



Decision support system for identifying priority projects for the development of medical facilities in the hospital district

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Abstract. The relevance of the study is to solve the scientific and applied problem of creating tools for identifying priority projects for the development of medical institutions in a hospital district. The purpose of the article was to substantiate the system-value approach and develop a decision support system based on it to identify priority projects for the creation and development of medical institutions. The methods of system-value analysis, multifactorial evaluation of medical projects, and computer modelling were used in the study. The analysis of scientific papers has shown that the development of a decision support system for priority projects of medical institutions in a hospital district is an important task that requires a system-value approach for integrated management. The expediency and features of the system-value approach, which allows to comprehensively identify priority projects for the development of medical institutions in the hospital district, are substantiated. The developed algorithm for the management process of identifying priority projects for the creation and development of healthcare facilities in the region was based on the proposed systemic value approach and involves 12 steps. It allows project managers to speed up the process of selecting priority healthcare projects. Based on the proposed value-based approach and algorithm, a decision support system was developed. The architecture of this decision support system includes a client-side (Frontend). It was developed using HTML and CSS for marking up and styling the page, as well as JavaScript for dynamically adding medical projects to the list, processing events, and sending requests to the server. The system uses jQuery for easy manipulation of DOM elements and Chart.js for graphing and visualising the results of identifying priority projects for the creation and development of medical facilities in the region. The use of the proposed decision support system for a given project environment ensured the identification of priority projects for the creation and development of medical institutions in the region. The practical value of the study lies in the implementation of a decision support system that allows project managers

Suggested Citation:

Malanchuk, O., Tryhuba, A., & Rudynets, M. (2024). Decision support system for identifying priority projects for the development of medical facilities in the hospital district. *Economic Forum*, 14(3), 21-34. doi: 10.62763/ef/3.2024.21.



to identify priority projects for the creation and development of healthcare facilities, which increases the efficiency of management decisions and optimises the use of resources in the healthcare sector

Keywords: higher education institutions; panel data; econometric modelling; fixed and variable effects; pooled regression; employment

Introduction

The relevance of this study lies in addressing the scientific and practical challenge of creating tools to identify priority projects for developing medical institutions within a hospital district. This is essential for optimising resource utilisation and enhancing the quality of healthcare services. Researchers H.J. Smith *et al.* (2022) noted that in 2019-2024, healthcare systems in many countries face several challenges, including limited resources, ever-growing population needs, changing demographics, and frequent crises such as pandemics or military conflicts. In these conditions, healthcare facilities must effectively adapt to new requirements, ensuring high quality healthcare for the population. M. Miao *et al.* (2023) noted that one of the key aspects of the successful functioning of healthcare systems is the proper planning and implementation of management processes, including the identification of priority projects for the creation and development of healthcare facilities. However, management decision-making in such a complex and multifactorial project environment requires the use of modern technologies and methods.

In modern healthcare system, there is a need to automate management processes, especially those related to the creation and development of medical institutions in hospital districts. Medical institutions play a key role in providing quality medical care to the population. Decision-making on the establishment and development of healthcare facilities should be based on a systematic approach that takes into account various factors of the project environment. In particular, there is a need to take into account the availability and types of funding sources, the needs of the population, infrastructure capacity and the urgency of implementing healthcare projects.

G. Gristina (2022) pointed out that there is an increasing complexity of the tasks facing the healthcare system, as well as limited human and financial resources, which makes the development and implementation of decision support systems (DSS) not only appropriate, but also urgently needed. The use of DSS helps to increase the efficiency of project management, reduce the risk of wrong decisions and optimise resource allocation, which is important in the context of economic instability and a changing project environment.

An analysis of the scientific work by M. Gholamzadeh *et al.* (2023) on the development of the DSS in the healthcare sector showed that this area is actively researched and has important practical implications. At the same time, identifying priority projects for creating and developing healthcare facilities is becoming an in-

creasingly relevant topic, especially in conditions of limited resources, which requires rational planning and implementation of modern management methods.

The scientific literature discusses various approaches to using DSS in the healthcare sector. Many researchers, in particular N.S. Mosavi & M.F. Santos (2022), focused on the use of DSS to optimise resources, plan infrastructure, analyse patient needs, and improve the quality of healthcare services. A. Tryhuba *et al.* (2021) presented approaches to the use of mathematical models and computer algorithms to determine optimal strategies for the development of institutions. The research proved that the use of DSS can significantly increase the efficiency of management decisions and reduce risks during project implementation.

However, despite the large number of studies in this area, the scientific and applied task of identifying priority projects for the creation and development of medical facilities in hospital districts remains unresolved. A. Tryhuba *et al.* (2018) noted that most scientific works focus on certain aspects of project management, such as financing or planning, without taking into account a comprehensive approach to identifying priority projects. Accordingly, there is a need for further research that would cover all the basic components of health facility development, as well as take into account the value for stakeholders.

R. Arthi & S. Krishnaveni (2024) pointed out that the DSS is an effective tool for solving complex management problems in the healthcare sector. They allow to provide a comprehensive analysis of possible development scenarios, optimise resource allocation and identify the highest priority projects for implementation in a given hospital district. In the study, the authors presented a binary classification model for a robust and energy-efficient healthcare decision support system that uses fog computing to optimise performance.

Thus, the development and implementation of the DSS to identify priority projects for the creation and development of medical institutions in a hospital district is an important scientific and applied task, the solution of which will ensure the creation of tools for managing these projects.

The purpose of the article was to substantiate the system-value approach and to develop, on its basis, a DSS for identifying priority projects for the creation and development of medical institutions, and also to consider its possibilities for improving the efficiency of management decision-making in the healthcare sector.

Materials and Methods

The system-value approach to identifying priority projects for the creation and development of medical facilities in a hospital district proposed in this study is to integrate system analysis and project value assessment from the perspective of different stakeholders (Fig. 1).

