DOI: https://doi.org/10.30837/MMP.2024.117

A DECISION SUPPORT SYSTEM TO IDENTIFY PRIORITY PROJECTS FOR THE CREATION AND DEVELOPMENT OF MEDICAL FACILITIES IN THE REGION

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The main components and stages of the approach to identifying priority projects for the creation and development of medical institutions in the region are substantiated. It is envisaged to determine the maximum value for stakeholders by coordinating the amount of investment with the budgets of individual medical projects. This is done on the basis of ensuring that the required amount of investment is received in individual projects that do not exceed the approved budget, which is formed from various sources of investment. The use of the proposed approach will increase the efficiency of medical project management and ensure compliance with the needs of the population and resource capabilities. Based on the proposed approach, a decision support system has been developed to identify priority projects for the creation and development of medical institutions in the region. The system is a web application written using HTML (HyperText Markup Language), CSS (Cascading Style Sheets), JavaScript, and jQuery to simplify manipulation of the DOM, and Chart.js to visualize data in the form of graphs. Based on the developed decision support system, priority projects for the creation and development of medical institutions in the region have been identified for the given conditions of the project environment. Project managers should take into account the priority and give preference to projects with the highest value, maximizing the benefits for stakeholders with minimal resource costs.

Introduction

The creation of effective hospital districts in certain regions is one of the main challenges in ensuring the health of the population of communities and providing them with quality healthcare services [1–3]. Currently, Ukraine is experiencing socioeconomic changes due to the war and reforms. At the same time, due to limited resources, there is a need to implement innovative projects, taking into account the dynamic project environment and value for their stakeholders. This is why it is expedient to develop and implement new tools that will ensure high-quality planning processes with the ability to accurately identify priority projects for the creation and development of medical institutions in the region. This should take into account both the needs of society and limited budgetary resources.

When implementing projects and their development portfolios in various industries, project managers use appropriate decision support systems (DSS) [4–6]. They make it possible to automate and optimize decision-making processes based on the consideration and analysis of many factors of the project environment.

Currently, the expediency of creating a DSS is quite relevant for determining priority projects for the creation and development of medical institutions in the region [7–9]. Their use contributes to the effective implementation of projects for the creation and development of medical institutions in the region, as well as the development of medical infrastructure.

Our research presents the approach, algorithm, and results of the development of the SPRP for identifying priority projects for the creation and development of medical institutions in the region. This system ensures maximum value for stakeholders by aligning the amount of investment with the budgets of individual medical projects. This is done based on ensuring that the required amount of investment is received in individual projects that do not exceed the approved budget [10–12]. At the same time, investment sources are properly distributed among priority projects for the creation and development of medical institutions in the region. The use of the proposed approach will increase the efficiency of medical project management and ensure their compliance with the needs of the population and resource capabilities.

Purpose and task statement

The purpose of the research is to propose an approach to identifying priority projects for the creation and development of medical institutions in the region, to develop a decision support system on its basis, and to use it to study the impact of project environment components on the selection of priority projects. In accordance with this goal, the paper should solve the following tasks:

1) to substantiate the main components and stages of the approach to identifying priority projects for the creation and development of medical institutions in the region;

2) to develop a decision support system for identifying priority projects for the creation and development of medical institutions in the region;

3) to identify priority projects for the creation and development of medical institutions in the region for the given conditions of the project environment based on the developed decision support system.

An approach to identifying priority projects for the creation and development of medical institutions in the region

The proposed approach to identifying priority projects for the creation and development of medical institutions in the region is based on maximizing value for stakeholders through effective alignment of investments with the

budgets of specific medical projects. To do this, first of all, the formation of the necessary knowledge to identify projects for the creation and development of medical institutions is carried out [13–15].

To identify projects for the creation and development of healthcare facilities, one should have knowledge of the changing project environment, knowledge of project product formation, knowledge of healthcare legislation, and knowledge of project management:

$$P_{in} = f\left(K_c, K_f, K_h, K_p\right), \quad (1)$$

where P_{in} – the process of identifying projects for the creation and development of healthcare facilities;

K_c – knowledge of the state of the changing project environment of projects for the creation and development of healthcare facilities;

K_f – knowledge of actions to form project products;

K_h – knowledge of healthcare legislation;

K_p – knowledge of project management.

Knowledge K_c about the state of the changing project environment is an important component for the successful initiation of healthcare facility construction and development projects. They are formed on the basis of data on the state of the changing project environment of healthcare facilities creation and development projects. In particular, these data are used to develop models for predicting the number of diseases by different population groups, the occurrence and course of epidemics and various types of diseases, as well as the availability and level of medical services, etc.

