BACKGROUND

Different concepts

In many countries, public governance is evolving into a "government as a platform" model. The platform focuses on the citizen in the new digital reality. The state should create conditions that will help people to discover their abilities, and create a comfortable and safe environment for their life and the realization of their potential, as well as for the creation and implementation of innovative technologies [6,7]. The target of such platform is a data-centric and process-based approach to public governance, which ensures:

- Collection, storage, processing and ordering of all necessary data;
- Determination of the rules for distinguishing access to data and data protection;
- Storage and archiving of data;
- Responsibility for data quality;
- “Seamlessness” when using any stored data;
- Transparency of the decisions (first of all, due to the maximum possible disclosure of data, the introduction of automated decision-making technologies and the maximum elimination of the human factor);
- Real-time data for decision-making, as well as reliable historical data [8].

Such digital ecosystem also ensures omnichannel interaction between the citizens, businesses and the government, using a variety of mobile devices. Provided the necessary technological infrastructure, the ecosystem expands the capacity and mechanisms for the delivery public services [9]. The crucial point is constant improvement of the system based on feedback from users regarding the level of satisfaction with the performance of their queries.

According to the majority of researchers, the key to achieving this target state is the availability of technological solutions that allow providing the main channels of interaction: G2C, G2B, G2G (or G2A, government-to-all) with the necessary data for effective and timely action. For the government, this primarily means the availability of necessary and relevant data for making decisions and predictive analytics mechanisms, modeling the consequences and the development of the situation in the future [10]. At present, the DOC concept appears to be the infrastructural and technological basis for such a model of public governance.

The topic of DOC is quite well studied by many modern researchers. It should be noted that for DOC as the main structural component of digital infrastructure, there is a variety of definitions and approaches. There is no doubt that the foundation of digital public governance is working with data and making decisions based on data.

Historically, the concept of decision support systems has evolved to respond quickly to the incidents and speed up the time to address them, as well as to monitor key parameters and indicators to prevent the occurrence of emergency situations. In this context, Security Operations Centers (SOC) were developed [11,12]. SOC laid the technological and functional basis for modern decision-support centers. Later, with the development of technology, the functionality of such centers began to be applied not only in the field of security and emergency prevention, but in other areas in order to support decision-making based on the processing of available data and predict the development of certain situations and the consequences of decision-making based on big data and artificial intelligence technologies.

Simultaneously with the SOC concept, so-called dashboards were introduced. Dashboards are interactive monitoring platforms with functions of visualizing information in a user-oriented format for further processing and decision - making.

Accordingly, there are currently two main approaches to implementing such solutions to support decision-making processes:

- Software and hardware systems that support decision-making based on data analysis, allow automating the key governance processes and ultimately lead to optimized mechanisms of interaction between the state, businesses and citizens, who, in turn, receive public services through the use of digital platforms, and the

public services themselves are characterized by individuality, timeliness and maximum compliance with the request (operational centers);

- Information and analytical systems, modified by the introduction of big data processing technologies and artificial intelligence, allowing decision makers to constantly monitor the ongoing processes, performance of key performance indicators in various areas, as well as having the functionality to support decision-making by forming recommendations based on the analysis of the current situation and forecasting its development in the future (dashboards) [13].

The presented concepts are linked by a common goal-to support decision-making. In the context of digital transformation, both options presented are the embodiment of the digital infrastructure for public governance. The core of such systems is data processing and its application in practice. The common characteristics of the described systems include:

- Data management: the decision-makers must be able to access the processed data stored on the platform. Thus, there must be applications with restricted access that offer, for example, the control opportunities and visualization, in an intuitive way so that it does not require specialized technical provision or staff;
- Real-time access: in any real-time information system, there may be a need to perform actions, triggered by the type of information handled, immediately. In the event that such action is to be performed by a human being, the best case is when the system automatically notifies them [14];
- Visualization: the data, must be presented using different methodologies. The most common way is linking the presented data with qualitative and quantitative characteristics of objects [15];
- Basic data processing: it is assumed that the data is received in the structured form and does not need further interpretation. This is typical for both human decision-making and the work of analytical systems in accordance with pre-set algorithms [16].

However, there are certain fundamental differences between the operation centers and dashboards. The end user of the dashboard is the person or agency that makes the decision, i.e., in this context, it is not intended to automate any processes, such a model is aimed solely at preparing all the necessary "base", but the final decision remains with the user [17]. Operational centers are focused more on citizens and businesses, as they involve optimization and independent system processing of incoming requests.

Definition

The mentioned examples characterize two main concepts of the decision support systems functioning in the modern world. We hold the opinion that the main infrastructure component of digital public governance is a kind of symbiosis of the above models. This does not mean the contradiction of the models, but they rather complement each other and are interdependent. In this study, the DOC concept is considered as the most comprehensive version of an intelligent decision support system based on big data analysis. It should be noted that such systems should include not only means of collecting and analyzing information, tools for forecasting and modeling development and visual presentation of results in a form that is informative for both decision-makers and citizens, but also assume automation of the processes of providing a range of services, responding to emergencies and threats based on adaptability and machine learning technologies.

So, further the DOC will be understood as a software and hardware complex (automated management system) that provides a united information space to support governance decisions in the implementation of public policy in a particular geographical area or functional sphere, expressed in the qualitative and quantitative characteristics of physical and socio-economic processes. Key sub-systems of DOCs include:

- Simulation environment: it allows to evaluate algorithms and simulate applications through predictive analytics technology, and demonstrate their operation before being implemented in a real environment;
- Incident management system: it allows the decision-makers to keep a record of incidents and notifications and display them in real time;
- Infrastructure monitoring system: it allows visualizing data in real time, determining what data is to be obtained and its form of visualization.