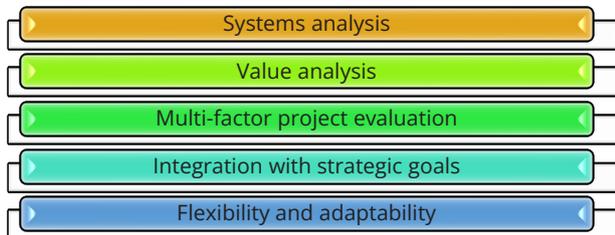


Figure 1. Main components of the system-value approach to identifying priority projects for the creation and development of medical facilities in a hospital district

Source: developed by the authors

This approach allows to assess not only the individual components of the projects, but also their impact on the healthcare system and society as a whole. The process of project identification is the key to identifying priority projects for the creation and development of healthcare facilities. In general, the process of identifying these projects can be represented by the following expression:

$$P_{in} \in (A_{st} \rightarrow I_{cc} \rightarrow F_{st} \rightarrow F_{pr}), \quad (1)$$

where P_{in} – the process of identification of projects for the creation and development of healthcare facilities in the region; A_{st} – analysis of stakeholders in projects for the creation and development of healthcare facilities in the region; I_{cc} – identification of contradictions and conflicts of interest between stakeholders in projects for the creation and development of healthcare facilities in the region; F_{st} – formulation of stakeholders' needs to change the current state of the healthcare system; F_{pr} – formation of projects for the creation and development of healthcare facilities in the region.

With regard to the use of system analysis in determining priority projects for the creation and development of medical institutions in a hospital district, it is proposed to consider the process of development of medical institutions as part of a complex health care system. This involves assessing the impact of medical projects on the overall performance of the hospital district's healthcare system according to the methodology of M. Konca & M. Top (2022). It involves analysing the relationships between projects.

To determine the key values for each stakeholder group (patients, medical staff, local authorities, investors, community), it is proposed to perform a value analysis using the methodology of Z. Zhang *et al.* (2023). It involves evaluating healthcare projects in terms of their contribution to achieving important social and

healthcare goals, such as improving access to healthcare services, improving the quality of treatment, reducing mortality, or improving disease prevention. It is also important to use criteria for prioritising projects based on a balance between costs, expected benefits and community needs.

It is proposed to evaluate each healthcare project according to several parameters, such as cost, expected implementation time, impact on public health, economic benefit and innovation. As a result of using multicriteria analysis methods, medical projects are ranked based on the set evaluation criteria for the relevant stakeholders.

It is also proposed to ensure that priority projects are adapted to changes in the external project environment, such as new legislative initiatives, changes in funding or demographic changes. The use of dynamic modelling to predict possible scenarios for the development of healthcare facilities and adjust priorities based on new data is one of the advantages of the proposed approach. The advantages of using the proposed system-value approach to identifying priority projects for the creation and development of medical facilities in the hospital district are shown in Figure 2.

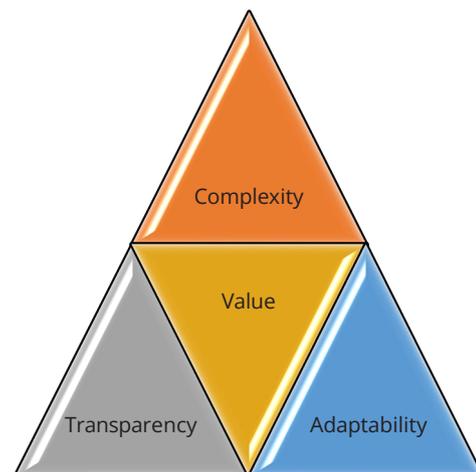


Figure 2. The main advantages of using the proposed system-value approach to identifying priority projects for the creation and development of medical facilities in a hospital district

Source: developed by the authors

The recommendations of W. Chen *et al.* (2023) regarding the use of a systematic approach that allows taking into account all the key factors that affect the effectiveness of healthcare projects and the healthcare system as a whole were taken into account. Transparency ensures clear definition of criteria and evaluation of healthcare projects, which avoids subjectivity in management decision-making. Adaptability allows for a quick response to changes in the external project environment and adjustments to the development plans of healthcare facilities. Value-based approach enables stakeholders

to receive benefits. It ensures the best use of available resources of hospital districts and ensures investment in the most valuable medical projects for society.

Thus, a systemic value-based approach to identifying priority projects for the creation and development of healthcare facilities in a hospital district makes it possible to make informed management decisions aimed at ensuring the sustainable development of the healthcare system and maximising value for stakeholders.

The formulated set of i -th projects $\{P_{ij}\}$ for the creation and development of healthcare facilities in the region requires further assessment of their value for stakeholders. Forecasting the value of these projects is carried out in the following sequence. First of all, the value of the formulated set of i -th projects $\{P_{ij}\}$ for the development of medical institutions in the region is quantified. For this purpose, computer modelling methods are used to forecast intermediate value indicators. The criteria for the value of the k -th projects for the creation and development of medical institutions in the region are the ratio of benefits (B_{sti}^{mk}) for stakeholders from the individual m -th medical systems to the costs (C_{pi}^{mk}) incurred to create these benefits:

$$V_{pi}^{mk} = \frac{B_{sti}^{mk}}{C_{pi}^{mk}}, \quad (3)$$

where V_{pi}^{mk} – value to i -th stakeholders from individual m -th healthcare systems due to implementation of k -th healthcare projects; B_{sti}^{mk} – benefits to i -th stakeholders from individual m -th healthcare systems due to implementation of k -th healthcare projects; C_{pi}^{mk} – costs incurred to create benefits from m -th healthcare systems due to implementation of k -th healthcare projects.

The basic value V_{pb}^{mk} from implementation for i -th stakeholders from individual m -th healthcare systems through the implementation of k -th healthcare projects:

$$V_{pb}^{mk} = \frac{1}{n} \sum_{i=1}^n V_{pi}^{mk}, \quad (4)$$

where V_{pb}^{mk} – is the basic value from the implementation of k -th medical projects; n – is the number of stakeholders who receive benefits; V_{pi}^{mk} – is the benefits from individual m -th medical systems due to the implementation of k -th medical projects.

