MODEL OF THE AUTOMATED ELECTRONIC ENVIRONMENT OF THE CONTROLLING SYSTEM FOR PUBLIC SECTOR ENTITIES

MODELO DO AMBIENTE ELETRÔNICO AUTOMATIZADO DO SISTEMA DE CONTROLE PARA ENTIDADES DO SETOR PÚBLICO

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Abstract: With the intensification of efforts to achieve the established national development goals, the search for new conceptual approaches to management in the public sector is becoming urgent. The role of information technology in management is growing, and the coverage of key functional areas of organizations by automation tools is expanding. The volume of tasks, requirements for the results of activities, and the content and quality of information used to make management decisions are rising. The introduction of a modern system of controlling as an element in the organizational structure of government agencies, public institutions, and public corporations is impossible without creating and applying an automated electronic environment that provides information support for effective decision-making. Creating such an environment is the purpose of the presented study. The research employs a wide range of applied methods of economic research: the methods of classification, groupings, general scientific methods of comparative analysis, forecasting, and modeling. As a result, a model of an automated electronic controlling system environment for public sector entities is developed, along with a step-by-step process of its implementation.

Keywords: Public administration sector. Automated electronic environment. Controlling system. SMART control (controlling).

Resumo: Com a intensificação dos esforços para atingir as metas de desenvolvimento nacional estabelecidas, a busca por novas abordagens conceituais de gestão no setor público está se tornando urgente. O papel da tecnologia da informação na gestão está crescendo, e a cobertura das principais áreas funcionais das organizações por ferramentas de automação está se expandindo. O volume de tarefas, os requisitos para os resultados das atividades e o conteúdo e a qualidade das informações usadas para tomar decisões gerenciais estão aumentando. A introdução de um sistema moderno de controle como elemento na estrutura organizacional de órgãos governamentais, instituições públicas e empresas públicas é impossível sem a criação e aplicação de um ambiente eletrônico automatizado que forneça suporte de informações para a tomada de decisões eficazes. A criação desse ambiente é o objetivo do estudo

apresentado. A pesquisa emprega uma ampla gama de métodos aplicados de pesquisa econômica: os métodos de classificação, agrupamentos, métodos científicos gerais de análise comparativa, previsão e modelagem. Como resultado, é desenvolvido um modelo de um ambiente de sistema de controle eletrônico automatizado para entidades do setor público, juntamente com um processo passo a passo de sua implementação.

Palavras-chave: Setor de administração pública. Ambiente eletrônico automatizado. Sistema de controle. Controle SMART (controladoria).

1. Introduction

A controlling system refers to information and analytical support for managerial decision-making and assumes automated collection and processing of the necessary information and data. In this regard, there arise questions on the need to create an automated electronic controlling environment that would fulfill the functions assigned to it.

At present, as part of the digital transformation of public administration, federal executive authorities are creating automated information systems that accumulate information flows of business processes concerning the competence of these bodies. For instance, under the digitalization process, the Accounts Chamber of the Russian Federation has developed a plan for the creation of an ecosystem. The Ministry of Finance of the Russian Federation is working to create a Unified Digital Information Platform to integrate information, messages, and data, including those in the course of interaction with regional divisions. Furthermore, the Ministry of Finance of the Russian Federation and the Federal Treasury are introducing SMART control (controlling), which is used in public finance accounting for management accounting. Under a departmental act, by 2027, it is planned to create a unified electronic system for generating accounting and reporting data on public finance based on the State Integrated Information System "Electronic Budget" by consolidating accounting information on public finances of the budgets within Russia's budgetary system. In addition, it is planned to develop a unified electronic data generation and analysis system environment for automated controlling, analysis, and accounting of state finance for state (municipal) bodies and budgetary organizations to improve the efficiency and quality of administrative decisions (Government of the Russian Federation, 2014). In this case, the users of the SMART controlling system are the bodies of internal state (municipal) financial control, units (subjects) of internal financial audit, and the objects of control. The implementation of such systems aims at improving the efficiency of public sector entities and reducing the financial cost of the decision-making process. A similar

goal is pursued by the development and application of automated electronic controlling system environments (hereinafter – AECSE).

2.   Literature Review

In the course of the study, scientific publications devoted to the study of the development of an automated environment in the public administration sector were reviewed.

