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Crisis Management in Socio-Economic Systems in the Context of Digitalization Using the Example of a "Smart City"

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ABSTRACT

The purpose of this study is to analyze the processes of transformation of crisis management in socio-economic systems in the context of digitalization and to develop, using the example of a "Smart City", an approach to the formation of a crisis management system using modern digital technologies and embedding in this system a controlling module responsible for information and analytical support of decision-making processes. **The research methodology** uses a systematic, complex and logical analysis of the ongoing processes of digitalization, as well as a theoretical and methodological apparatus for developing a crisis management system in socio-economic systems in the context of digitalization using the example of a "Smart City". **The results of the study include the following**: an approach to the transformation of crisis management in socio-economic systems in the context of digitalization has been developed using the example of a "Smart City"; the main requirements and provisions for the formation of a crisis management system in the conditions of digitalization have been formulated; based on the analysis, comprehensive proposals for the formation of a crisis management system using the example of a "Smart City" have been formulated with a built-in controlling module.

Keywords: crisis management transformation; crisis situation; digitalization; socio-economic system; Smart City; controlling

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INTRODUCTION

The unprecedented speed of development of digital technologies and platform solutions has led to the transformation of the structure of traditional economy and social life, modifying the existing methods of managing the sustainability of socio-economic systems. The need for digitalisation of all spheres of life of society and economic entities, along with the formation of new approaches to the design and implementation of the strategy of security and development of socio-economic systems due to the emerged geopolitical factors, require a rapid transition to domestic information technologies [1].

The significant growth of various crisis situations that are harmful to the life and health of people, the environment, enterprises and affect the security of the state as a whole predetermines the need to ensure sustainable development of existing socio-economic systems at the state level. The introduction of promising digital trends and technologies should contribute to the creation of fundamentally new products and services.

In the authors' opinion, the key task of managing the sustainable development of socio-economic systems should be the safety of all objects included in them. And in the conditions of increasing number of crisis (including emergency) situations and taking into account the scale of their consequences, it is necessary to activate all existing opportunities for their monitoring and prevention, as well as for protection against the emergence of risks [1]. In addition, there is a need to promptly inform the population, enterprises, and public institutions about actions in crisis situations. The analysis of the events of 2023 in Turkey and Syria, when the strongest earthquake occurred, demonstrates the obvious relevance of the implementation of this task, because without it the indicators of sustainable development of any socio-economic system — from a small enterprise to an entire state — may change.

The digitalisation of business processes is intended to ensure the development and implementation of a crisis management system (hereinafter — CMS) on a fundamentally new basis. Its tasks should include the development of predicative analytics of crisis occurrence, the creation and implementation of mass personalised user information services, as well as the introduction of special management modes in socio-economic systems in the event of crises. The crisis management system will make it possible to form an effective organisational and management mechanism for the timely identification of crisis situations and risk management, and will ensure the availability of the necessary resources for this purpose. Such a system includes a set of proactive measures to assess and mitigate risks, the development of contingency plans and the introduction of early warning systems. It also includes mechanisms for rapid response, crisis communication, resource allocation and coordination among all stakeholders.

The authors suggest using the example of a "smart city" as a new paradigm of digital development of the urban environment to consider the implementation of a crisis management system for effective problem solving in the event of any crisis situations (natural, man-made, political, social, etc.). Such a system will ensure life safety and sustainability of all objects of the "smart city" in any place and at any time.

THEORETICAL FOUNDATIONS OF CRISIS MANAGEMENT IN SOCIO-ECONOMIC SYSTEMS UNDER CONDITIONS OF DIGITALISATION

Digitalisation should be considered in the narrow (as the conversion of information from analogue to digital form in order to increase its volume and speed, as well as to reproduce the signal with absolute accuracy) and broad (as the application of digital technologies in various spheres, which results in a complete digital transformation of all processes occurring in socio-economic sys-

tems) sense of the word [2]. And if a few years ago information technologies were used mainly for specific applied tasks, today they are capable of solving problems that require the application of complex algorithms as well [3]. Digitalisation is aimed at improving the quality of life of the population, and economic development acts as the main sphere for the introduction of digital tools [4].

This process covers all aspects of state and social life [5]. It is important to remember that socio-economic systems differ from other systems, first of all, because their integral part is the activity of people [6], who should be provided with maximum security and comfortable existence.