The greatest basic value V_{pb}^{mk} for stakeholders from individual m -th healthcare systems through the implementation of k -th healthcare projects is provided by those projects that allow for maximum benefits $B_{sti}^{mk} \rightarrow \max$ for i -th stakeholders at the minimum cost incurred $C_{pi}^{mk} \rightarrow \min$ to create these benefits:

$$V_{pb}^{mk} = f(\{B_{sti}^{mk}\}, \{C_{pi}^{mk}\}) \rightarrow \max. \quad (5)$$

On the basis of the identified basic value V_{pb}^{mk} for stakeholders from individual t -th medical systems through the implementation of k -th medical projects, priority projects are selected for a given hospital district.

Subsequently, priority projects for the creation and development of medical institutions in the region are identified. To determine the priority k -th projects, they are ranked in descending order by their basic value V_{pb}^{mk} for stakeholders:

$$V_{pb}^{m2} \geq V_{pb}^{m4} \geq \dots \geq V_{pb}^{mk}. \quad (6)$$

This ensures the creation of a vector of priority projects for the creation and development of healthcare facilities in the territory of hospital districts. It is worth describing in mathematical terms the identification of priority k -th projects, which are then ranked in descending order of basic value V_{pb}^{mk} for stakeholders. In this case, the set of projects is known $P = \{p_1, p_2, \dots, p_n\}$, as well as the basic value V_{pb}^{mk} for different stakeholders for each of them. Then the vector of priority projects P_p can be defined as:

$$P_p = (p_{(1)}, p_{(2)}, \dots, p_{(k)}), \quad (7)$$

where $p_{(z)}$ – is a medical project with the z -th basic value in terms of quantitative value; k – is the number of priority medical projects to be implemented, units.

To form a vector of priority projects, medical projects $p_{(z)}$ are ranked by their basic value V_{pb}^{mk} in descending order. That is, for i from 1 to k . Thus, the ranking formula is as follows:

$$V_{(i)} = \max\{V_j | p_j \in P \setminus \{p_{(1)}, p_{(2)}, \dots, p_{(i-1)}\}\}, \quad (8)$$

where $V_{(i)}$ – is the medical project with the highest base value.

Once found, this project is removed from the set P_p . The procedure is repeated until the priority medical projects are identified. This allows us to form a vector of priority projects P_p , which includes the k -th number of medical projects with the highest core values for stakeholders.

To match the amount and sources of investment with the budgets of priority projects for the creation and development of healthcare facilities in the region, the k -th number of healthcare projects, the budget B_i of each i -th healthcare project (where $i \in \{1, 2, \dots, k\}$, is the amount of investment I_i for each i -th healthcare project and the amount of available investment S_i for each i -th healthcare project from all sources. The amount of investment I_i for each i -th medical project should not exceed its budget B_i :

$$I_i \leq B_i \text{ for all } i \in \{1, 2, \dots, k\}. \quad (9)$$

The amount of investment I_i for each i -th medical project should be equal to the sum of available investments S_i from all sources:

$$I_i = S_i \text{ for all } i \in \{1, 2, \dots, k\}. \quad (10)$$

If S_i it consists of several sources of investment (e.g., state budget (D_i), local budget (L_i), private investment (P_i), and other sources (O_i), then:

$$S_i = D_i + L_i + P_i + O_i \text{ for all } i \in \{1, 2, \dots, k\}. \quad (11)$$

Thus, the following system of equations (9-11) is used to match the amount of investment I_i with the budgets B_i of the i -th medical projects. These equations ensure that each i -th healthcare project receives the required amount of investment I_i that does not exceed the approved budget. At the same time, investment sources should be properly distributed B_i among priority projects.

For each of the project environment factors, the variability index is calculated using the formula:

$$k_{mi} = N_{zi} \cdot v_i \quad (12)$$

where k_{mi} – is the coefficient of variability of the project environment during a given period of medical project implementation; N_{zi} – is the number of changes in the i -th factor of the project environment during a given period of medical project implementation; v_i – is the importance of the i -th factor of the project environment for the implementation of the medical project. The total weighted number of changes in the project environment is determined by the formula:

$$W_{nc} = \frac{\sum_{i=1}^n k_{mi}}{n} \quad (13)$$

The described system-value approach to identifying priority projects for the creation and development of

medical institutions in a hospital district is the basis for creating an appropriate decision support system. The proposed approach is based on comprehensiveness, transparency, value and adaptability, which ensure the evaluation of priority projects in the hospital district.

Results and Discussion

In order to speed up and improve the quality of the management process of identifying priority projects for the creation and development of medical institutions in the region, an algorithm has been developed. It is based on the proposed system-value approach, which takes into account the peculiarities of the project environment, budgeting of projects for the creation and development of medical institutions in the region, and the value of the given benefits. On the basis of the proposed algorithm, a decision support system is proposed, which makes it possible to identify and visualise trends in the indicators of priority projects for the creation and development of medical institutions in the region.

The flowchart of the algorithm of the management process for determining priority projects for the creation and development of medical institutions in the region includes 12 steps (Fig. 3).