The need to expand the capabilities of electronic resources to meet the challenges of transparency in public administration is noted by Cerrillo-i-Martínez (2011). The presence of a direct correlation between the quality management of information resources and critical success factors in both the public and private sectors of the economy is pointed out by Ward and Mitchell (2004). Research by Kuziemski and Misuraca (2020) confirms the need to introduce automated decision-making systems in the public sector, emphasizing society's growing expectation to see governments play a predominant role in the digital society.

Panagiotopoulos, Protogerou, and Caloghirou (2022), studying the issues of strategic management in public organizations, note that the structures already existing in the public sector mainly focus either on exogenous sources of dynamism or on the critical role of public executives in advancing strategic initiatives, without exploring internal processes of organizational change. The authors emphasize the need to expand the presence of information and communications technologies (ICT) in the public sector, translating the strategic management approach popular in private firms to public sector organizations.

The challenges of the digital transformation of obsolete systems in the public sector are indicated by Irani and co-authors (2023). The researchers argue that of key importance is the issue of compatibility and integrability of autonomous systems, which, as part of larger systems, perform their own unique tasks.

Tan, Mahula, and Crompvoets (2021) look into the possibilities of using blockchain technology to make management decisions in the public sector. The authors propose a conceptual framework for management structured around nine types of management decisions (infrastructure architecture, application architecture, interoperability, decision-making mechanism, incentive mechanism, consensus mechanism, management organization, management accountability, and management control) for three levels of analysis (micro, meso, and macro levels). The authors suggest that this architecture provides a framework for

researchers and practitioners to develop blockchain-based information systems in the public sector.

The review of scientific literature indicates that most of the works are devoted to information-analytical support of management decisions. However, the issues of automation of controlling systems in the public domain are not covered sufficiently, which defines the relevance of this study.

3.   Methods

When building a model of an automated electronic controlling system environment for public sector entities, we proceeded from the assumption that it should be aimed at coordinating the operation and optimizing the information flows of the public sector entity. Given that controlling is a system of information support for management decision-making, the volume, analysis, and quality of generated information flows are of particular importance. In this case, the amount of information depends on the type of public sector entity and the set of automated business processes (procurement, personnel, accounting, etc.). The quality of information must meet the purpose of controlling and provide data that are optimal in volume and sufficient for decision-making. Analysis of information flows is performed by an automated electronic environment, which combines not only the hardware and data array but also the software, environment users, and public sector entity employees – the users of software products that act as a source of information for the controlling environment, as well as staff that maintains the information controlling systems.

In the course of the study, we analyzed the requirements for the content of information in an AECSE, as outlined in the works of Gusynina (2011) and Lisitsin (2019). Complementing the existing research, including accounting for the specifics of the public administration sector, an original approach to the content of AECSE information is proposed and a basic flowchart of information support for decision-making is generated (Figure 1).
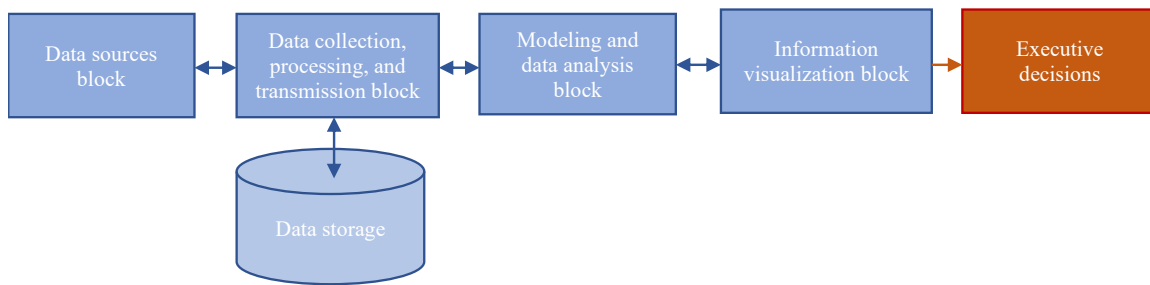
Figure 1. Basic flowchart of information support for decision-making

Source: compiled by the authors

Among the main requirements for the content of information in an automated electronic controlling environment are the following:

—objectivity and completeness, allowing for a comprehensive analysis of the management object, taking into account internal and external relationships and factors;

—measurability, availability for analysis, and comparability, which ensure constant and continuous monitoring of the management object through the analysis of changes;

—efficiency and proactivity, contributing to timely management decisions and adjusting the activities of the management subject;

—targeting and structure, which allow for hierarchical decision-making;

cost-effectiveness, which implies that the cost of preparing the information should not exceed the benefits of its use.

