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DEVELOPMENT OF A DECISION SUPPORT SYSTEM IN PROJECT MANAGEMENT

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Abstract:

In a number of scientific works, the authors consider the problems of development of the various sectors of the industry and suggests methods of solution in the framework of the theory of managing projects and portfolios of projects. It should be noted that in the project management process many different solutions are adopted. All of these solutions can be divided into two groups. The first group is solutions that are associated with current issues and not related to the implementation of the project (for example, with the personal interests of staff of the project). The second group of decisions influences significantly the effective implementation of the project. These decisions are made by the head of projects, and they directly affect the achievement of the goals of the project. Moreover, the project manager has to make decisions constantly, at every phase of the life cycle of the project requires the adoption of certain managerial decisions. Decision-making is practically difficult because of the diversity and complexity which requires the consideration of the business processes of investment, production, financial, managerial, as well as numerous characteristics of external and internal market environment of a business project. It is incumbent on decision-makers to face complex problems, an effective solution of which is impossible without the use of a systematic approach. The paper identifies the levels in the system of support of decision-making. The analysis of the solution process of the activities of the project tasks is carried out to develop a conceptual model of information support of decision-making. The simulation system is for decision support and shows how information is stored in the internal database. The features of the architectural approach to implementing a decision support software product are demonstrated, as well as testing such a system is illustrated by examples. Using this information system provides the advantages as e.g. are receiving different types of messages quickly; increasing the speed of decision-making; rapid detection of trends using predictive methods.

Keywords:

Project management, reporting module, forecasting module, decision support.

ACM Computing Classification System:

Real-time system specification, interaction design, human computer interaction.

Introduction

Changing the managing style in the middle of a project cycle is a highly debatable topic. Most business enterprises consider it a risky process and therefore resist it. Change can mean a shift to agile management, but this is usually possible for smaller projects or partial subprojects (see [1]). One of the major problems of the modern enterprise is the problem of decision-making and its affect on project management, which is common because of the rapid life cycle of the project or change the composition of the participants. To solve this problem, you need a tool, which has in its functional mechanism the data collection and analysis as well as reporting and the conclusion of proposed solutions to address the current problems in the project [2].

The relevance of research due to the need to solve problems of increasing of project management quality, which is caused by the need for a visual representation of information on the problems of employees and obtaining the prediction of possible decision options.

The results of the analysis of the existing information system make it possible to support goal of decision-making in project management tasks so as to address the contradiction between the need to improve the quality of management of processes based on objective review and the lack of software products that enable this control to be effectively implemented [3].

Based on this improved project management it is possible through the introduction of a new tool that provides support for decision-making and project management solving quality problems evaluation of design decisions. For this purpose, as a tool, you can use the information decision support system for data collection, analysis, problem identification and forecasting of project management options in view of the possible alternatives.

The aim of this paper is the theoretical basis and practical implementation of information provision to support decision making in problems of project management to improve their quality.

1 Analysis of the Problems and Possible Solutions of the Problems in the Management Decision Support

Features of hardware and software are continuously improved, while their prices does not increase or increase only slightly. Corporations develop distributed systems that provide easy access to information held in various places and combining them with other information and control systems. In any corporate system, there are reports that are generated for controlling grass-roots level, mid-level and senior managers.

The decision is practically difficult because of the diversity and complexity of requiring registration of business processes - investment, industrial, financial, administrative, as well as the numerous characteristics of internal and external market environment of the business project.

It confronts decision-makers face (DMF) challenges, where an effective solution is impossible without the use of a systematic approach for the implementation of which in this case will be understood that the following tools:

1. the mathematical models that adequately reflect the content side of the business processes;
2. methods and algorithms for the analysis of these mathematical models that allow automated processing of information extracted from them;
3. software packages, numerically implementing the above methods and algorithms for analyzing and enabling DMF process and present this information in an automated mode.

Typically, large corporations have a separation of departments, which can be viewed as a set of projects, over each of which has a control - decision maker.

An increasing number of transactions within a company, however, the external transaction savings are obtained. Corporation has a wide range of possibilities to work with projects and tasks, so delegating one of the elements forming the organizational management structures. It is necessary to find an acceptable balance of centralization and decentralization, depending on factors such as the size of the organization, production technology, and the external environment. The decision process at the lowest levels must complement high control system and being part of the daily decision-making processes. Every project has its own level of difficulty. This complexity is made up of a variety of factors such as: a goal that will be of value to the business, completed with certain specifications; specific start date and end date; to have a certain limit of financing; to have a certain human and non-human resources.

If the project manager has many different resources available, then it is necessary to decide whether for some individual resources only the senior official will decide. The control system, on the basis of information about the state of information coming from the external environment, determines the target decision object and generates a directive activity acting for the management team.