In recent years, there have been many studies that analyse both positive and negative consequences of digitalisation [7]. One of the works states that it currently acts as an anti-crisis tool, which began to lead to its widespread implementation [8]. It is logical to assume that all elements of the socio-economic system will use digital tools and take into account the results of digital transformation. For example, organisations are developing new business models, revising value creation processes, as smartphones, which are an integral part of people's daily life and activities, are becoming more and more widespread.

Today, digital platform solutions are not only tools for business. Forming ecosystems [9], they attract a huge number of users, providing them with a wide range of tools and services, and coordinate the interaction of participants through special rules, regulations, and standards.

At the state level, electronic data and information technologies are used to improve the efficiency and transparency of the work of government agencies at all levels of government to ensure more responsive management. According to Professor S. G. Kirdina-Chandler, digitalisation changes the system of interaction between citizens and the state, allowing them to interact through the provision of a set of services in real time [2]. Therefore, it is a fundamental element of competent management and development not only of the state as a whole, but also of each individual element of the socio-economic system [10].

The tasks to develop and improve the system of prevention and actions of management structures in the emergency mode, to enhance the quality and efficiency of its functioning on the basis of integrated automation of management processes were formulated in the late 80s — early 90s of the last century and are associated with the emergence of fundamentally new for that time complexes of software and hardware [11]. However, the processes of digitalisation have formed prerequisites for the design and implementation of a fundamentally new crisis management system, in which all key elements will be integrated into the digital environment with the ability to form and receive the required information in a personalised, real-time manner.

Any crisis situation in a socio-economic system disrupts its functioning [12], therefore, the crisis management system to be developed should have the following properties:

1. Readiness for any crisis situations. This implies the need to implement a set of measures to assess the probabilities of potential crises and possible consequences, to develop various scenarios of response and practical actions in crisis situations.

2. Availability of effective digital coordination and feedback with all participants of the socio-economic system.

3. Flexibility and adaptability, implying that all plans and actions formed with the help of algorithms for making and implementing management decisions in crisis management system can be adjusted in real time, depending on changes in the nature of the crisis and emerging challenges. A high level of flexibility and adaptability is achieved by implementing digital tools.

4. Availability of an expert system which, in case of a crisis situation, is capable, based on

existing digital technologies, to ensure instant processing of incoming information, make a decision and communicate information and the algorithm of subsequent actions to all objects.

5. Presence of a controlling system to provide an organisational and methodological basis for supporting all elements in the crisis management cycle through the regulation of management functions [13].

6. The possibility of personalised communication within the crisis management system, which is provided by a high level of penetration of subscriber devices; this allows for the optimal formation of the user's behaviour programme in the event of a crisis situation, taking into account his location, health status and other personal factors.

7. The ability to allocate and manage resources optimally in order to cope effectively with crises, minimise their impact on the socio-economic system and facilitate its rapid recovery.

8. The ability to utilise Internet of Things, artificial intelligence and machine learning technologies to improve the quality of predictive and reactive mechanisms. This makes it possible to collect high-quality information on the state of infrastructure, provide monitoring and forecasting of crisis situations, and prepare analytical data for further in-depth analysis of the situation.

METHODOLOGY OF DEVELOPMENT OF CRISIS MANAGEMENT SYSTEM IN SOCIO-ECONOMIC SYSTEMS

The development and implementation of crisis management systems in the context of digitalisation has been the subject of active research by a number of Russian scholars. Most of them agree that the role of crisis management system becomes especially relevant at the present stage, because, on the one hand, there is an increase in emergency situations and growing geopolitical instability, and on the other hand, the ever-increasing capabilities of information technologies have formed an objective need and technological base for the creation of standardised digital models for managing people, enterprises, regions, industries, and the state as a whole.

A number of authors note that in the case of crisis situations it is not enough to use conventional tools due to the limited time for decision-making [14]; there is also a lack of competences to solve problems under stress and various medical and psychological factors [15]. Thus, the introduction of special management regimes is required [16, 17], the development of which in crisis situations should be carried out in advance, with the definition of rights and responsibilities of all participants of socio-economic systems [18–20]. And it is precisely with public funding, since it is difficult to attract the required huge resources to such projects due to the unobviousness of the potential financial effects of investments [21].