Architecture and key principles

According to the given definition, the DOC architecture requires the creation of a single platform that unites heterogeneous systems and allows them to interact with each other to achieve the desired and optimal results. The classic architecture of DOC includes the following main technological components:

1. *Data semantics.* Proper real-time functioning requires that the DOC environment consists of a single semantic data space. It is a complex module that includes: sensors for real-time data collection, data storage infrastructure, a knowledge base for collecting and describing formal and informal decision logic and transforming data into knowledge. An important element of this data space is the access control program, which also helps to ensure that data is collected, stored, and validated. Semantic compatibility affects the entire life cycle of information, both between individual devices and systems, and between heterogeneous systems. Semantic compatibility is defined as the ability of computer systems to exchange data with an unambiguous common sense and as a requirement for enabling machine-computable logic, inference, knowledge discovery, and data aggregation between information

systems. Standardized semantic models transform unstructured data ("information silo") into utilitarian information ready to be addressed decision-making purposes.

2. *Interdisciplinary competence.* The DOC functioning model can be presented as a process of negotiation, evaluation, and consensus decision - making, where embedded systems act as an independent group of participants and interdisciplinary experts in a particular field. Decisions are made by the participants through negotiations in the interests of all parties concerned. It requires the deployment of specialized hardware that allows different data sources to connect to distributed computing centers and exchange information among themselves.
3. *Big data analysis.* It implies huge amounts of data (both structured and unstructured) unprocessable by traditional computational database management tools or data processing applications. Big data management requires the introduction of common requirements for the characteristics of the data format, a common algorithm for data and information exchange, rules for data "ownership" and exchange protocols, the definition of data quality criteria, ensuring the security, confidentiality of data and responding to cyber threats. Big data should be processed and transformed through a knowledge base
(a repository for query response scenarios, DOC functional patterns, and procedural knowledge about public services delivery mechanisms).
4. *AI services.* Intelligent decision support systems imply the following modules based on artificial intelligence: administration module, natural language processing module, script execution module (integration of all incoming and processed data, preparation and execution of approved scripts, query generation in external and adjacent systems), learning module (system adaptability based on implicit machine learning and explicit script-based learning).
5. *Digital twin technology.* Based on the digital model, intelligent systems are able to predict and model development scenarios, monitor the actual implementation of key performance indicators, and model response strategies in the event of emergency (critical) situations.
6. *Smart services.* Each DOC sub-system can operate independently, as well as part of a larger system. It implies responding to events, modeling of decision-making, and coordination of the decisions with other systems. The implementation of this technological function is provided by four types of interfaces: G2A (government-to-all) interaction, external systems interaction interface, head system interaction interface (fixation of scenarios for further creation of implicit machine-learning patterns).
7. *Public access.* It is carried out through special personalized mobile applications that allow citizens to interact with the state through the digital infrastructure (receive services, submit appeals, participate in making decisions that affect them).

For further work and a comprehensive understanding of the structure and functioning of the DOC, it is necessary to define the basic principles of their operation (Table 1).

Table 1

№	Principle	Description
1	Complexity	Automation of tasks for maximum coverage of services.
2	Consistency	Interrelationships between the automated processes, the subprocesses and operations in dynamics.
3	Integration	Seamless integration. Getting the required data without unnecessary approvals and "manual" operations.
4	Process reengineering	Avoidance of processes and process groups automation based on outdated standards or "paper" processes.
5	Self-learning	Willingness to respond adequately to situations that stand out of scripts, and to remember a new pattern.
6	“One-window” access	All users work with a single resource that uses its integration capabilities with government information systems and the system's memory of the history of interaction with each user to minimize the collection of information within a specific request.
7	Omnichannel	Interaction with the system occurs through various communication channels, the system remembers the entire history of interaction with a particular applicant, regardless of the channel and the frequency of its change.
8	Multimodality	Interaction (Q&A) with the system is carried out using various methods of transmitting information: text messages, voice, sending document files and images.
9	Multilingualism	Interaction with the system in both software and natural languages.
10	Customer focus	The system is focused on solving the applicant's issues. The amount of information requested from the applicant should be minimal, and the citizen's requests should be anticipated.
11	Foresight	The system anticipates citizens' requests based on models of different types of applicants, their needs and the information model of the locality. The system can be the first to initiate interaction with the citizen to remind information or provide

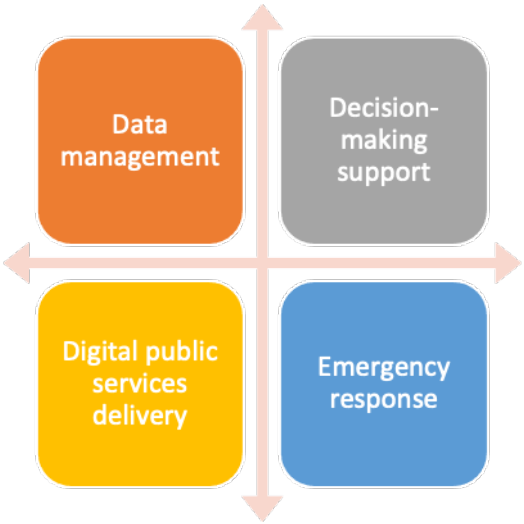
		individual services.
12	Personification	The system is developing as a "virtual personality" with its own communication style and visualization, which will make the services more open and understandable for all types of applicants.
13	Personalization	Providing citizens with personalized services designed not on the basis of averaged statistical information, but as a result of analyzing the “big data” of a particular applicant.
14	Archiving	Creating a repository of contextual information (data about applicants). The system should request a minimum of information.