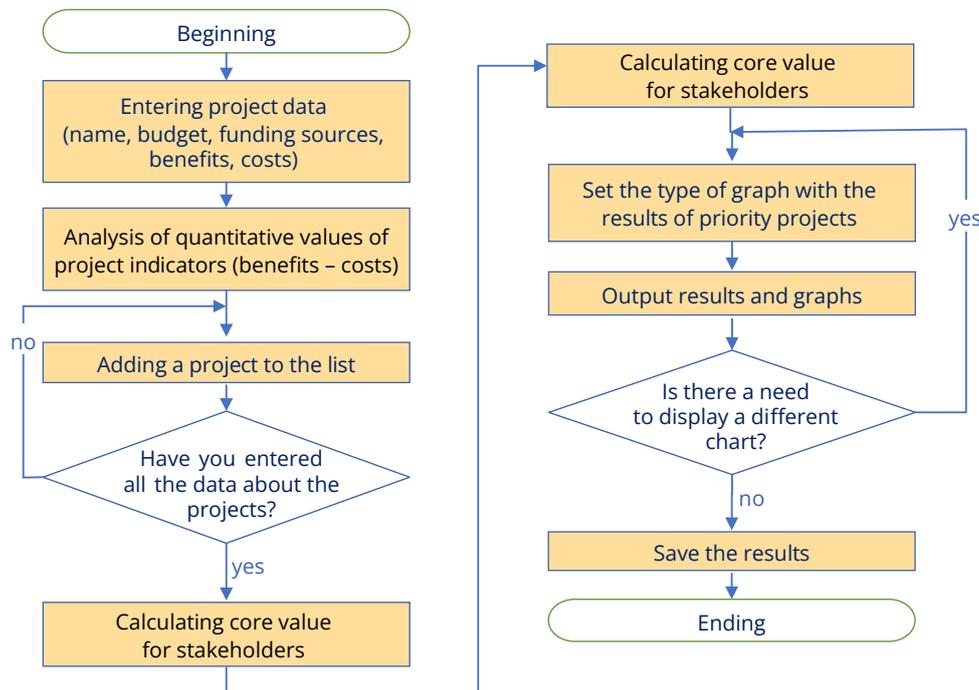


Figure 3. Flowchart of the algorithm of the management process for identifying priority projects for the creation and development of healthcare facilities in the region

Source: developed by the authors

The paper described the proposed algorithm of the decision support system for identifying priority projects for the creation and development of medical institutions in the region, which provides for:

1. Start. At the beginning of the DSS operation, the user opens the interface for entering data on projects that need to be prioritised. For this purpose, a webpage was developed that allows users to enter the necessary

information about each of the projects for the creation and development of healthcare facilities in the region.

2. Entering data on the project for the creation and development of healthcare facilities in the region. The user fills in the form provided to him/her, entering the following data about each project:

- ▣ project name – enter an identifier or name of the project that allows it to be easily recognised among others;
- ▣ project budget – the total amount of funds required for the project implementation;
- ▣ state budget – the amount of funds coming from the state budget is entered;
- ▣ city budget – the amount of funds to be received from the local budget;
- ▣ private investments – the amount of funds to be received from private investors;
- ▣ other sources – the amount of funds coming from other sources of financing;
- ▣ benefits from the project implementation – a quantitative assessment of the benefits that will be brought by the project implementation;
- ▣ costs of creating the benefits – enter the quantitative value of the costs required to achieve the benefits of the project.

3. Analysis of quantitative values of project indicators (budget – benefits – costs). After entering the project data, the system automatically analyses the values of the project indicators, which include the budget, benefits and costs of its implementation.

4. Adding a project for the creation or development of healthcare facilities in the region to the list. All analysed project values, together with other entered data, are added to the list of project characteristics. This list is saved in the PC memory for further processing and analysis.

5. Check whether the list contains all the necessary data on projects for the creation or development of healthcare facilities in the region. If some data is missing, the user is informed about this absence and should proceed to step 2. If all the data is available, proceed to step 6.

6. Calculation of the base value from the implementation of projects to create or develop healthcare facilities in the region. For this purpose, use the formulas (3-5) described in the Materials and Methods section.

7. Ranking of projects for the creation or development of healthcare facilities in the region in descending order of their basic value. This allows to identify which of the existing projects have the highest value and, accordingly, should be prioritised for funding and implementation.

8. Set the type of graph with the results of priority projects. To do this, use the drop-down menu to select the name of the desired graph to be displayed. In particular, these can be graphs with trends in the value, budget, benefits, and costs of project implementation.

9. Displaying results and graphs. The system displays the results of the analysis in the form of a list of projects for the creation or development of medical institutions in the region with the values of their indicators.

Additionally, a graph is generated that visually displays the value (budget, benefits and implementation costs) of the projects, which facilitates decision-making. The graph is created using visualisation libraries.

10. A condition is checked to see if there is a need to display another graph. If there is, the user returns to step 8 and sets the desired type of graph. If there is no need to display graphs anymore, the system proceeds to step 11.

11. Save the results. This step saves the calculations and graphs to a file for further work by project managers.

12. Termination. After the results are displayed and saved, the algorithm completes its work. The user can view the saved results and perform further analysis based on comparison with other data on the implementation of projects for the creation or development of healthcare facilities in the region.

A number of tools have been selected to develop a decision support system for identifying priority projects for the creation and development of healthcare facilities in the region, which is a web application. In particular, HTML (HyperText Markup Language) and CSS (Cascading Style Sheets), are the main technologies for creating web pages. They are used for structuring content and designing web pages. In this case, HTML is used to structure the web page. CSS is used for styling and design, including the Bootstrap 4 library for creating responsive designs.

The JavaScript programming language was used to add dynamic behaviour and interactivity to the web page. This allows executing client-side logic, interact with the user, change page content without reloading, work with data, etc. In addition, jQuery is used to simplify DOM manipulation, and Chart.js to visualise data in the form of graphs. It also used the server-side scripting language PHP (Hypertext Preprocessor) to develop the web application. PHP runs on the server and generates HTML code that is sent to the user's browser. PHP interacts with databases, manages user sessions, processes forms, and performs other server-side tasks. To create a decision support system for identifying priority projects for the creation and development of medical institutions in the region as a web application, the Replit development environment (IDE) was integrated.

As for the architecture of the decision support system for identifying priority projects for the creation and development of healthcare facilities in the region, the client part (Frontend) involves the use of HTML and CSS for marking and styling the page, JavaScript for dynamically adding projects to the list, processing events, and sending requests to the server, jQuery for more convenient manipulation of DOM elements, Chart.js for building graphs and visualising the results of the analysis. At the same time, the server side (Backend) involves the use of PHP to process POST requests from the client side, process project data, and sort them based on the calculated value. The `php://input` file is supposed to be used to receive data from the POST request and temporarily store it in the PC memory.

The user interface (UI) of the decision support system provides for users to enter data on the characteristics of projects for the creation and development of healthcare facilities in the region through a form that includes fields with their name, budget and its sources of revenue (state budget, municipal budget, private investment, other sources), benefits and costs (Fig. 4). There is a button “Add project” that allows adding project characteristics to the list of projects on the client side. Data processing is performed after clicking the “Analyse projects” button. In this case, the data on the characteristics of individual projects for the creation

and development of medical institutions in the region are sent to the server using an AJAX request. The PHP script on the server receives data on the characteristics of individual projects for the creation and development of medical institutions in the region, processes them, sorts them by the value of the specified projects, and returns the results back to the client side. On the client side, the results are displayed in the form of a list of priority projects for the creation and development of medical institutions in the region sorted by value (Fig. 5). At the same time, Chart.js is used to build a graph with priority projects.