That is, digitalisation has created prerequisites and necessitated the development of a scientific basis for the practical implementation of an information platform for the management of various complex socio-economic systems. At the same time, the obtained practical experience should be extended to the elimination of all crisis situations, which will lead to the creation of a platform capable of ensuring the implementation of the entire set of legal, administrative, economic and information regulation measures that are activated in case of emergencies of natural and/or man-made nature [22]. In fact, we are talking about a public service of crisis management.

The basis for the implementation of such a platform should be the proposed concept of the system of individualised subscriber behaviour management, which was developed by Russian scientists [23–25] (*Fig. 1*).

The presented block diagram is created within the framework of the system of individualised subscriber behaviour management and subscriber information (mainly for real-time control) for monitoring and preventing the de-

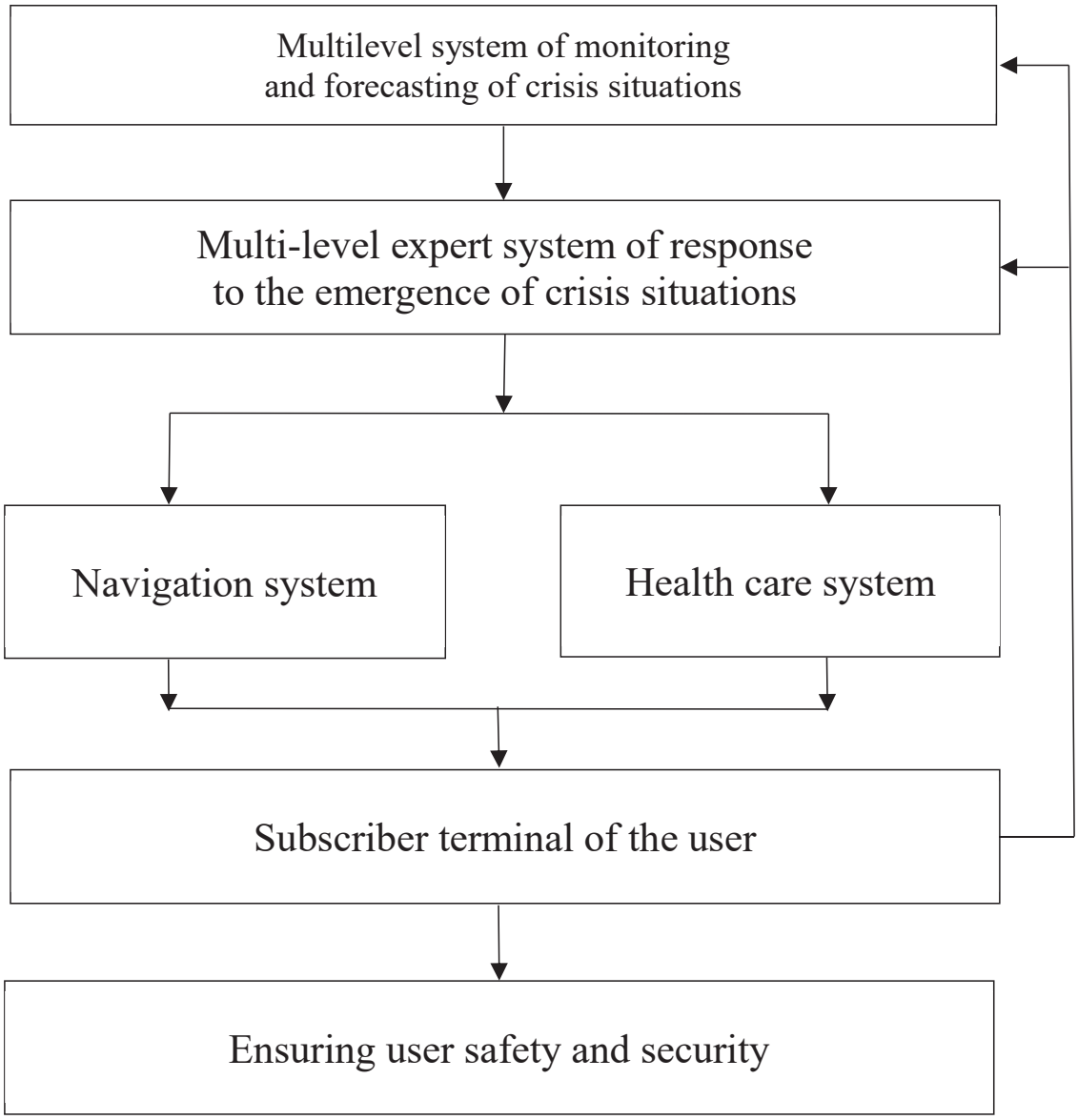

Fig 1. **Block diagram of the organization of an individualized management system of subscriber behavior in a crisis situation**

Source: compiled by the authors.

velopment of dangerous situations. In addition, it can be used in times of crises to monitor the status of resources that need to be activated when special administrative and legal regimes are introduced.