Compiled by the authors

The above information describes our comprehensive understanding of the concept and principles of DOC. The rest of the article is devoted to the analysis and consideration of the best practices of the functioning of such systems in the world, summing up the results of the analysis and forming recommendations for partitioners. [18]

Practice shows that currently there are 4 main areas of DOC implementation in digital public governance (diagram 1). However, such a functional division does not mean that DOCs function only in a specific area, there are cases when they perform tasks in all four areas.

Diagram 1. DOC implementation areas.



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RESULTS

1. Global best practices

There’re three countries under close consideration as for global best practices of DOC implementation: South Korea, the United States and Estonia. These particular countries are chosen because they are ranked highest in the 2020 E-Participation Index (2020 United Nations E-Government Survey). The choice of such a criterion as E-participation is explained by the fact that DOC as a concept has the goal of increasing the satisfaction of citizens and their participation in public governance through the implementation of digital solutions [19].

1.1. South Korea

South Korea seems to be one of the most advanced and developed countries in terms of forming e-government and digital public governance infrastructure. The informatization of the state, in particular the governance bodies of this state, began in 2003. The capital city of Seoul was chosen for detailed consideration. The position of Chief Information Officer (CIO) in this city was introduced back in 1999. That official was supposed to deal with the implementation of ICT in the activities of state bodies. In 2003, for the first time in the world, Seoul set up e-Seoul Net connecting its 36 agencies via fiber-optic cables along Seoul's subway tunnels. It was a high-speed telecom network that provided citizens with audio, video, and internet services so that they can access any of the city’s smart public services anytime, anywhere including mass transit information. Since 2003, Seoul has topped the Municipal e-Governance International Survey conducted by Rutgers University and sponsored by the United Nations (2003-2009) for five consecutive times during the last 10 years Seoul has become the benchmark for many cities worldwide in terms of digital governance. Up until 2011, Seoul was the highest-ranked OECD municipality [20]. ITU (International Telecommunication Union), which is under the auspices of the United Nations, published a special report titled “Smart Cities - Seoul: a case study” in February 2013. Referring to Seoul as one of the world’s

tech-savviest cities that has retained its top ranking in the UN e-Government Survey since 2003, the report cited the characteristics of Seoul e-Government along with its diverse unique digital services for its citizens [21, 22].

In the initial stages of implementing big data and decision support mechanisms, the Seoul government has implemented 477 types of information systems in all areas of public services, including urban planning, culture, tourism, transportation, and housing. All of them worked as structural components of the Seoul Data Center, which implemented integrated control of the systems through its 973 servers, 272 pieces of telecom equipment, and 89 information protection systems.

Currently, Seoul is developing according to the smart city strategy and is recognized by many experts as one of the most successful cities in the world in this area. The particular object of consideration in our study is the Seoul Smart City Platform (SCP). The system was launched in 2017 for work efficiency and transparency of city management for the Mayor's use. The main task of such a platform is to provide digital tools for city management, in particular, rapid response to emergency situations, monitoring of socio-economic development and implementation of the KPI, and the platform also allows the mayor to organize emergency meetings with responsible persons through video calls. SCP also ensures the G2C interaction in terms of disclosure of information about the activities of the government, the provision of public services and consideration of citizens' requests. Seoul City enhances not only the work efficiency but also transparency and fairness of the City management by turning information into data and sharing that data with citizens. Users can receive a status report on the Seoul City's projects such as 'Seoullo 7017' and 'Sewoon Again Project' via the Smart City Platform [23]. Accordingly, such a platform fully complies with the DOC concept described above.

In terms of public governance bodies interaction SCP provides Stable call, voice, video and conference features that improve the quality of governance. Seoul City's main situation rooms and the SPC help allow conferences to take place regardless of time and location which improves the speed, quality and the decision-making efficiency of administrative tasks. This is indeed an innovative feature that reduces redundancy and wasted time.

The foundation of Seoul City's data is "Open Data Plaza". Open Data Plaza, one of the websites Seoul runs, releases public data to the citizens and communicates with them. This service helps Seoul improve work efficiency and transparency as well as create new services and public value with active civic engagement. It includes highly utilized public data such as traffic, culture, education and health. The private sector, public institutions, organizations and academia gathered to engage and utilize the public data. The Open Data Plaza works as a sort of communication square, allowing participation and sharing.

In terms of local governance, the SCP directly and meaningfully contributes to sustainable city and local communities. The immediate access to figures, real-time status of data, key projects and policy indicators increase the accountability of the city administration. The policy decisions take a few weeks to months in general; however, the SCP streamlines this escalation procedure, allowing its users to comprehend the process as fast as within 24 hours. With this source, Seoul citizens are able to quickly understand the relevant urban issues and disasters and deal with the problem in safe manner. This improves the trust between the municipal authorities and the citizens. Improved quality of life for citizens is closely related to having better trust in the city they are living in. This helps Seoul transform into a 'City for everyone'.