4. Results

The above-presented flowchart (Figure 1) identifies the following integral basic components of an AECSE: input data and information, technical and software tools, and human resources.

The first component is data and information, which are used and processed by technical means and software to satisfy management information needs. As opposed to information, data are raw numbers, values, and facts that are fed into the information system and processed in it according to a prescribed algorithm. Consequently, information is the result of processing, interpretation, and systematization of data in the form of definable patterns, cause-effect relationships between previously made managerial decisions and business processes, as

well as recommendations for new managerial decisions. In this sense, any information entered into the AECSE is data for it.

The second component is the technical means of collecting, processing, and storing data (personal computers, server equipment, software, information security, communication channels, etc.) that make up the information infrastructure.

The third component is a person, and this refers not only to the manager who makes decisions, but also to the employees who form the input data by working in specialized software products, specialists who maintain hardware and software products for the AECSE, information security specialists, and the controller, who develops the concept of the process and monitors its implementation. In addition, there are contractor organizations that provide services for the delivery and setup of the software, information security, etc.

From the point of the processes to be implemented, the recommended AESSC model is one of the varieties of data collection and analysis systems. Consequently, such a system will cover the processes of data collection, processing, and transmission, as well as modeling possible management decisions.

The considered AECSE is nominally divided into the functional zone (incoming information about the tasks and functions implemented by the organization), the informatization zone (application of appropriate software), and the controlling zone (in which the concept and requirements for the AECSE will be created, adjusted, and developed, including under the influence of feedback from other zones), and the controlling zone (general methodological direction of the AECSE). In this line, the component structure of the AECSE model can be presented as a three-dimensional cube (Figure 2).
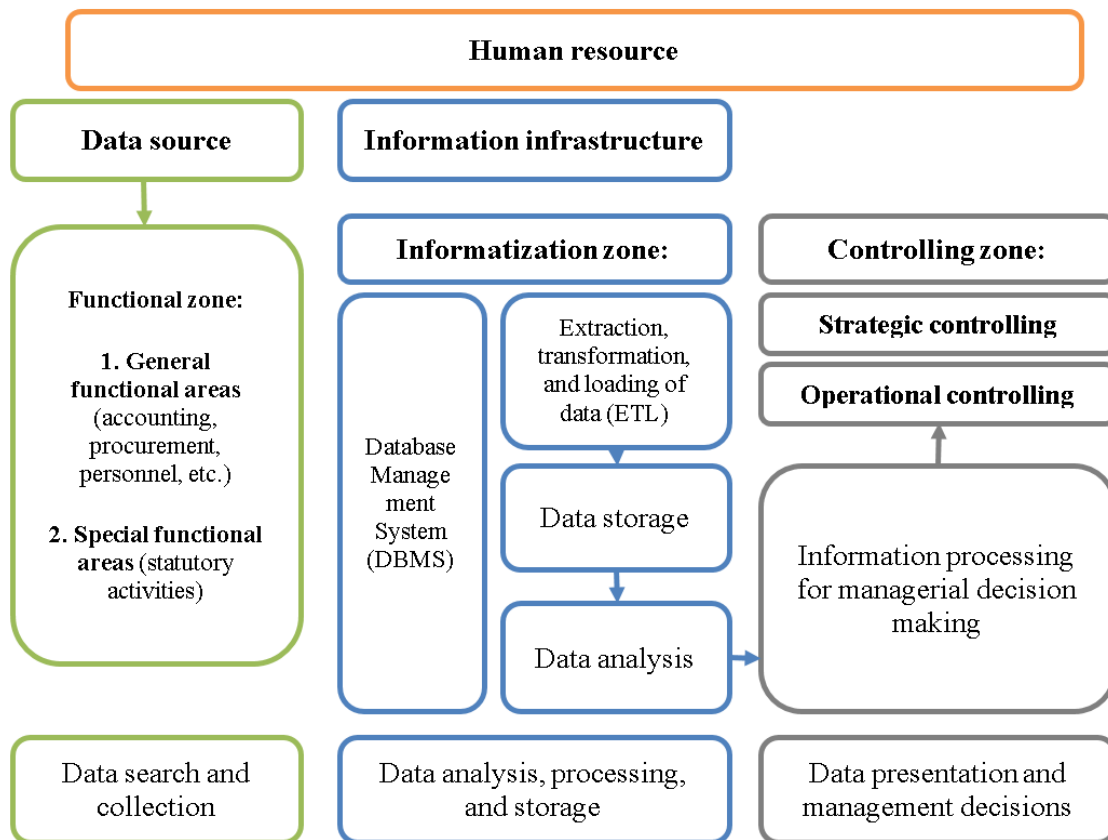
Figure 2. Components of the model of an automated controlling system environment for public sector entities

Source: compiled by the authors

The model components are interconnected with each other. Any data processing begins with data search and collection. Information and data represent the input point of the AECSE model. A distinction is made between external and internal information depending on the origin of the input.