To form a crisis management system, it is necessary to:

1. To use general principles of construction similar to the system of individualised management of subscriber's behaviour.

2. To create and justify systems of approaches, principles, methods, and techniques for short-term, medium-term, and long-term forecasts of the onset of crisis situations.

3. To define a list of indicators and signals derived from the data of continuous monitoring of economic, social, and legal life of the society. This should take place in correlation with the indicators of digital socio-economic and legal models of predicted crisis situations, created by

interdisciplinary teams. Thus, it will be possible to manage the socio-economic system (state, region, city, industry, enterprise, people) within the timeframes defined by this model.

4. To combine interdisciplinary models of multilevel expert systems with the system of individualised subscriber behaviour management. Such integration on the basis of a single digital platform will allow the newly formed crisis management system to implement a mass information personalised service in case of crisis situations and to track not only the state of the natural and man-made environment, but also other parameters within the framework of special control modes.

EXPLORING THE PROSPECTS FOR DEVELOPING A CRISIS MANAGEMENT SYSTEM USING THE EXAMPLE OF A "SMART CITY"

The main technological, socio-economic, and environmental changes that have occurred in recent years have caused the revision of approaches to the management of the city as one of the most complex socio-economic systems. Today, the most important project of urban environment development, which covers all areas of its functioning and improvement, is the concept of "smart city". Within its framework, based on the achievements of advanced info-communication technologies and digital transformation, the efficiency of all processes of functioning of urban services and infrastructure is increased. At the same time, the diverse needs of present and future generations are fully met [28, 29].

Another advantage of the "smart city" is an integrated approach to the formation of an accessible, comfortable, and safe urban environment based on the digitalisation of urban resource management and the system of analysis of urban space transformation with feedback from the residents of the territorial unit [29]. This will improve the living standards of the population and the quality of urban services, economic development, and competitiveness of the city, as well as create a safe environment for citizens and the functioning of businesses.

Thus, the "smart city" concept is a systematic approach to the use of information technology based on data analytics to provide services that promote sustainable economic development and high standards of living [30] (*Fig. 2*).

"Smart economy" implies the development and introduction of innovative products and new, more efficient methods in the production process, as well as the implementation of innovative approaches in the field of marketing, strategies for promoting digital economy services and the introduction of new methods for managing the structural divisions of companies.

"Smart governance" is aimed at the development of services of state, regional and municipal services, implementation of proactive city security model, "smart healthcare", healthy lifestyle, "smart systems" of housing and communal services and digitalisation of social protection.

"Smart Finance" focuses on the development of the city's investment portal and the implementation of open budget principles.

"Smart Infrastructure" involves the development of unmanned and electric motor transport, creation of smart car parks, high-speed trains, introduction of digital payment for services, and development of areas for pedestrians and cyclists.

"Smart environment" includes development of energy saving projects for office and industrial buildings, use of renewable energy sources and waste recycling, minimisation of harmful emissions into water and atmosphere, planning of friendly urban space incorporated into the natural landscape.

"Smart residents" will be covered by adaptive education, based on the use of specialised software, and allowing to change the complexity and content of courses depending on the degree of preparation and development of students' skills directly in the learning process. This in-