Next, it is necessary to define the structure of the platform in order to show its practical application in city management and interaction with citizens. There're 4 worth mentioning elements: analytical information, data management architecture, basic user services, public disclosure.

Analytical information is presented through main section (depicts the most relevant and actual data in visualized format), public opinion section (provides citizens with an opportunity to share opinions and communicate with relevant officials), administrative status (presents key indicators and projects), city résumé (real-time city status including environmental status, financial status, traffic situation, important announcements etc.).

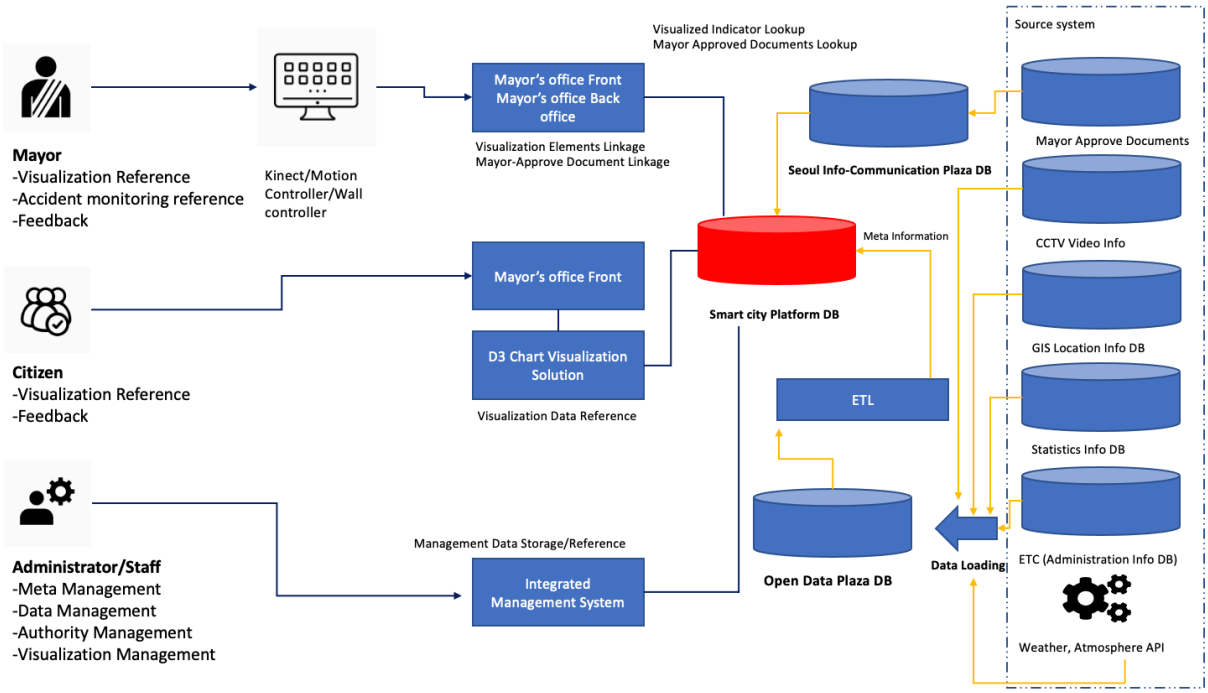
Data management architecture is based on the Open Data Plaza database. Open Data Plaza, Seoul's Public data website, first collects the raw data that is gathered by 1,200 CCTV videos as well as Seoul Online Civil Complaints, Democracy Seoul, Social media and categorizes them. The information serves as a database of the SCP. After visualization is complete, it turns into the data that the mayor, the civil servants and the citizen can use. With this process, the distributed information from single point of views and current status data that is scattered across multiple websites are linked and integrated so that anyone can check the policy and current state of the information at a glance. This big data is managed by the Big Data Division. The Big Data Division handles the data integration and its system while the City Planning Division overviews the indicator selections and navigates the opinions amongst data management divisions. Also, the General Affairs Division sets up and manages the required equipment for the operation.

Basic user services are the detailed content information that citizens would want to utilize. There're 5 basic categories of such services: "Visiting Seoul", "Enjoy Seoul", "Job Seoul", "Handsome Seoul" and "Walking City Seoul". Each category contains the information that the citizens would need in their real lives.

Public disclosure presents an opportunity for citizens to connect to the SCP via mobile applications and find out the status of current projects in the city, key indicators of the city's development, and also has the functionality of communicating with the corresponding city services on issues of interest to them.

Diagram 2 shows the complex structure of the SCP and the main lines of interaction within it.

Diagram 2. Principle Structure of SCP



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1.2. The United States

Considering the experience of the United States, it was decided to focus on New York (NYC). New York was one of the first American cities to adopt digital technologies and develop a digital transformation strategy to create a smart city. The first projects on the introduction of digital technologies in NYC date back to 2010-2013, when all the main initiatives were aimed at introducing technological solutions to solve such problems as ensuring environmental protection, effective management of urban resources, involving citizens in the process of city management, etc. All decisions were initially implemented in order to monitor and analyze data, so the New York City authorities realized the need to work with the data in time. Since then, a number of achievements have been made. In the last twelve years, New York authorities introduced the NYC 311, Mayor's Management Report, the Mayor's Office of Data Analytics, the City's first Digital Officer and Open Platforms Officer, and the most advanced municipal digital records and open data law, Local Law 11 of 2003 and 2012, respectively. Currently, New York is developing as a smart city according to the Digital NYC Roadmap [24]. There're five basic pillars of current digital development:

- Accessible Infrastructure;
- Education and Lifelong Learning;
- Industry, Employment, and Economic Mobility;
- Effective and Open Government;
- Smarter Communities.