Integration of knowledge from different fields is an important condition for successful identification of healthcare facility development projects. This knowledge is necessary to understand both the existing state and the specifics of its transition to the desired state, as well as to assess the risks and opportunities associated with healthcare facility creation and development projects.

In general, the stage of identification of projects for the creation and development of healthcare facilities in the region is described by the following expression:

$$P_{in} \in \left(A_{st} \to I_{CC} \to F_{st} \to F_{pr}\right), \quad (2)$$

where P_{in} – the process of identifying projects for the creation and development of healthcare facilities in the region;

A_{st} – analysis of stakeholders in the projects for the creation and development of healthcare facilities in the region;

I_{CC} – identification of contradictions and conflicts of interest between stakeholders in the 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 medical system;

F_{pr} – formation of projects for the creation and development of healthcare facilities in the region.

The formulated set of i-th projects $\{P_{ri}\}$ for the creation and development of medical institutions in the region requires further evaluation of their value for stakeholders.

The next stage involves quantifying the value of the formulated set of i-th projects $\{P_{ri}\}$ for the creation and development of medical institutions in the region. For this purpose, computer modeling methods are used to predict intermediate value indicators. The criteria for the value of k-th projects for the creation and development of medical institutions in the region are the ratio of benefits $\left(B_{sti}^{mk}\right)$ for stakeholders from individual m-th medical systems to the costs $\left(C_{pi}^{mk}\right)$ incurred to create these benefits:

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

where V_{pi}^{mk} – value for i stakeholders from individual m-th medical systems due to the implementation of k-th medical projects;

B_{sti}^{mk} – benefits for i stakeholders from individual m-th medical systems due to the implementation of k-th medical projects;

C_{pi}^{mk} – costs incurred to create benefits from m-th medical systems due to the implementation of k-th medical projects.

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 benefit 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 to obtain maximum benefits $B_{sti}^{mk} \to \max$ for i-th stakeholders at the minimum cost $C_{pi}^{mk} \to \min$ incurred to create these benefits:

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

Based on the determined basic value V_{pb}^{mk} for stakeholders from individual m-th medical systems through the implementation of k-th medical projects, priority projects are selected for a given hospital district.

Priority k-th projects for the creation and development of healthcare facilities in the region are identified based on their ranking in descending order of basic value V_{pb}^{mk} for stakeholders:

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

This ensures the creation of a vector of priority projects for the creation and development of medical facilities in the territory of hospital districts. Let us describe the determination of the priority k-th projects for the creation and development of medical institutions in the region, which are subsequently ranked in descending order of basic value V_{pb}^{mk} for stakeholders. In this case, the set of projects is known $P = \{p_1, p_2, \ldots, p_n\}$, as well as the basic value V_{pb}^{mk} for different stakeholders for each of them. Then the vector of priority projects P_P is defined as:

$$P_P = \left(p_{(1)}, p_{(2)}, \ldots, p_{(k)}\right). \quad (7)$$

where $p_{(z)}$ – is a medical project that has 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:

$$V_{(i)} = \max\left\{V_j \mid \; p_j \in P \setminus \left\{p_{(1)}, p_{(2)}, \ldots, p_{(i-1)}\right\}\right\}, \quad (8)$$

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

Once found, this project is removed from the set P_P. The procedure is repeated until the k-th number of 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 basic values for stakeholders.

To coordinate the amount and sources of investment with the budgets of priority projects for the creation and development of medical institutions in the region, you should specify the k-th number of medical projects, the budget B_i of each i-th medical project (where $i \in \{1,2,\ldots,k\}$, the amount of investment I_i for each i-th project and the amount of available investment S_i for each i-th project from all sources.

The amount of investment I_i for each i-th medical project should not exceed its budget B_i:

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

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:

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

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:

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

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 B_i. At the same time, investment sources should be properly distributed among priority projects.

Results of the development of a decision support system for identifying priority projects for the creation and development of medical institutions 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 medical institutions in the region, which is a web application. It is a web application developed in the Replit integrated development environment (IDE).

As for the architecture of the decision support system for identifying priority projects for the creation and development of medical institutions in the region,

the client side (Frontend) uses HTML and CSS for marking up and styling the page, JavaScript for dynamically adding projects to the list, processing events, and sending requests to the server, jQuery for easier manipulation of DOM elements, Chart.js for graphing and visualizing 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. It is planned to use the php://input file to receive data from the POST request and temporarily store it in the computer's 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. 1).