External information is that falling outside the organization's field of activity and therefore subject to search and/or integration into the AECSE (official correspondence, information about the activities of subordinate organizations (if it is not in the information field of the parent organization), information and legal systems, news sources, mass media and online publications that reflect information about the activities of the public sector entity, the unified federal information registry, the state integrated information system of public finance management "Electronic Budget". Among external sources of information, particular attention should be paid to media resources, owing to the development of digitalization of society,

information wars, and the spread of independent rankings and evaluations of the work of public sector entities.

Internal information is produced by information systems of the organization, such as internal document management, internal regulations and contracts, and data on the specific area of activity of the public sector entity. Examples are software products used for accounting (1C or Parus), personnel support (Unified information system "Public Service" ["Gossluzhba"]), contract support (Unified information system in the sphere of procurement), and planning and financial support ("Parus" software product, the state integrated information system "Electronic Budget", etc.). Internal data sources require no additional effort to find and integrate them into the controlling environment and will be internal data sources for the AECSE.

The information flows are then processed, transmitted, stored, and analyzed. This is accomplished using specialized software.

Data processing is performed in two stages: primary processing and data analysis. Primary processing involves the conversion of raw data for use by other modules, validation of the data and its compliance with the specified criteria, and classification of data into specified groups (functional areas). Next, the data that has undergone primary processing are transferred for storage and further analysis in the database management system (DBMS).

The development of the software part of the automated electronic controlling system environment for public sector entities should be based on the GovTech platform, created to ensure the information security of the state. In October 2020, the Government of the Russian Federation adopted a resolution on conducting an experiment on the creation, translation, and development of state information systems and their components on the unified digital platform of the Russian Federation "GovTech" ["GosTekh"]. The platform constitutes "an ecosystem for the creation, development, and operation of government information systems, which includes a unified software and hardware environment and methodology that supports the relationship between citizens, government agencies, and commercial organizations based on modern information technology to improve the availability of public services and functions, and is aimed at reducing the costs of participants to use public services" (Government of the Russian Federation, 2020). It appears reasonable to create the AECSE for public sector entities based on this digital platform.

At the second stage, the information after primary processing is analyzed using built-in algorithms and various methods of mathematical, statistical, and economic analysis. The outcome of the second stage is information that satisfies the specific needs and requirements of

users. At this stage, modeling and forecasting of possible outcomes of events and proactive analysis can be applied using BI-system (Business Intelligence) and the capabilities of artificial intelligence, which receive data from disparate sources, analyze them, and simulate variants of the outcome of events according to predefined trends.

The information required for the output can be very diverse and depends on the specific needs of the management of the public sector entity in each particular case. It should be noted that the information formed in the AECSE is used to form (offer) management decisions for all functional areas of the organization.

The model proposed in this paper accounts for the particularities associated with information security. As a rule, information protection involves the protection of information transmission channels, inaccessibility of storage databases for information attacks, and compliance with recommendations to eliminate threats to information security. In this regard, the relevant services and tools of information protection are integral elements of the AECSE. Information flows to be protected are marked separately in the model diagram.

The concluding stage is the visual presentation of information. At this stage, the information obtained earlier is visualized in the required formats, cross-sections of information, and forms of visualization and presentation, tailored to the needs of the manager. In essence, this block is a showcase for the information contained in the AECSE.

In addition to the step-by-step movement of data in the AECSE, there are feedback loops. So, in particular, based on the output analytical information on the activity of the management subject, measures of influence are implemented with regard to the functional areas, controlling tasks are created (adjusted), and decisions influencing the AECSE are made. In conjunction with this, the volatility of the organization's sphere of operation sets tasks for the controller to adjust and refine the AECSE to respond to these factors.

To achieve these goals, software in the controlling system is designed to perform the following tasks:

- integrating and storing information from other information systems undergoing automation;

- processing information and presenting it in a relevant form;

- alerting on negative facts;

- providing relevant data for management decisions;

- building strategic maps for the development of public sector organizations.