The necessary information of process control is recorded, transmitted, stored, accumulated and processed. The complex of these procedures is an information management process. Project management systems are toolboxes, methodologies, techniques and resources used in the control process, include means for scheduling tasks, scheduling, budget management, resource allocation, documenting, reporting, collaboration performers.

These circumstances forced to use the currently available advanced software and hardware. Widespread and effective use of these funds was one of the factors of survival and success of the enterprise in the conditions of intense competition. In recent years, this widespread automated information system has often been referred to as an information system that cannot be imagined without automation [4].

Usually, these are corporate information systems (Enterprise Resource Planning, ERP). For discrete manufacturing it is an important aspect, which has a significant impact on the planning model inherent in the system, as a serial production and available for stock management. The current trend in almost all industries is characterized by the gradual expansion of the range of products and the reduction of seriality. From a planning perspective this feature complicates the task and increases the initial data sets, both in number and nomenclature. However, the implementation of corporate information systems is a complex process, due to the fact that the management of the enterprise is not a process of collecting and analyzing data for decision-making on project objectives and emerging issues. Therefore, into an existing system it can be integrated a decision support system (DSS). This will improve the speed of data processing and analysis, as well as to identify ways of decisions and their impact on the project. Decision support system can be divided into several levels.

1. User level.

1.1. Passive decision support system - a system that helps the decision-making process, but can not make a proposal, what decision to take.

1.2. The active system - can make an offer which solution to choose.

1.3. Cooperative system - allows the decision-maker, modify, add or improve the solutions offered by the system, then sending these changes to the system to check. System changes, adds or enhances these solutions, and sends them back to the user. The process continues until an agreed solution is found.

2. The conceptual level.

2.1. Control posts support a group of users working on a common goal.

2.2. Control data oriented to access and manipulate data.

2.3. Control documents are searched to manipulate unstructured information defined in different formats.

2.4. Control of knowledge to provide a solution to problems in the form of facts, rules and procedures at divided data levels.

2.4.1 Operational decision support system designed to respond immediately to changes in the current situation in the management of financial and economic processes of the company.

2.4.2 Strategic systems are focused on the analysis of significant amounts of various information collected from various sources.

2.5. Control models are based on mathematical models. For their construction, you can use OLAP-systems that make the complex data analysis, and then a system of decision support can be attributed to hybrid systems that provide modeling, search and processing.

There are three main problems in decision support systems: data entry, data storage and data analysis. Similarly, the system does not make the right decision just to give an idea of the possible solutions and their consequences. The main characteristics of decision support systems are these:

1. DSS is flexible, adaptable and quick reaction,
2. DSS is designed so that the user can control the input and output data,
3. DSS from the user does not require special knowledge and specific skills,
4. DSS applies modeling tools and complicated analysis,
5. DSS includes user-friendly software,
6. DSS is interactive, that is subject to change and include the new data.

We can confidently say, that with proper project management of resources it is achieved maximal efficiency. In many ways, human re-sources are exactly what the decision-maker has to work with [5].

Proper allocation of the project tasks to participants is a difficult task, in which there is necessary to make data collection and analysis, and further to develop of the project development strategy and finally to make a decision. Particular attention is required in the initial stages of the project - the initiation and planning of resources.

2 Analysing the Process Solutions Activities of Project Tasks

The existing process of the design is targeted to the following features. Firstly, every interaction with the search engine of a specific project or person is complicated due to lack of a common list of activities. And secondly, to search for and collect all the necessary information the user should own search engine API, which is described by the similarity of SQL queries. Third, a comparison of the activities is possible only through autographic collection of all the materials and a subsequent analysis of materials at hand.

Thus, the user has to make calculations on the possible increase in the pace of work on activities. The first feature of the system is an important issue in the event of critical situations within the company, where the response time can be the most critical factor that allows to solve the situation in a positive or negative direction. In solving such problems, the user will be easier to see possible solutions to problems and ways of preventing them in the future, rather than the use of other internal resources and combining them through the tools available. Thus, the development of the interaction element, taking into account the preservation and display activities is a prerequisite for the information system decision support.

Each time the user is required to perform these operations to obtain relevant information, for editing and shaping of the result set. The use of two external systems, as well as two software products complicates the logic operations and thus there are risks of errors that will affect the final result of the decision [6].

When optimizing this process, we get a lot of time and does not take advantage of any user of the machine resources in view of the fact that all the work is done on the side of the information system.

The second feature of forcing the user to learn the basics of SQL queries, when to obtain information from an external system, is leading to loss of time or to need professionals who could write a valid request. This point is related to a feature of the external system, which focuses more on the technical specialists, however, to find any information to non-technical user it performs only a minimal functionality, where most of the work has to be done manually.