Figure 4. The user window of the decision support system for identifying priority projects for the creation and development of healthcare facilities in the region
Source: developed by the authors

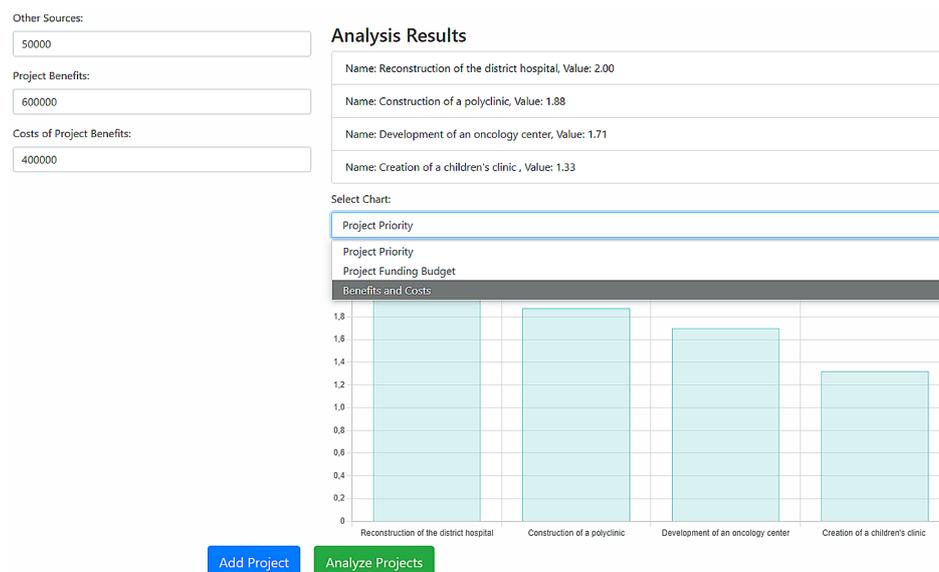


Figure 5. The user window of the decision support system for identifying priority projects for the creation and development of healthcare facilities in the region with the results of the analysis and the graph of projects sorted by value
Source: developed by the authors

The features of the decision support system for identifying priority projects for the creation and development of healthcare facilities in the region are that users can dynamically add new projects and see them in the list without reloading the page. The system automatically calculates the value of each project based on benefits and costs, sorts them and displays the results. The use of Chart.js for visual representation of priority projects helps users to better understand data and make

management decisions. At the same time, the proposed decision support system has a simple and intuitive interface that allows project managers to quickly enter data and get results.

Based on the use of the proposed decision support system, priority projects for the creation and development of medical institutions in the region were identified. Initial data for this management process are presented in Table 1.

Table 1. Initial data for identifying priority projects for the creation and development of medical institutions in the region, USD (as of 2023)

Project name	State budget	Local budget	Private investments	Other sources	Benefits from project implementation	Variability of the project environment
Reconstruction of the district hospital	200000	100000	150000	50000	1000000	0.4
Construction of a polyclinic	300000	200000	200000	100000	1500000	0.21
Development of an oncology center	250000	150000	180000	120000	1200000	0.284
Creation of a children's clinic	220000	130000	150000	100000	800000	0.321
Modernisation of the ambulance service	150000	100000	100000	50000	600000	0.297

Source: compiled by the authors

Table 1 indicates that the costs of creating benefits are equal to the project budget, while the benefits of the project refer to what stakeholders receive from each

project. In Table 1, the project budget is calculated as the sum of the state budget, local budget, private investment, and other sources of funding (Fig. 6).

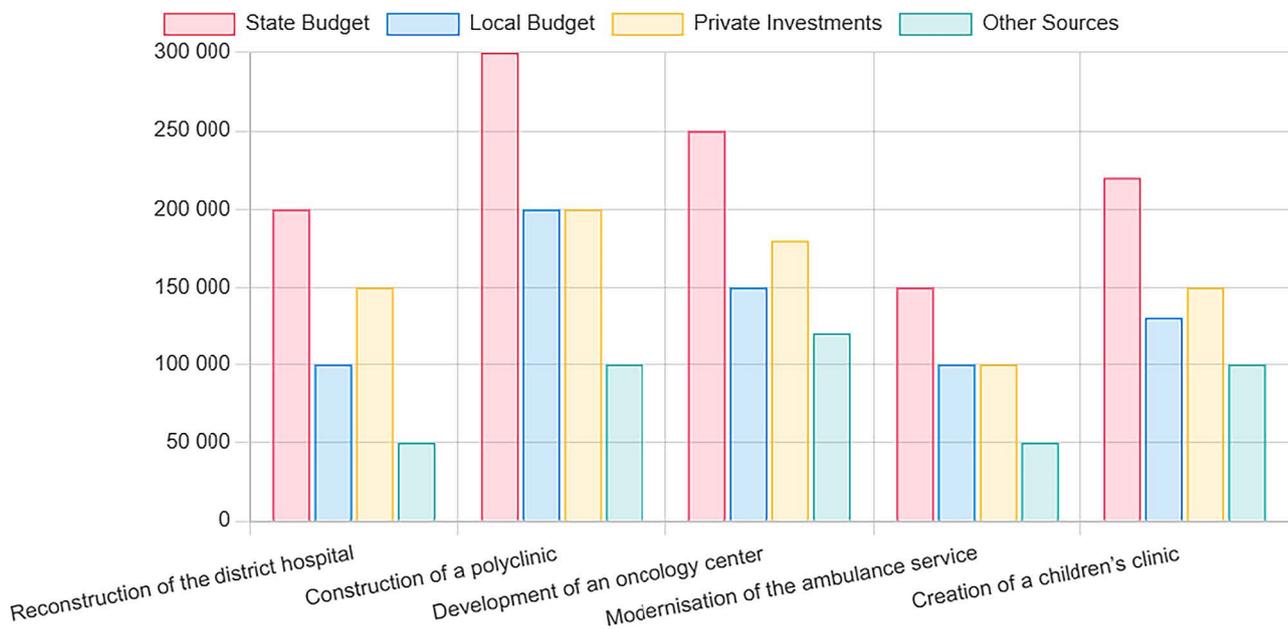


Figure 6. Budget structures of projects for the creation and development of healthcare facilities in the region, USD (as of 2023)

Source: developed by the authors

The variability of the project environment reflects the volatility of the conditions in which a healthcare project is implemented. Its quantitative value depends on

various factors, such as changes in funding, availability of resources, legal regulation or technological innovations. For example, the project environment variability for the

reconstruction of a district hospital is 0.362, which indicates a relatively high rate of change in this project, while for the construction of a polyclinic, the value is 0.21, which means a more stable project environment. The variability of the project environment is used to assess risks and adapt the project management strategy.