Here we should note that analytical capacities are now well-developed in most information systems. However, the expansion of their proactive capabilities deserves special attention. We believe that the AECSE has to not just aggregate and analyze information, but build forecasts and trends for the future using this information. These are the features that will create the value of the automated electronic controlling system environment and define the efficiency of the software products used.

The final component of the AECSE is human resources. In our view, the human resource of the AECSE is represented by the head of the public sector organization, the controller (controlling service), the IT service, and the information security service. In this case, each subject of the AECSE performs their own tasks in the system. In this way, the tasks of the head of the public sector entity are to set the purpose of operation and measures to influence the AECSE, define tasks for the controller, and make decisions. The objectives of the controller (controlling service) can be the concept of creation and operation of the AECSE; requirements for the list and composition of information and its visualization; monitoring of the AECSE and its adjustment in accordance with changes within and outside the organization; interaction with the IT service for task setting, consulting, assistance in operation; development of the AECSE. IT services must provide for and maintain the AECSE; administer workstations, servers, and network equipment; create software for the AECSE (including through outsourcing services); interact with the controlling service to set tasks, provide consultations, and assist in operation; participate in AECSE development activities. In turn, the information security service must ensure the protection of personal data and the information security of workstations, servers, and network equipment.

Summarizing the above, the AECSE model can be represented as a complex of data, human resources, and information infrastructure that provides automatic processes of data collection, processing, storage, analysis, and presentation to prepare management information and model management decisions. On the whole, the proposed model is universal for state agencies, public institutions, and state corporations. However, it can be tailored to each subject of the public sector by adapting internal and external information flows. For this purpose, above all, it is necessary to clarify the list of normative legal acts regulating the activity of the subject, and special functional support should be provided in the data sources. For instance, in the case of state corporations, the model may include information on the areas of their activities: goals and objectives, the performance of work/provision of services according to the development

strategy of the state corporation, international cooperation, innovative activities, investment activities, social responsibility.

The development of an algorithm for building the presented model of the automated electronic controlling system environment for public sector entities should boil down to the formation of a core (center) that accumulates information flows from various software and other sources of information about the activities of the organization. In this case, the algorithm of formation of the AECSE itself can be divided into several stages (Figure 3).
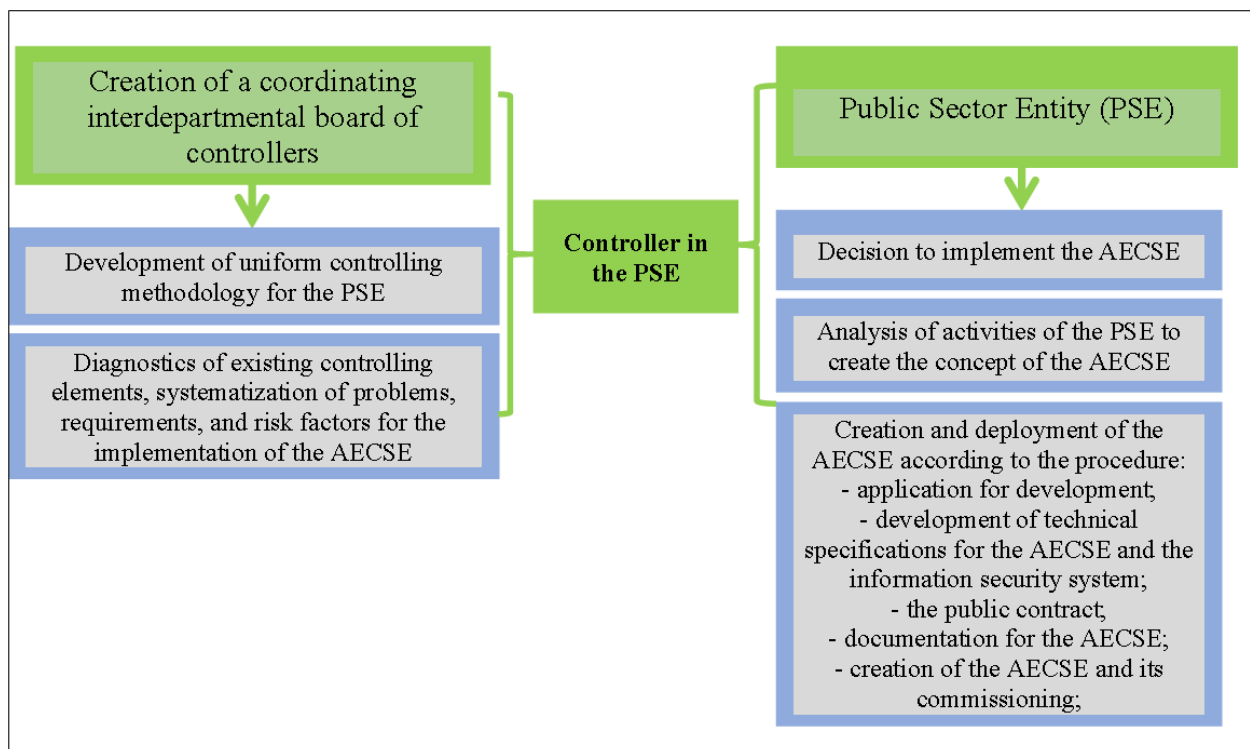
Figure 3. Algorithm of AECSE model generation