The Mayor's Office of Data Analytics (MODA) will be considered as the practice of applying the DOC. MODA has been operating in the city since 2018. MODA is not only a software and hardware complex, but also human resources, that is, a headquarters engaged in providing data management activities. They apply strategic analytical thinking to data to help city agencies deliver services more equitably and effectively, and to increase operational transparency [25]. The core functions are:

- Collaborating with agencies to implement data-driven solutions for service delivery and resident engagement;
- Working with Department of Information Technology & Telecommunications to implement the city's Open Data Law and engage constituents;
- Convening analytics professionals across city agencies;
- Facilitating data sharing among city agencies.

The main initiatives of this agency are divided into three categories: Analytics Projects, Citywide Data Sharing and Open Data.

Analytical projects involve interaction with the authorities and providing them with support in the implementation of strategic initiatives. As a rule, it is all about the analytical support of projects by forming specialized datasets. Detailed data on analytical projects are published in open sources. Examples include the following projects:

- Pay and Demographics Report - publication of annual reports on the revenues of municipal officials by agencies, employment, and demographic situation references;
- Tenant Protection - information and analytical support for tenants by publishing verified and up-to-date data in cooperation with landlords;
- Emergency Response – support of relevant agencies by providing up-to-date strategic data for the identification, forecasting and effective use of data in order to prevent and eliminate the consequences of emergency situations;
- Program Launches - maximizing the potential effects of implemented programs by providing the necessary data. It is also about interaction with the relevant authorities and the formation of the most effective mechanisms for working with data and support to achieve the desired result.

Citywide Data Sharing is a platform that hosts about 2000 types of information in the format of data sets for use by citizens. They include both general analytical information about the state of the city and current projects, as well as private datasets on the areas where citizens most often receive public services. In addition, interdepartmental data exchange is set up through this platform, and a secure network is formed for the transfer of confidential information.

Open Data a portal of open-access data about the city, where mainly user information is published. Here citizens also have an opportunity to form dataset through special mobile applications. The portal is designed to provide up-to-date coverage of the situation in the city, as well as work with citizens in terms of consideration of their appeals and transmitting them to the relevant authorities.

In the activities of MODA in the above areas, big data processing technologies are mainly used, which corresponds to the functionality of this example of DOC. The complex principles and mechanisms of working with data in the framework of the execution of functions include the following layers:

- *Information (data management)* - organizing data into a form flexible enough to be used for a variety of purposes;
- *Understanding (decision support)* - analyzing data to increase situational awareness for decision-makers;
- *Action (operational analytics)* - applying data analysis to an operational goal that advances an agency's mission.

As the above-mentioned structure shows, DOC is not always just a set of digital and platform solutions, it can also be a team of people with certain technological equipment and knowledge, specializing in working with data within the DOC functionality. The considered example corresponds to the DOC concept presented above and shows one of the options for the operation of such a system based on data processing algorithms and interaction of government bodies to achieve the goals of public governance.

1.3. Estonia

Estonia is one of the most developed countries in the field of digital transformation. The practice of this state is distinguished by the creation of a truly digital society. Almost all public services are provided in digital form, the infrastructure for working with data was created to provide access to datasets both for state/municipal public governance agencies and citizens [26].

It should be noted that the first steps in the development and transition to digital transformation were taken back in 1996 with the adoption of the first Personal Data Protection Act (PDPA). PDPA Act extends all general principles applying to the processing of personal data and to the processing of the personal identification code (the unique number assigned to every Estonian citizen and resident). The act regulating the development of digital technologies in this state is Digital Agenda 2020 for Estonia.

The basic principles of creation an information society and developing digital technologies in Estonia according to the main strategic planning documents are the following:

- Government ministries and their agencies have direct responsibility for their ICT strategies, investments, and data-information architecture, and departmental ICT strategies are decentralized;
- A critical coordinating and guidance function in negotiating ICT investment decisions and the formulation of crucial design principles is performed in the center;
- Deliberate focus on public–private networks rather than on individual organizations. Estonia's e-government landscape consists of a number of organizations (agencies such as Information System Authority, or departments within ministries such as Department of State Information Systems) and cross-organizational networks that are sometimes formalized (such as the Estonian Defence League's Cyber Unit) [27].

The practice of implementing DOC in this state will be considered in the framework of an initiative called e-estonia. It is a set of measures for the introduction of information-communication and digital technologies in public governance and other areas of state development. Some of the latest achievements of this initiative are seamless services roadmap (proactive government services that react to life events requiring minimal bureaucracy)

and the Government AI Strategy (a detailed strategic plan for promoting implementation of AI solutions in public and private sector).

Within the framework of the DOC concept, it is necessary to note one of the current development programs - e-governance. E-Governance is a strategic choice for Estonia that aims to improve the competitiveness of the country and increase the well-being of its people. The aim is to keep the government working seamlessly 24/7. This is supported by a number of initiatives, such as Government Cloud, Data Embassy, i-Voting and E-cabinet. E-Governance consists of transparent and efficient use of ICT in state administration (e-Administration), user-friendly online public services provision (e-Services and active involvement of citizens in decision-making processes
(e-Participation) [28]. The development of the Estonian e-Governance ecosystem has been supported by strategic vision, trust of citizens and cooperation with the ICT sector.