The variability of the project environment was determined as follows. The frequency of changes in the

main components of the project environment for individual healthcare projects during the six months of their implementation was taken into account. This included changes in funding, availability of resources, technological changes, changes in legislation, and changes in the project team. The results obtained from the example of the district hospital reconstruction project are presented in Table 2.

Table 2. Results of the assessment of the components of the changing project environment of the district hospital reconstruction project (as of 2023)

Month	Financing	Availability of resources	Technologies	Legislation	Project team
1 st month	Change	No changes	No changes	No changes	Change
2 nd month	No changes	Change	Change	No changes	No changes
3 rd month	Change	No changes	No changes	Change	Change
4 th month	No changes	Change	No changes	No changes	No changes
5 th month	No changes	No changes	Change	No changes	No changes
6 th month	Change	No changes	No changes	Change	No changes

Source: compiled by the authors

Based on the data in Table 2, the number of changes in each of the factors of the project environment under consideration was calculated. It is established that during the period under consideration there were 3 changes in financing, availability of resources – 2 changes, technology – 2 changes, legislation – 2 changes, and project team – 2 changes. Depending on the specifics of each medical project, the weight of the influence of each of the factors of the project environment under consideration is taken into account. In particular, funding – 0.4, availability of resources – 0.2, technology – 0.15, legislation – 0.15, and project team – 0.1.

Substituting the corresponding values into formula (12), the quantitative values of the coefficients of variability of the project environment during a given period of implementation of a medical project are obtained. The total weighted number of changes in the project environment for the project of reconstruction of the district hospital is:

$$W_{nc} = \frac{2.4}{6} = 0.4.$$

It has been established that taking into account the weight of each factor of the project environment, the weighted frequency of changes in the main factors of the project environment is 0.4 (changes per unit of time, i.e. per month). Similarly, calculations were made to determine the variability of the project environment for other medical projects under consideration.

As a result of using the proposed decision support system, priority projects for the creation and development of medical institutions in the region were

identified using the initial data presented in Table 1, and the graphs presented in Figures 6-8 were obtained.

The obtained graph of the budget structure of projects for the creation and development of medical institutions in the region (Fig. 6) makes it possible to analyse the share of funding received from different sources. It has been established that all the projects under consideration are largely dependent on public funding. In addition, the second most important source is the local budget, which provides funds to finance projects for the creation and development of healthcare facilities in the region. Project managers should look for additional sources of funding if the state budget is limited. In addition, strategies should be developed to attract the private sector to participate in project financing. The costs of creating benefits are equal to the project budget, and the benefits of the project reflect the value that stakeholders receive from each project (Fig. 7). The presented schedule of benefits and costs of implementing projects for the creation and development of healthcare facilities in the region provides for the identification of projects with the highest benefit-to-cost ratio. This helps to identify the most effective projects, such as the reconstruction of the district hospital and the construction of a polyclinic. At the same time, the analysis of project implementation costs will help determine their feasibility. In particular, it was found that the polyclinic construction project requires significantly more costs compared to the project reconstruction of the rayon hospital at a lower cost. Therefore, if the budget is limited, the project to reconstruct the Rayon Hospital should be preferred (Fig. 8).

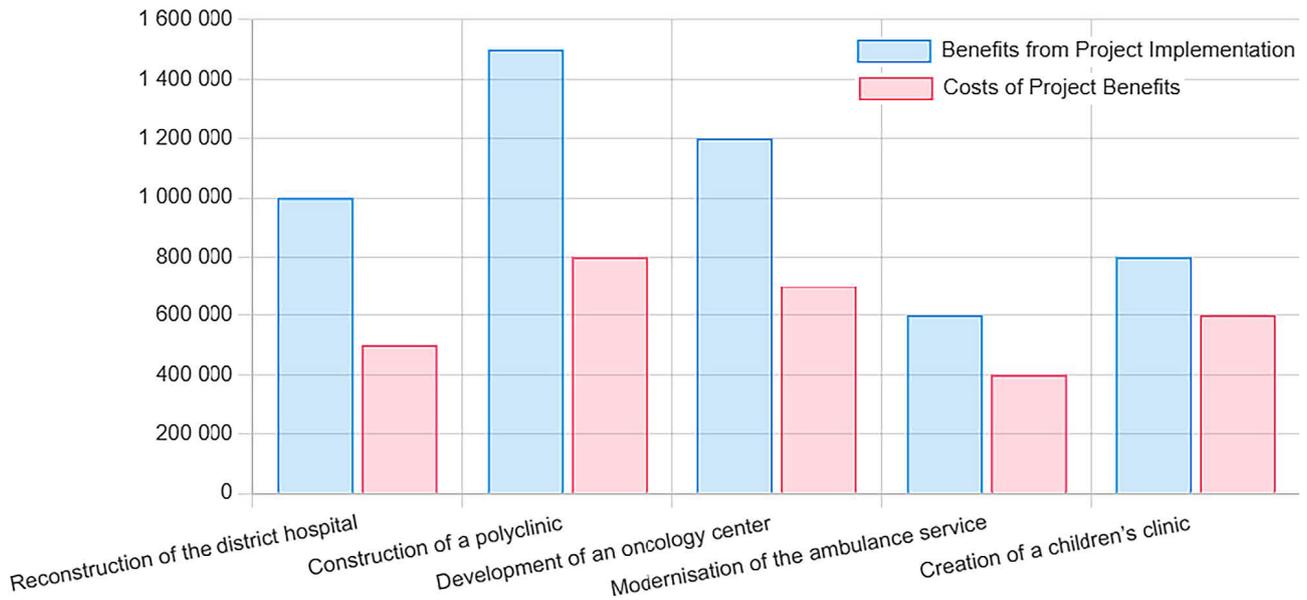


Figure 7. Budget structures of projects for the creation and development of healthcare facilities in the region, USD (as of 2023)