Source: compiled by the authors.

A key step is the creation of a coordinating interagency board of controllers, whose responsibilities will include, among other things, the development of a unified basic methodology of controlling focused on the operation of the AECSE in the public sector entities that have decided to implement it, thus taking into account the characteristics of all public sector entities that implement the AECSE.

5. Discussion

The need for automation has been conceptualized in studies on management accounting as a prerequisite for preventing problems in control (Emmanuel et al., 1990). Elaborating on this statement, Brown et al. (2020), using the example of a service organization, explain how automation and related management control are designed and used to achieve organizational goals. The authors emphasize the need to standardize processes related to automation by incorporating control attributes (recovery, flexibility, internal transparency) to increase user flexibility. The requirement for flexibility in software to control and manage innovation in the public sector is emphasized by Cao et al. (2023). These provisions are addressed in our proposed model of an automated electronic controlling system environment (AECSE), which is typical and can be used by various public sector entities with adaptation to the peculiarities of their activities.

Mikalef et al. (2023), analyzing the potential of digital transformation in public organizations, prove the impact of information technology development on the key performance indicators of the organization. The role of information technology in improving the quality and efficiency of public administration is stressed by Aydin, Tarhan, and Tecim (2015). Exploring the extent of improvement in efficiency under the established performance criteria with the use of information technology in public institutions, the authors find that the use of IT can reduce the cost of services and expenses of the organization by at least 25%. The attainment of key performance indicators and improvement of public administration efficiency are the main objectives of the controlling system in the public sector, the model of an automated electronic environment which is outlined in this publication.

Our research findings on the need for information security correlate with the findings of Warkentin and Orgeron (2020), who focus on information security issues. The authors examine the impact of blockchain technology on public sector processes through the lens of information security and propose using the CIA Confidentiality-Intelligence-Accessibility (CIA) triad model for security, governance, and regulation. The appropriate information protection services and tools are part of our recommended AECSE model. The flows of information to be protected are marked in the model diagram (Figure 2).

Hoai, Hung, and Nguyen (2022), drawing on new public administration theory and innovation systems theory, explore the relationship between internal control systems (ICS) and organizational efficiency. The authors hypothesize the effect of automation of ICS on the

efficiency of a government organization. The AECSE model proposed in this paper is aimed at informing the controlling system in the public sector, which will help improve the efficiency of all organizations in the field of public administration.

Mikalef et al. (2023) point out the possibilities of harnessing the potential of digital transformation for government organizations through AI. We advance this thesis by proposing the use of AI in analyzing information flows, modeling possible event outcomes, and conducting proactive analysis.

The review of scientific publications proves the need for the development of automated information processing processes to make quality management decisions in the public sphere.

6. Conclusion

Prerequisites for the formation of an automated electronic controlling system environment for public sector entities are the comprehensive digitalization of the budgetary process carried out by the Government of the Russian Federation, the continuing practice of control procedures without the use of ICT, large labor costs of employees for collecting, processing, analyzing, and verifying information, the continuing risk of incorrect information processing due to human factors, the lack of a comprehensive approach to information analysis, the growing number of operations carried out by the objects of information systems, and the constant need for reliable and up-to-date information.

The development of the model of an automated electronic controlling system environment for public sector subjects requires the systematization of a large array of information and data accumulated under the activities of government agencies, public institutions, and public corporations. In this connection, the automated electronic environment should be formed under unified regulations, but taking into consideration the specifics of each subject of the public sector. Thus the considered environment will allow bringing the public sector entity to a new qualitative level for an efficient comprehensive systematic process of management decision-making with the use of new technologies and modern methods.

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