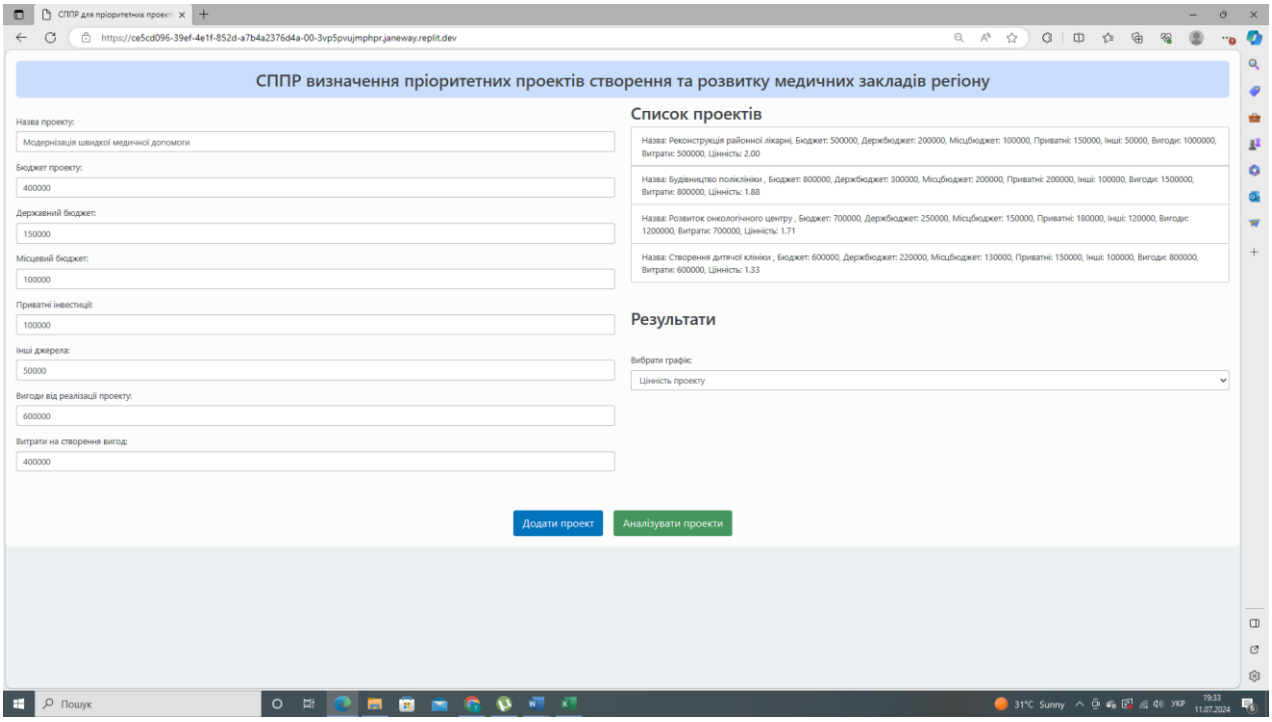

Fig. 1. User window of the decision support system for identifying priority projects for the creation and development of medical institutions in the region

There is an "Add project" button that allows you to add project characteristics to the list of projects on the client side. Data processing is performed after clicking the "Analyze 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 as a list of priority projects for the creation and development of medical institutions in the region sorted by value. At the same time, Chart.js is used to build a graph with priority projects.

The peculiarity of the decision support system for identifying priority projects for the creation and development of medical institutions in the region is that users can 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 to visually represent priority projects helps users 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.

The results of using a decision support system to identify priority projects for the creation and development of medical institutions in the region

The proposed decision support system was used to identify priority projects for the creation and development of medical institutions in the region. Initial data for the implementation of this management process are presented in Table 1. In this table, the costs of creating benefits are equal to the project budget, and the benefits of project implementation are reflected as the value that stakeholders receive from each project.

The project budget is calculated as the sum of the state budget, local budget, private investment, and other sources of funding. The costs of creating benefits are equal to the project budget, and the benefits of project implementation reflect the value that stakeholders receive from each project. We have obtained a schedule of priority projects for the creation and development of medical institutions in the region, sorted by their value (Fig. 2).

It was found that the reconstruction of the district hospital has the highest value (2.0). At the same time, the benefits are twice as high as the costs of implementing this project. 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 projects of reconstruction of the rayon hospital and construction of a polyclinic have the highest value and are prioritized for priority funding and implementation. They will bring the greatest benefits to stakeholders at the optimal cost of their implementation. Project managers

should prioritize and give preference to projects with the highest value, maximizing stakeholder benefits at the lowest cost.