Source: developed by the authors

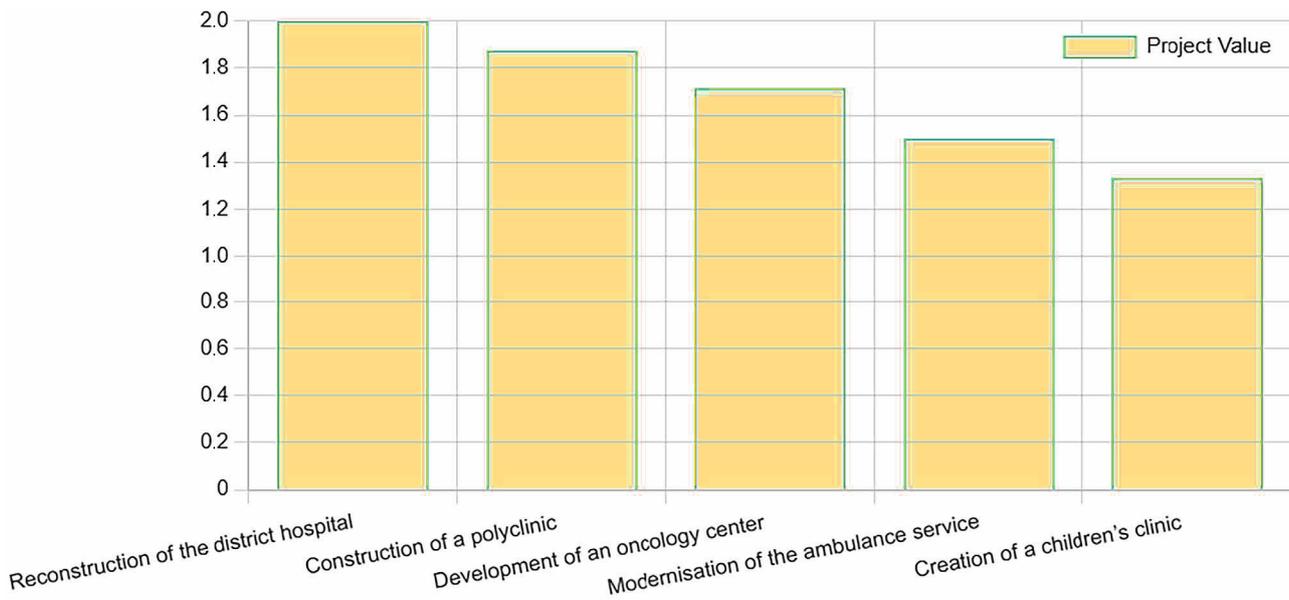


Figure 8. Histogram of priority projects for the creation and development of medical institutions in the region sorted by their value (as of 2023)

Source: developed by the authors

As a result, a schedule of priority projects for the creation and development of medical facilities in the region was obtained, sorted by their value. It was determined that the reconstruction of the district hospital has the highest value (2.0). The benefits of this project are twice as high as the costs of its implementation. The projects to build a polyclinic and develop an oncology center have high values close to 2.0, which also indicates high efficiency. Establishing a children's clinic has the lowest value (1.333), but is still profitable to implement. The results indicate that the highest value projects are the

reconstruction of the rayon hospital and the construction of a polyclinic, which are prioritised for priority funding and implementation. They will bring the greatest benefits to the stakeholders at the optimal cost of their implementation. Project managers should prioritise and give preference to projects with the highest value, maximising stakeholder benefits at the lowest cost.

In general, the identification of priority projects for the creation and development of healthcare facilities in the region using the proposed decision support system enables project managers to obtain information about

them, which allows them to focus on higher-priority projects to quickly obtain benefits for stakeholders. Based on the analysis, project managers make decisions about the need to find and attract additional sources of funding to ensure the stability of project budgets. Conducting a cost-benefit analysis for stakeholders is the basis for improving the efficiency of using available resources. These recommendations will help project managers to effectively manage healthcare facility creation and development projects, ensuring maximum benefit for the region's stakeholders at the optimal cost of resources.

The study developed a decision support system (DSS) to identify priority projects for the development of medical facilities in a hospital district. This system is designed to improve the accuracy and quality of management decision-making by project managers in a resource-limited environment. H. Hu *et al.* (2016) argued that one of the tools to improve the accuracy and quality of management decisions is DSS. They are important tools for improving management decision-making processes, including in the healthcare sector. DSSs provide the ability to comprehensively analyse a large amount of data, model possible development scenarios, and assess the impact of various factors in the project environment. Implementation of the DSS allows taking into account financial constraints, population needs, infrastructure capacities, and other aspects that are crucial for successful planning of healthcare facilities development. Analysing scientific papers, it has identified both common features and differences with the results of other studies in this area. For example, H.C. Lin *et al.* (2021) discussed the implementation of a patient management system in the clinical practice of Chinese medicine, focusing on the digitalisation of healthcare services. Although, this study aimed to create tools for prioritising projects, both papers emphasised the importance of technological solutions for improving healthcare services. However, in contrast to the approach taken in this paper, H.C. Lin *et al.* (2021) focused on aspects of patient management rather than systematic project analysis.

The work of B.F.F. Rodrigues *et al.* (2020) focused on risk assessment of investments in biofuel projects, reflecting the importance of risk management. D. Benavides *et al.* (2024) also analysed approaches and platforms for analysing and presenting data that facilitate effective energy management and decision-making. The DDS also takes into account risks, but this study focused on healthcare projects, which requires a more comprehensive approach to analysing the project environment.