The Government Cloud initiative involves the use of cloud technologies by public authorities for a flexible system of interaction between authorities and the provision of public services in digital form to companies and citizens. The use of new digital technologies in this initiative helps to work effectively with data, including ensuring its security and confidentiality. It is important to note that in the event of an emergency and a threat to national security such a system will allow the exploitation of all the necessary resources to implement effective public governance, regardless of location.

Data Embassy is closely connected with the previous initiative. Data Embassy ensures the normal functioning of a state in case of a cyber-attack, war or natural disasters. The government has chosen strategically important datasets that are crucial for continuity and that are regularly backed up. The Data Embassy is part of the national cloud policy – the Estonian Government Cloud. The Government Cloud supports Estonian digital independence and uninterrupted operations of public IT services. Physically, it is a data center located in Luxembourg. Data embassy is something completely new under international law. It is fully under the control of Estonia, but has the same rights as physical embassies such as immunity.

I-Voting is a system of effective involvement of citizens in public governance and decision-making. The functionality of the system is the ability of citizens to vote remotely from any device connected to the Internet, having logged in through personal documents in the system. Estonia's solution allows to vote as many times as the voters want during the pre-voting period. Since each vote cancels the last, a voter always has the option of changing his or her vote later.

E-cabinet is a system for supporting decision-making during meetings of relevant ministries and other government agencies. At its core, the system is a multi-user database and scheduler that keeps relevant information organized and updated in real time, giving ministers a clear overview of each item under discussion. Access to the system and information on each specific issue is provided in advance so that officials can review all available materials and make their decision. That way the officials' positions are known beforehand. Decisions that have no objections are adopted without debate, saving considerable time. E-Cabinet uses web-based software and audio-visual equipment, officials can take part remotely. Decisions made at the meetings can be e-mailed to interested parties or posted on a website even while the meeting is still going on.

Thus, within the framework of the e-government initiative, Estonia has created a system for managing public data, providing public services, interacting with citizens, as well as deploying the infrastructure necessary to simplify and reduce the decision-making time of the relevant authorities. It should be noted that in this State, the DOC fully functions in a digital form and includes relevant digital solutions.

2. Russian Federation

In Russian practice, the DOC concept is being successfully implemented both at the state and regional levels. DOCs exist in the form of so-called "situation centers" (SC). The creation of a unified state system began in 2013 in accordance with the decree No. 648 "On the formation of a system of distributed situation centers operating under the unified rules of interaction" of the President of the Russian Federation. [29]. The creation of such system was due to the need to create a single information space for interaction between federal and regional authorities in order to conduct and monitor a single state policy. The main tasks of SCs are:

- Informing senior governors about the situation in order to make operational management decisions;
- Monitoring, comprehensive analysis and evaluation of the development of socio-economic and socio-political processes, based on the data of the relevant authorities;
- Analytical support for decision makers;
- Monitoring of the operational situation in the field of public security and emergency situations;
- Supervising the implementation of priority projects;
- Monitoring the situation in smaller municipalities. [30]

The features of DOC concept' development in Russia are explained by the peculiarities of the state internal policy development and implementation. Despite the vast geographical area and the disparity of the socio-economic development levels of the regions, homogeneous development and constant redistribution of resources are required in order to provide complex and targeted system of public governance. Implementation of such a concept demands a so-called "strong center". This principle can be traced in the implementation of the DOC concept in Russia: the data of regional DOCs is transmitted to federal ones both for operational response and strategic planning, and vice versa,

the federal agenda is transmitted to the regions taking into account their basic development indicators and resource provision in order to implement a policy aimed at the comprehensive and gradual development of the state.

2.1 Functional characteristics

SC is a room (hall/office) equipped with means of communication (video conferencing and other means of interactive presentation of information), designed for operational governance decision-making, control and monitoring of objects of various nature, situations and other functions [31].

The main elements of its technical equipment are:

- *The shared screen.* A system for multi-screen presentation of various types of data (video images, electronic maps, graphs and diagrams, text documentation in electronic form). The modular design allows the system to be configured individually for specific rooms and tasks. The key feature of the shared screen is its information capacity, which allows to present a set of "windows" on a single screen containing full-fledged images from a variety of sources;
- *Videoconferencing tools* play a key role in the SC, providing collective meetings between remote participants in the discussion;
- *The sound system* usually includes a conference system designed for collective discussions. At the same time, each workplace of a conference participant is equipped with a separate microphone (microphone console) for speeches. The sound system also includes sound amplification (mixing) systems and acoustic systems;
- *Auxiliary equipment* is electronic means of entering and displaying graphic data, such as document cameras, interactive whiteboards, etc.
- *The control system* of SCs ensures the interaction of all elements of technical equipment. Due to the high complexity of the control system, it usually requires the constant presence of maintenance personnel.
- *Remote object management tools.* The SC functions as a “remote control" for certain objects. The decision maker is expected to have the ability to quickly adjust operational tasks in order to organize the work as to ensure the maximum quality and speed of information transmission, regardless of the location of the monitoring objects, and full mobility.

2.2 Actual agenda

The current phase of digital public governance development is characterized by the need of working with big data, its operational processing and preparation for making vital governance decisions, as well as the introduction of predictive analytics mechanisms in order to build a system for modeling development scenarios. In addition, an important task is the digital transformation of the process of providing public services in order to move to a proactive format on an initiative basis.