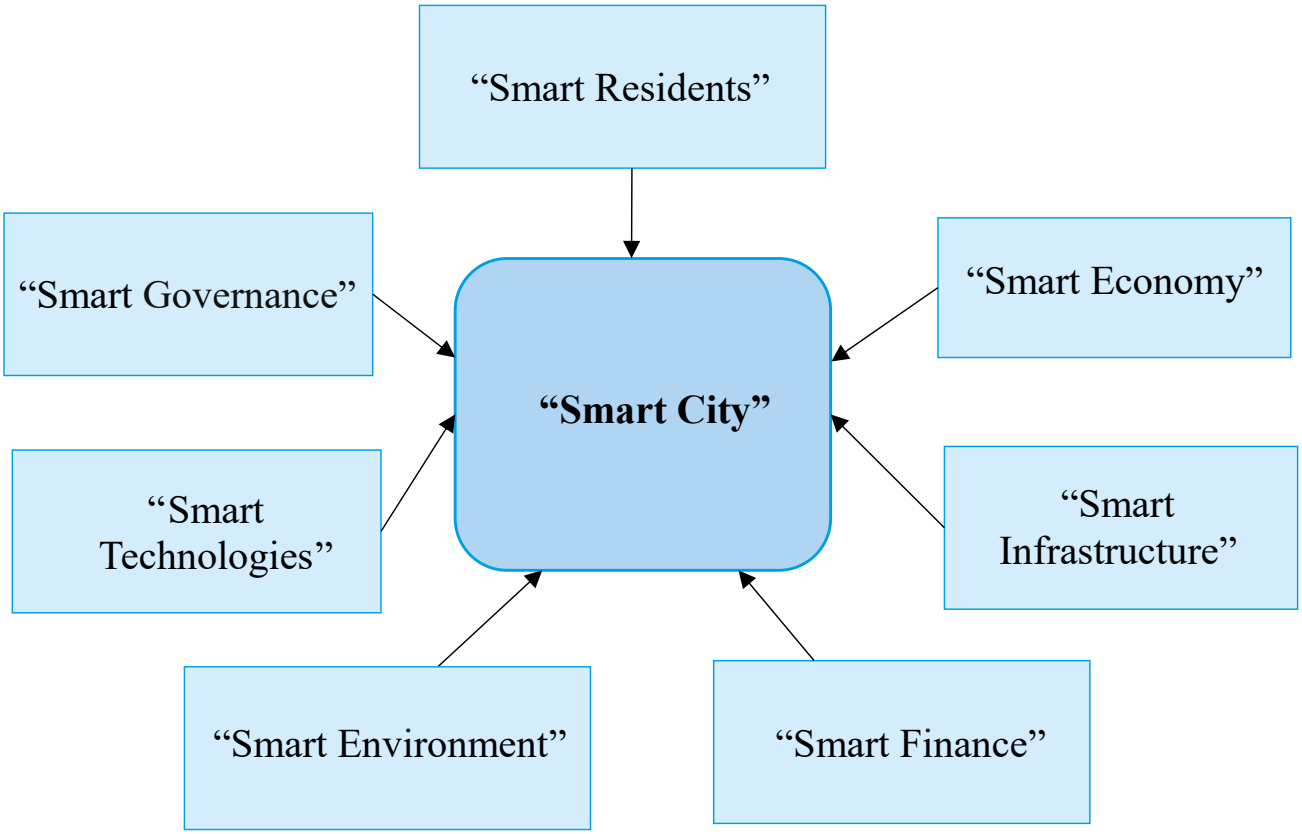

Fig 2. **The main “Smart City” projects**

Source: compiled by the authors based on data from the Report on the results of the research work “Indicators of smart cities NIITS 2017”. URL: https://www.tadviser.ru/images/8/8b/SmartCities_%D 0%9D% D 0% 98%D 0%98%D 0%A2%D 0%A1_2017.pdf

cludes the use of neurotechnologies and virtual and augmented reality technologies; training in skills for future professions; and cooperation between municipalities, scientific and public organisations.

“Smart technologies” are aimed at developing the entire range of technologies and maintaining digital infrastructure objects in a workable condition, as well as ensuring cyber security.

In our opinion, it is within the framework of a “smart city” that it is possible to start introducing a crisis management system, which should become a necessary addition to its concept and solve many problems.

It is expected to introduce a set of digital solutions in a number of areas, such as “smart city transport”, public safety systems, “smart housing and utilities”, communications, tourism, services, etc., but there are a number of problems.

Firstly, the lack of a unified development system and a competent management approach to the project implementation. The very concept of “smart city” in regulatory documents is very vague, there is no clear idea of what should be done, there is no algorithm of implementation and a set of services. As a result, different regions and cities perceive the project in their own way, which leads to ambiguity of the final results and assessment of the quality of its implementation. The requirements for the development of digital infrastructure are also perceived differently. To solve this problem, it is necessary to develop a unified methodology for the construction and development of a smart

city, including standardisation of requirements for digital infrastructure.