3 Development of a Conceptual Model of Information Support of Decision-Making Support

The conceptual model of the information system is created on the basis of characteristic features of the solution design for IS users. The model describes the full range of all the tasks necessary to address the issues associated with the project activity.

The conceptual model includes the following tasks and functions: reports on the construction projects and the projected scenarios under a specific set of input parameters; a creation of a virtual project with the existing resources; configuration of the virtual project and help in decision-making resource changes; building the assessments and identification of specific resources and capabilities; support for redistribution to the most appropriate position, taking into account the future growth of activities and a possible increase in the progress of a particular human resource.

It should be also taken into account the possibility of an authorization in view of the fact that the project objectives are not open data and the information is accessible to users with accounts that have customized lists (see activities).

This integration with external systems makes possible in the future to set up working more closely with all external resources. And for this it will be necessary to develop an external API, which allows other systems to integrate this solution to fit the needs. In general, the model of decision support system is shown in (Fig.1) - The support system for decision-making model. (Fig.2) shows a conceptual model of information system (data flow).

System model is built from components that will continue to be joined together:

1. the user interaction component for input parameters;
2. the logic component describing basic functions and tasks of the system;
3. the reaction of the component with the data store.

Logic component contains the following components and it is implemented in the server portion of the application:

1. the module working with projects;
2. the reporting module;
3. the prediction unit.

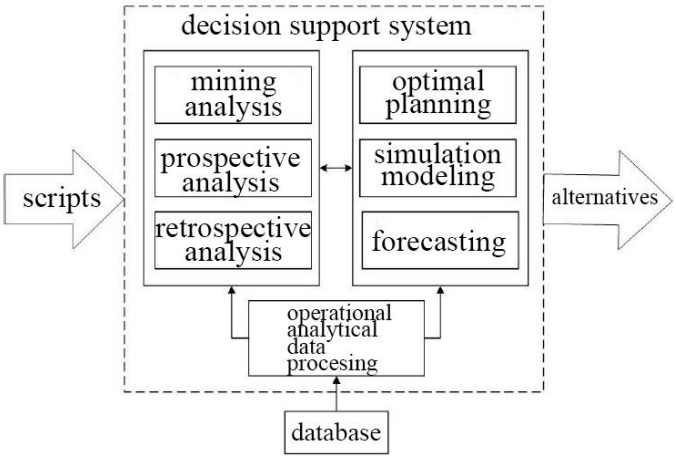

Fig.1. The support system for decision-making model.

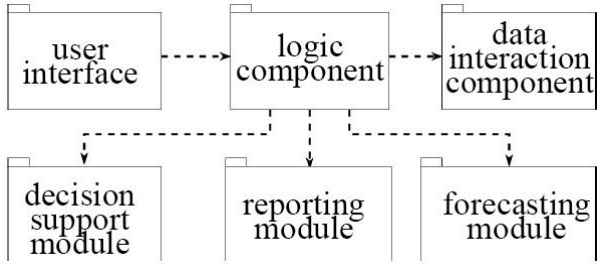

Fig.2. Data flow for conceptional model.

For reception of the input parameters and to display information to the user using a web interface (see Fig.2), these components of this update will not affect the other parts of the next information model. The component includes a visualization of all the parameters describing problems and provides system interoperability through a standard set of web components.

4 Support System Modeling of Decision

After logging the user can select the system module to obtain the necessary information. Realization of movement between subsystems is routed to the user interface level. The major transitions of the main page are: prediction unit; support decision module; reporting module.

Finding the optimal design, it is based on the history of completed tasks, and comparing them with the project objectives. Search optimization problems also use already existing statistics to identify strengths and weaknesses, which will point to the possibility of working with a particular type of task to choose the candidate as resource. The user may refer to the records system for references and records of the company's existing activities. This will avoid the occurrence of any error in the system and make the job even easier. Reports are available to the following entities in the system: companies; staff projects. Reports can be shared or have their own specifics. Prediction of the system is based on a survey method using extrapolation.

This extrapolation method uses the principle in which the predicted level taken as equal to the mean value of a number of levels in the past. The result of using this method is the point estimate that is suitable for the task because it is more effectively used for short-term forecasting.

5 Storing Information in an Internal Database

The current model of information support means to make a local storage for quick access. Such a decision is based on the fact that the local information will have a consistent look, thereby reducing the time of issuance of system output to the user. Updating and addition of data will be carried out at the user's request for a specific activity. If the data has been updated in external systems, it will be made with data synchronization with the local copy. For data storage, it is used an object-oriented database.