In this regard, there is a need to refine and develop the functionality of the SC, which was set back in 2013. Today, the idea of the SC as just a “situation room” is not relevant. Priorities today are given to goal setting, formalization of functional tasks, creation of analytical systems, formation of interconnected databases and generalized metadata (knowledge bases) [32].

There are five key tasks for modern SCs:

- solving operational issues based on multiple compression of information;
- comprehensive assessment of the current situation based on big data analysis, operational modeling of likely development scenarios, and management decision-making;
- integration into a single system to improve the quality of public administration in terms of efficiency, quality and efficiency of information analysis;
- the use of the SC system for the organization of strategic planning, control, management, monitoring, comprehensive analysis of the country's development and national security;
- multivariate analysis based on monitoring results.

In terms of adapting to the needs of citizens and delivery of public services, the initiative to create regional management centers (RGC) has been implemented in Russia since 2020. Despite the naming, they are not a separate platform, but are a module of the SC aimed at working with citizens ' appeals (receiving, processing, distributing and sending to the relevant departments, feedback). Important to note that the project of RGCs creation and implementation is a municipal-level project, since the authority to work with citizens belongs to the competence of municipalities.

2.3 Evaluation of the system at the regional level

With the aim of a comprehensive objective assessment of the currently deployed SC system in the Russian Federation, a study was conducted aimed at reviewing the practices of implementing SC in the municipal entities (ME) of the Russian Federation. The study was conducted considering all 85 ME of Russian Federation based on open data on two criteria: the regulatory framework and data management techniques and methods.

The primary results of the study show that SCs are not implemented in all ME of the Russian Federation, while RGCs are deployed. However, the RGC is just an element of a full-fledged SC, engaged in providing information and analytical support for the work of municipal authorities with citizens and businesses (first of all, prompt

processing and response to incoming requests), thereby acting as a "feedback center" functioning within the SC. Accordingly, ME that implement RGC independently, not on the basis of the SC, the system of decision-making support is limited to the "feedback" functionality.

Approximately 17% of MEs of the Russian Federation implement solely RGC. Therefore, there are no complex software and hardware complexes to support governance decisions. Their tasks are limited to dealing with appeals from citizens and businesses. In addition, RGS are being created in Russia since 2020, and the presence of only RGC in ME indicates that there were no complex governance DOCs at all until 2020.

In SC, data is loaded via integration with agencies' information and analytical systems, while the RDC is filled with data from the state portals for processing appeals of citizens and businesses. Based on the conducted research, it was determined that in 29 ME (34% of the total number), automated data uploading from information systems in machine-readable formats is carried out. This indicates a fairly high degree of automation of the work of SC locally, but on a national scale, taking into account the general level of development of information processing and analysis technologies, it indicates the inefficient implementation of technological solutions within the framework of SC operation.

The review of the SC implementation practices leads to the following conclusions:

- The regional governance level is not sufficiently provided with integrated decision support systems;
- There is a lack of unified mechanisms to support management decision-making (in most ME, only sectoral DOCs function);
- Untimely implementation of DOC in regional governance, "technological lag";
- Low degree of data management automation.

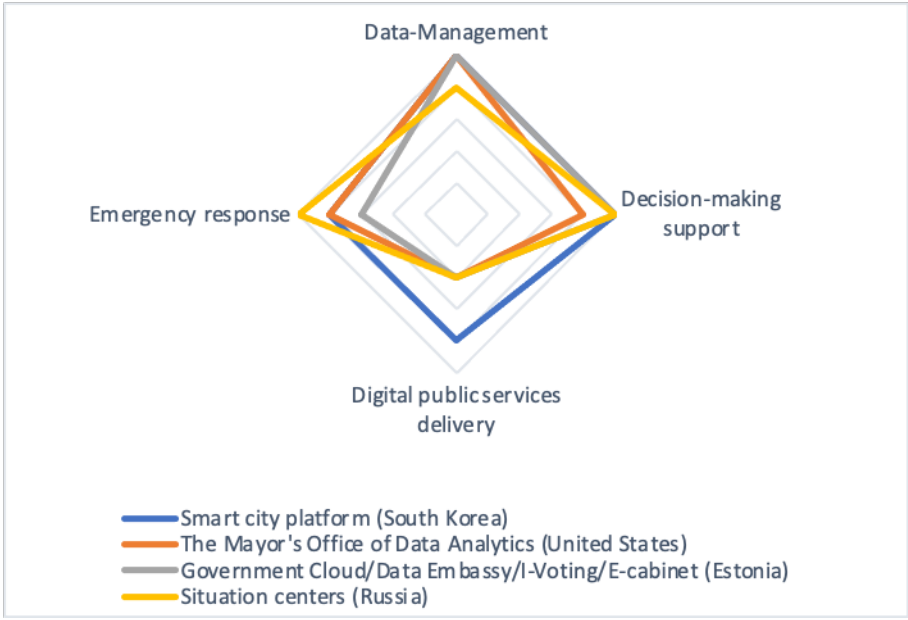
DISCUSSION

1. Comparative analysis

Considered practices of DOC implementation in the digital public governance infrastructure of various states testify to the variability of this concept both in terms of the technological structure and the main tasks that the DOC faces. There is a clear correspondence of the considered examples to the basic principles of the DOC concept, the variative part is the implementation areas (indicated in Diagram 1).

Another distinctive feature of the considered practices is their physical implementation. If in the case of South Korea and Estonia, DOC is a digital platform, then Russia and the United States differ in that DOC is more about a team of people whose public governance activity is maintained by digital technologies.