Secondly, a clear system of state management of the project at the federal, regional, and municipal levels must be formed. It is important to note that to date, the management outline does not include such necessary components as the development of a green economy, prevention of crisis situations, as well as (taking into account the development of the geopolitical situation in the world) digital solutions in the field of cyber security, anti-terrorist protection, prevention of offences, etc.

According to the authors, ensuring the sustainability of the smart city, i.e., its ability to cope with crisis situations, should be based on the construction of control contours including [31]:

Strategic, where management tools and technologies should be developed and used to coordinate the efforts of various elements of the digital economy and society as a whole to achieve the formed strategic goals of sustainable development. The crisis management system in the structure of this contour should guarantee the fulfilment of the set goals due to the built system of predicative signals and a set of anti-crisis measures.

The strategic contour is the main one in the "smart city" system, in accordance with it all other contours will be formed and applied. At the same time, the adoption of strategic goals should be based on the methodological principles of green economy and achieving sustainability of digital economy objects.

Ideological, where tools and technologies are used to form a new way of thinking about smart city management, life safety and green economy. The crisis management system is considered here as an integral part, without which it is impossible to achieve sustainability of digital economy objects and form a full-fledged solidarity information system.

Organisational, which implies the formation of an optimal structure and principles of functioning of all elements — objects of the digital economy. This contour ensures the effective organisation of employees' activities and information flows within the smart city, distribution of authority and responsibility for making managerial decisions to achieve the set strategic goals. The crisis management system in this contour is responsible for digital models and regulations of behaviour, modes of functioning of objects of the digital economy depending on the crisis situation that has arisen.

Operational, necessary for the coordination of smart city life, when in practice it is necessary to make managerial decisions and allocate resources based on the received information in real time. In fact, this contour is responsible for the implementation of all developed principles, mechanisms and regulations aimed at achieving strategic goals.

The above hierarchy of management levels makes it possible to form a unified process based on the goals and development strategy of the smart city, which ensures its more efficient functioning. However, at the onset of any crisis situation, all levels should switch to the ***anti-crisis one***. It automatically switches the management into a special mode, which ensures functioning in a crisis situation from the moment of its occurrence and detection to the end and elimination of all the resulting consequences.

Figure 3 presents the author's interpretation of crisis management system implementation in a smart city.

Such a platform should become an automated system capable of linking the Internet of Things, big data processing systems and cloud technologies in order to automate one or more functions of management of all socio-economic activities. It will help to form an objective picture of emerging situations (including crisis situations) in various spheres of urban life.

Development of controlling in the system of crisis management in a smart city

Taking into account the proposed crisis management system and the highlighted

management contours, for the optimal development of the "smart city" it is necessary to implement a comprehensive system of decision-making support in the conditions of prevention and occurrence of crisis situations. It is about comprehensive information and analytical support of decision-making processes in crisis management through the development of a system of key indicators and benchmarks [32].

Figure 4 presents the author's interpretation of controlling in the crisis management system of the "smart city". Its main task is to prevent possible crisis situations, as well as to manage them in case of their occurrence. Information support of controlling should include analysis, monitoring, modelling and risk assessment of crisis situations, as well as planning and coordination of actions, organisation of communications and information support. In addition, controlling is responsible for planning and evaluating the performance of the crisis management system and adjusting it to achieve optimal characteristics.

Priority directions of controlling development for the implementation of crisis management system can be summarised as follows:

Designing a digital platform for managing crisis situations in a smart city with the ability to use tools and algorithms for semi-automatic and automatic response to their occurrence.

Introduction of technologies of the Internet of Things, artificial intelligence and machine learning, which will raise the level of crisis management to a new level and provide processing of huge amounts of information to support managerial decision-making [32]. With their help, it is possible to form models for predicting crisis situations and personalised recommendations to subscribers in case of their occurrence.