Table 1

Initial data for determining priority projects for the creation and development of medical institutions in the region, USD

Name of the project	State budget	Local budget	Private investments	Other sources	Costs of creating benefits	Benefits from project implementation
Reconstruction of the district hospital	200000	100000	150000	50000	500000	1000000
Construction of a polyclinic	300000	200000	200000	100000	800000	1500000
Development of an oncology center	250000	150000	180000	120000	700000	1200000
Creation of a children's clinic	220000	130000	150000	100000	600000	800000
Modernization of the ambulance service	150000	100000	100000	50000	400000	600000

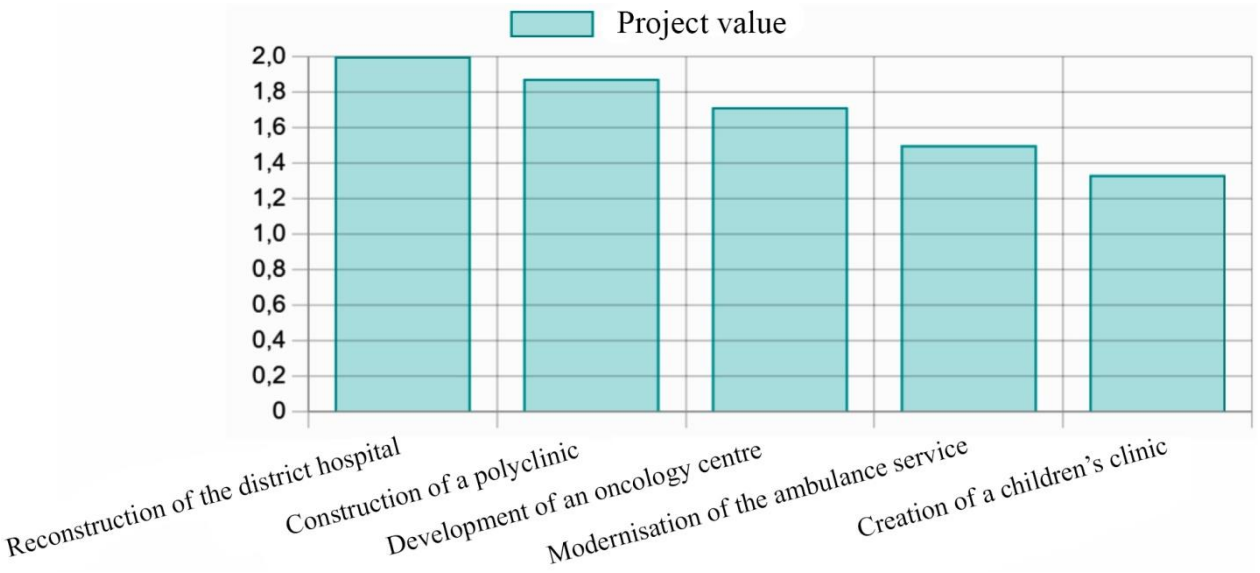

Fig. 2. Graph of priority projects for the creation and development of medical institutions in the region sorted by their value

In general, the identification of priority projects for the creation and development of healthcare facilities in the region using the proposed decision support system allows project managers to obtain information about them, which makes it possible 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 increasing the efficiency of using available resources. The following recommendations will help project managers effectively manage projects for the creation and development of healthcare facilities, ensuring maximum benefit for the region's stakeholders at the optimal cost of resources.

Conclusions

1. The substantiated main components and stages of the approach to identifying priority projects for the creation and development of medical institutions in the region involve determining the maximum value for stakeholders by matching the amount of investment with the budgets of individual medical projects. This is done on the basis of ensuring that the required amount of investment is received in individual projects that does not exceed the approved budget, which is formed from various sources of investment. Using the proposed approach will increase the efficiency of medical project management and ensure their compliance with the needs of the population and resource capacities.

2. Based on the proposed approach, a decision support system has been developed to identify priority projects for the creation and development of medical institutions in the region. It is a web application that is written using HTML (HyperText Markup Language) and CSS (Cascading Style Sheets), which are used to structure the web page, as well as styling and design, including the Bootstrap 4 library to create an adaptive design. In addition, we used the JavaScript programming language to add dynamic behavior and interactivity to our web page, as well as jQuery to simplify DOM manipulation, Chart.js to visualize data in the form of graphs.

3. On the basis of the developed decision support system, priority projects for the creation and development of medical institutions in the region for the given conditions of the project environment are identified. It is established that for a given project environment, the reconstruction of the district hospital has the highest value (2.0). At the same time, the benefits are twice as high as the costs of implementing this project. Project managers should consider prioritizing

and giving preference to projects with the highest value, maximizing benefits for stakeholders with minimal resource costs.

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