Diagram 3. DOC implementation areas in the context of the considered practices



Complied by the authors

Diagram 3 shows the main areas of DOC implementation within the framework of the considered practices. The bottom line is the active and high-quality exploitation of DOC in order to improve the efficiency of governance decisions by implementation of decision support mechanisms. There is a clear inclination to the use of data processing technologies, which indicates a high degree of awareness of the need to work with high-quality, verified

and automated data in the framework of digital public administration of the 21st century. Emergency response is clearly highlighted, due to the fact that this function is at the core of DOC concept historical development.

Digital public services delivery area is not developed enough in terms of using DOC digital infrastructure. Improvement of this area should become a priority for the development of DOC technologies in the near future. The goal should be the development of proactive delivery of public services with a seamless data collection mechanism, and the priority of this development direction should be given to the maximum satisfaction of citizens in terms of G2C interaction.

Moreover, the given practices differ in the approach of the authorities of different States to the implementation of DOC technologies in terms of digital development level. There is a clustering of states depending on those approaches. A conditional gradation can be made into the following categories (in ascending order):

- Conservative informatization;
- Active informatization;
- Digitalization;
- Digital transformation.

2. Projecting global trends in DOC evolution

The results of the conducted case studies confirm the fact that in countries with a high level of e-participation of citizens in public governance, DOC is used as a key element of the e-government infrastructure. Despite the diversity and different forms of DOC implementation, they are united by a single goal-technological support for decision-making, as well as the development of proactive sustainable G2C interaction.

There is a historical chronology that is traced in the main areas of DOC implementation, reflecting the various stages of development of this concept in accordance with the requirements for the development of the entire system of public governance. The chronology is as follows:

1. Emergency response - the basic function that was laid down in the early stages of the development of the DOC concept;
2. Decision-making support - an extension of the functionality of the previous sphere, which involves not only emergency response, but also management measures taken in so-called standard life situations;
3. Data management - assumes a transition to data-driven governance. In this case, DOC requires big data processing technologies and elements of predictive analytics for reliable and up-to-date provision of governance decisions with data, as well as modeling the consequences of decision-making;
4. Digital public services delivery - this function is seen as the least developed among the considered practices, but the existing technological base in cases where DOC has passed the previous three stages should, according to the authors, assume the development of public services delivery in a digital form.

Accordingly, the obvious direction in DOC evolution is the digitalization of public services delivery. In this area, it assumes the introduction of such concepts as seamless data collection, predictive analytics of citizens' needs, the introduction of intelligent recommendation systems that help citizens navigate the mass of available services and participate in making decisions that affect them specifically. At this stage of development, the variety of DOC forms is not applicable. Obviously, the DOC should act not only as a team of people or a room equipped with information and telecommunications equipment. Interaction with citizens require simple and understandable tools (for example, portals), which will be directly linked to modules aimed at supporting governance decision-making. The key goal of the development in this direction is the proactive provision of public services, that is, a situation in which the state does not respond to the request, but acts as the initiator of the process of providing public services based on the analysis of both typical life situations and possible needs of citizens.

It is important to note that the given chronology of DOC evolution is not a unified pattern for the development of all DOCs. In theory, it is assumed that the DOC follows this chronology in its development, but it is necessary to take into account the peculiarities of public governance in each specific case, as well as the goals and objectives that are set for the DOC. In a number of cases, DOC can successfully function and be applied while remaining at the initial stages and without involving further development, that is, it can remain just an infrastructure component of public governance. However, the theoretical concept analyzed by the authors still assumes the development of DOC as the mechanisms of public governance develop.

CONCLUSION

As a result of the research, an understanding of the DOC as a platform that combines the infrastructure of modern digital public governance was formed. This concept was considered both at the theoretical level and on specific examples. (DOC) will evolve in two phases: the first phase – DOC as interface between digital infrastructure and offline decision-making systems, the second phase – DOC virtualize decision-making in public governance and develop as online public administrations. is confirmed by the considered examples. As a result of the review of international practices, the forms of DOC implementation were identified and the understanding that it can be both a platform and a team of people equipped with certain ICT technologies was confirmed.

Comparative characteristics of the main areas of application of the DOC allowed us to assess and predict the possible direction of development. the main vector of development of such technologies in the near future will be

the digital provision of public services, as the basis in the form of Emergency response, Decision-making support and Data management seems to be quite developed.

As for the examples considered, there is a clear difference in the level of "digital development" and the corresponding application of the DOC. It is expressed both in the approach to DOC implementation and in the principles of its “construction” and operation. Based on this variability, the states considered were grouped into the following categories:

- *Conservative informatization* (New York, United States) – characterized by the introduction of information and communication technologies in order to react to real-time objectives, to a greater extent the work depends on a team of people;
- *Active informatization* (Russia) - in this case, a complex approach and integration of implemented solutions can be traced, but the leading role is still assigned to human labor. The strategic vision of the applied ICT technologies and the transition to digital transformation is not typical. Russia can represent a case of leapfrogging from active informatization to digital transformation directly because of heavy preparation for digital transformation in public governance system;
- *Digitalization* (Estonia) - this phase is characterized by the introduction of digital technology and their implementation in digital public administration, but there is no unified policy and complexity of the implemented solutions, i.e., sectoral nature;
- *Digital transformation* (Seoul, South Korea) - in this case, there is a comprehensive and timely introduction of digital technologies, the transition to a platform approach, decision support and timely digital development.

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