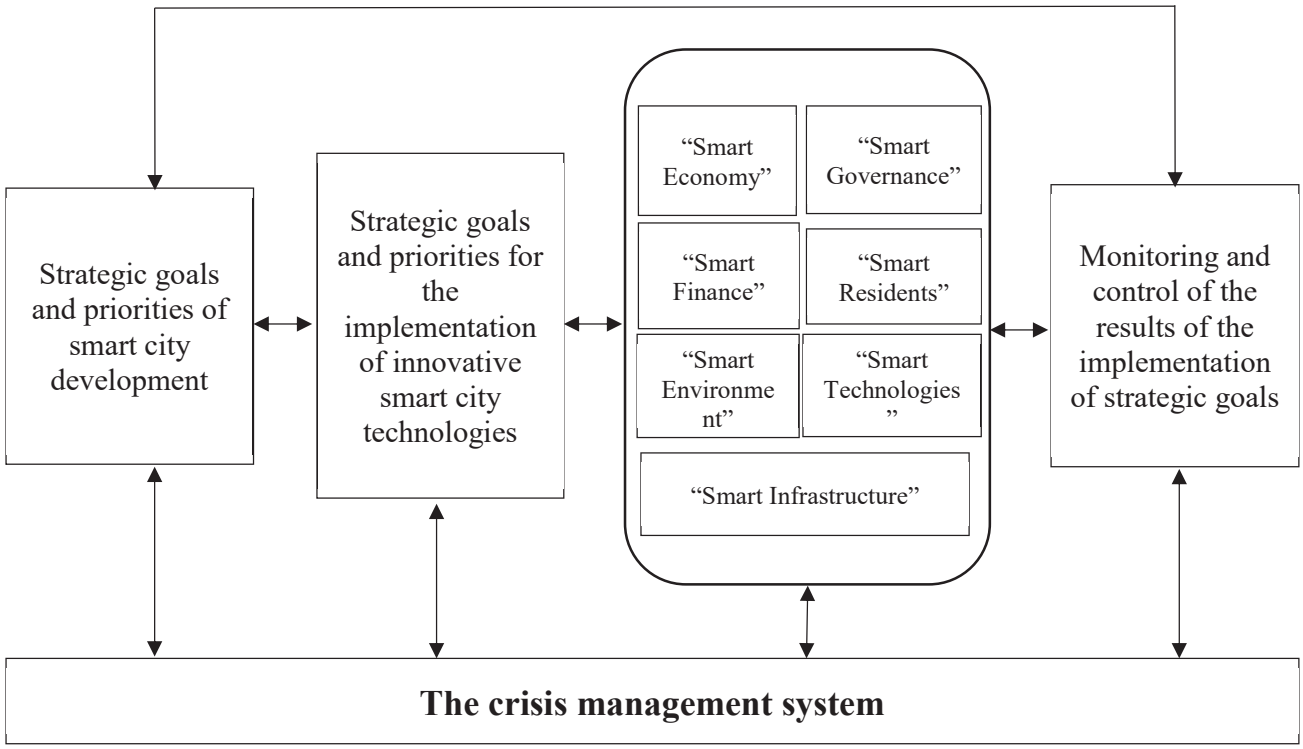

Fig 3. **The role and place of the crisis management system in a "Smart City"**

Source: compiled by the authors.

Formation of a system of key indicators and parameters in the crisis management system for making timely and effective management decisions.

Development of regulatory documents defining the procedure for interaction between all departments and users of the Smart City, as well as training of employees responsible for managing crisis situations.

It is important to note that, despite the existence of a well-developed scientific and technological basis for the concept of forming a crisis management system, for its full-fledged implementation it is necessary to assess the