The author K. Burdyka (2023) examined models for creating community fire suppression projects, focusing on the practical aspects of project implementation. Although, the paper illustrated the importance of a systematic approach to project management, this article suggests other mechanisms for setting priorities in healthcare facilities, which underlines the uniqueness of the study.

Researchers Y. Zheng *et al.* (2023) studied eight OHMC hospitals planned for construction based on the conditions and potential of several districts in terms of economies of scale. The authors concluded that hospital expansion can contribute to the group's development, but it can also create problems, such as rising costs, increased management and operating costs, inefficient allocation of medical resources, and unbalanced development. A. Vallee & M. Arutkin (2024) noted that virtual hospitals offer an effective solution to many systemic problems, including rising costs and increased workload for healthcare professionals.

Researchers Y. Wang *et al.* (2024) presented a neural network-based model for predicting and estimating head injury parameters in children. Although the main focus of their study is on risk assessment, the use of neural networks for prediction is a common approach in this study. This work also used prediction models, but unlike the study by Y. Wang *et al.* (2024), the presented system is aimed at identifying priority projects of hospital districts rather than individual risks.

The systematic review by D. Johnson *et al.* (2024) examined clinical decisions that promote genetically targeted medicine. This study demonstrated how new technologies can improve treatment outcomes, but they do not focus on management decisions in the direction of health facility development projects. In contrast, the DSS, as outlined in this paper, focuses on project environment factors that influence project prioritisation.

The study by M. Gholamzadeh *et al.* (2023) emphasised the importance of knowledge in supporting clinical decision-making to improve adherence to evidence-based medicine in the treatment of chronic diseases. The authors focused on improving medical practice through the use of knowledge, which partially coincides with results of this research. However, this work is more focused on managerial aspects and identifying priority projects in the healthcare sector.

Thus, the study adds to the existing knowledge in the field of project management by creating a decision-support system for healthcare. The authors focused on identifying priority projects for the development of medical institutions in the hospital district, which makes the results an important contribution to project management.

Conclusions

The proposed system-value approach to the multifactorial evaluation of medical projects, their integration with strategic goals, and taking into account the adaptive project environment allows to comprehensively identify priority projects for the development of medical institutions in a hospital district. This approach was based on the principles of comprehensiveness, transparency, value and adaptability, which allow for effective evaluation of priority projects in the hospital district. This approach makes management decision-making on priority projects more informed and

focused on the real needs of the population, which contributes to improving the quality of healthcare services. This approach significantly reduced the risks of inefficient use of resources and ensures the sustainable development of medical institutions.

The substantiated algorithm of the management process of identifying priority projects for the creation and development of medical institutions in the region involved 12 steps that allow project managers to systematically select priority projects. The algorithm included the stages of data collection and analysis, assessment of benefits and costs, and identification of risks associated with each healthcare project. With this clear structure, project managers can make management decisions based on objective data and quantitative indicators, which ensures transparency and clarity of the process. This is especially important in a resource-constrained environment where every decision needs to be as well-founded as possible.

Based on the proposed system-value approach and algorithm, a decision support system was created. The architecture of this system includes a client-side

(Frontend) developed using HTML and CSS for markup and styling of pages, as well as JavaScript for the dynamic addition of medical projects to the list, event processing, and sending requests to the server. To make it easier to work with DOM elements, jQuery was used, and Chart.js was used to build graphs and visualise the results of identifying priority projects for the creation and development of medical facilities in the region. The proposed decision support system facilitates the identification of priority projects in the hospital district. Further research should be carried out using the developed decision support system to assess the relationships between the components of the project environment and determine their impact on the priority projects for the creation and development of medical institutions in the hospital district.

Acknowledgements

None.

Conflict of Interest

None.

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Система підтримки прийняття рішень для визначення пріоритетних проєктів розвитку медичних закладів госпітального округу

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Анотація. Актуальність дослідження полягає у вирішенні науково-прикладної задачі створення інструментарію для визначення пріоритетних проєктів розвитку медичних закладів госпітального округу. Метою статті було обґрунтування системно-ціннісного підходу та розробка на його основі системи підтримки прийняття рішень для визначення пріоритетних проєктів створення та розвитку медичних закладів. У роботі було використано методи системно-ціннісного аналізу, багатофакторної оцінки медичних проєктів, комп'ютерного моделювання. Аналіз наукових праць показав, що розробка системи підтримки рішень для пріоритетних проєктів медичних закладів госпітального округу є важливим завданням, яке потребує системно-ціннісного підходу для комплексного управління. Обґрунтовано доцільність та особливості системно-ціннісного підходу, який дозволяє комплексно визначати пріоритетні проєкти для розвитку медичних закладів у госпітальному окрузі. Розроблений алгоритм управлінського процесу визначення пріоритетних проєктів створення та розвитку медичних закладів регіону базується на запропонованому системно-ціннісному підході і передбачає виконання 12 кроків. Він дозволяє проєктним менеджерам пришвидшити процес вибору пріоритетних медичних проєктів. На основі запропонованого системно-ціннісного підходу та алгоритму розроблено систему підтримки прийняття рішень. Архітектура цієї системи підтримки прийняття рішень передбачає клієнтську частину (Frontend). Вона розроблена із використанням HTML та CSS для розмітки і стилізації сторінки, а також JavaScript для динамічного додавання медичних проєктів до списку, обробки подій, а також надсилання запитів на сервер. Використано jQuery для зручнішого маніпулювання елементами DOM та Chart.js для побудови графіків і візуалізації результатів визначення пріоритетних проєктів створення та розвитку медичних закладів регіону. Використання запропонованої системи підтримки прийняття рішень для заданого проєктного середовища забезпечило визначення пріоритетних проєктів створення та розвитку медичних закладів регіону. Практична цінність дослідження полягає у впровадженні системи підтримки прийняття рішень, яка дозволяє проєктним менеджерам визначати пріоритетні проєкти створення та розвитку медичних закладів, що підвищує ефективність управлінських рішень та оптимізує використання ресурсів у сфері охорони здоров'я

Ключові слова: управління проєктами; стратегічне планування; системно-ціннісний підхід; першочергові медичні проєкти; проєктне середовище