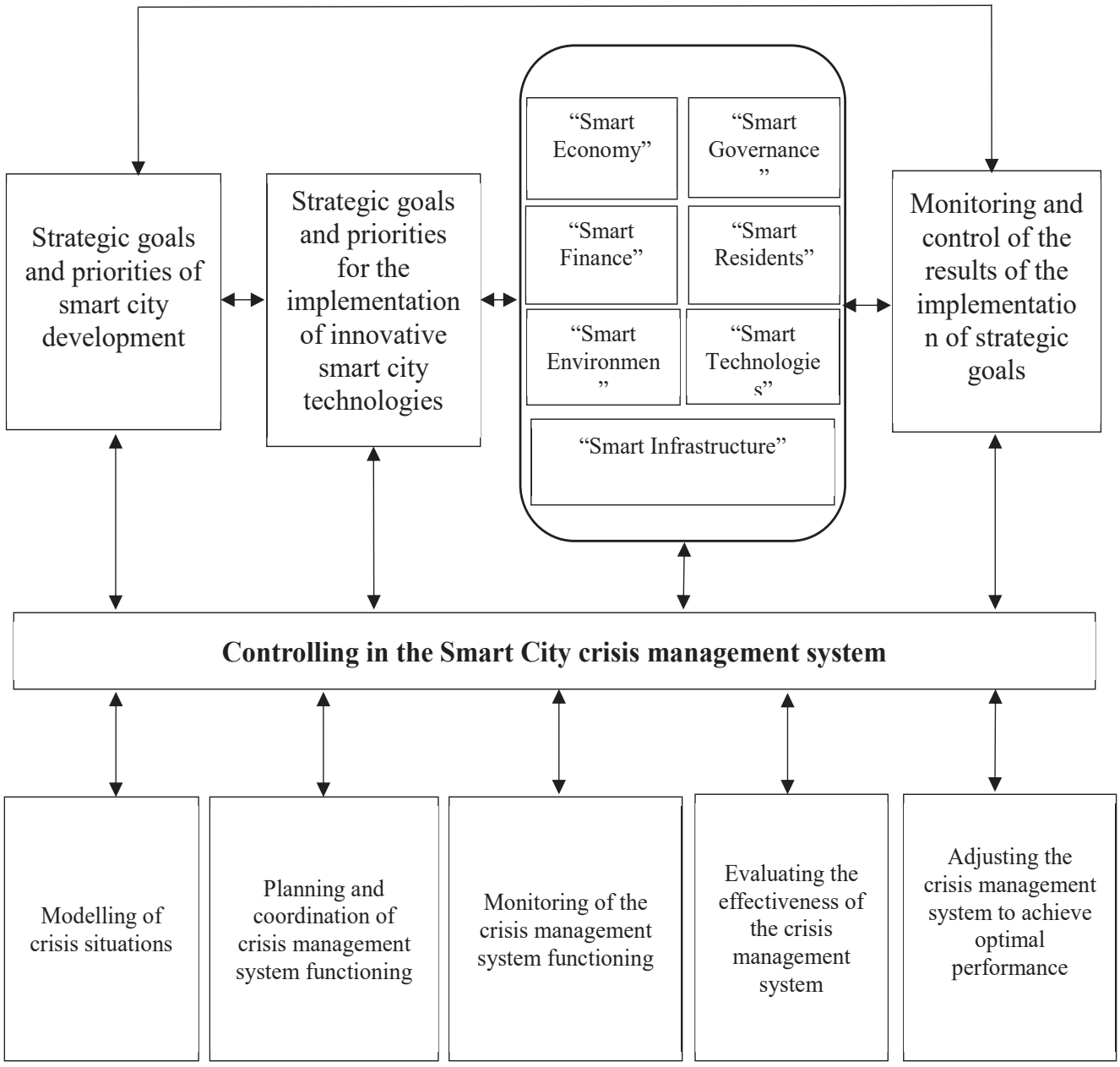

Fig 4. **Controlling in the "Smart City" crisis management system**

Source: compiled by the authors.

readiness of all participants (government and industry organisations, telecom operators, etc.) to build such an information platform and the level of technical support for users. In addition, a significant factor in the success of implementation should be human and financial resources for the implementation of this project at the federal, regional and local levels.

CONCLUSIONS

Thus, under the conditions of digitalisation of socio-economic systems and the growth of crisis situations, there is a growing need to develop and implement large-scale management solutions for the construction and effective functioning of crisis management systems in socio-economic systems at any level.

The development and implementation of crisis management system will be an important step in the development of Russia's info-communication system and an integral part of the emerging state management information system using Russian information technologies and infrastructure of telecom operators.

The creation of crisis management system in the conditions of "smart city" on the basis of the developed system of individualised subscriber behaviour management will allow to ensure a high level of sustainable development of complex socio-economic systems in the conditions of growing crisis situations. It is especially important to emphasise that such a crisis management system can be implemented taking into account existing domestic developments. This should be reflected in the implementation of projects under the national programmes "Digital Economy of the Russian Federation" and "Data Economy", as well as the Federal Law "On Protection of Population and Territories from Natural and Technogenic Emergencies" and the Programme of Fundamental Scientific Research in the Russian Federation for the long-term period of 2021–2030.

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