The main entities that are present in the system are: the staff; project; task; a comment. Using the Object storage allows you to avoid the decomposition of objects and attributes in reverse action.

This is a common approach for decision-making system, to be used for modeling situations, given that the objects are displayed in diagrams and their actions are better understood by man as object attributes.

It is also an object-oriented approach allows us to use all of features and programming approaches which is used to support decision-making: it contains aggregated and atomic data. It occurs combining data from a plurality of external resources.

Internal database comprises current and historical data: users can not change the data (minimal storage costs). Loading data in the storage occurs with a certain frequency (combining data from a plurality of external resources).

6 The Architectural Approach to the Implementation of a Software Product

Based on the identified requirements, the client-server architecture should be used to implemented solutions for decision support. This approach will allow the system to decompose entity, thereby guaranteeing the simplest design and support of the individual components. The decision support system is implemented in the form of an information system. Following (Fig.3) shows a model of a software product: Support system of decision-making.

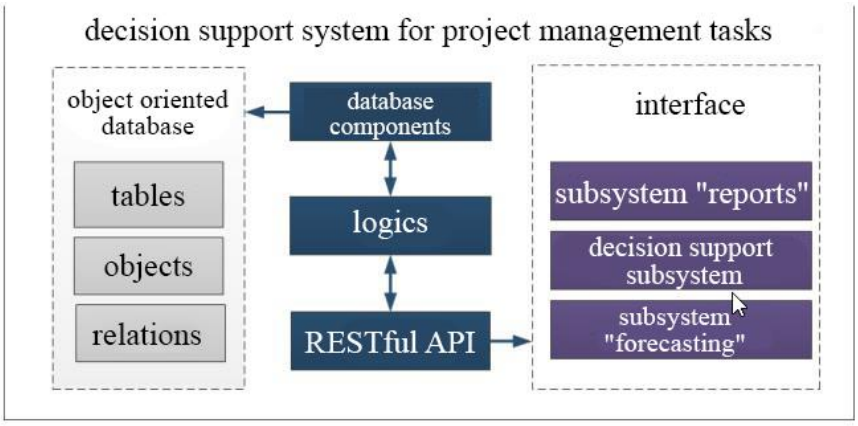

Fig.3. Model of support system of decision-making.

Following the architecture, implementation should be divided into two main parts, the first of which is responsible for interaction with the user, and the second one implements the logic of business processes and the interaction with the data. The user interface has a four individual modules that allow correctly generate a re-quest for the server side.

Business logic and data management are in close interaction with each other and work on one environment. Business logic responds to all requests of the user, a direct request to read data is not present, all is regulated within the business processes. Data Management includes, in addition to work with the already loaded data, the work with remote application servers to swap data in an internal database. The results will be used to model a proposed system that simulates a simple artificial intelligence system to support project decision-making.

Next (Fig.4) shows the user interface components. This set of components allows users to effectively use the software to solve business problems and automate processes that were previously handled manually.

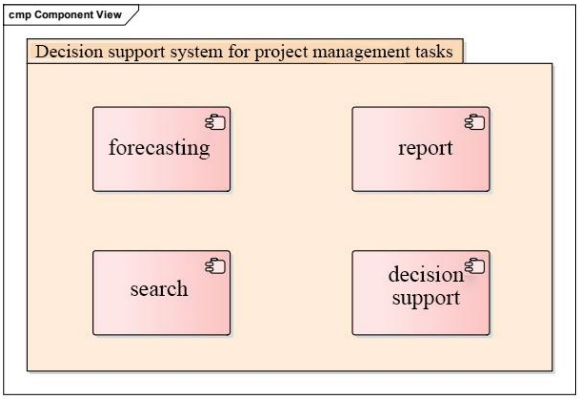

Fig.4. User Interface Components.

7 Implementation of an Information System to Support Decision Making

To implement the tool, following technologies were used: Java Spring Boot; Angular 2. To implement the server-side framework it was used an open Java Spring Boot, which implements REST API architecture interaction with the user of the application. Also, the server part is responsible for interaction with the database. However, implementation has not any graphical user interface and operates autonomously via downloaded and installed assembled packet to the application server.

In this case, we used Apache Tomcat. The implementation of the user interface used by Angular 2. The platform is built on the JavaScript language and has its own Typescript language and a compiler that converts all code written in JavaScript. Typescript provides greater flexibility in writing code and its support because every web page can work with an object. Thereby maintaining the integrity of data stored on the server side, since no permanent serialization and de-serialization of objects is transferred.

8 The Results of Some Product Data

Once the software has been implemented, the system was filled with sham-generated data to provide complete testing. Testing was started with the reporting module. Tables show a scenario was used to test the performance of the module. Following (Tab.1) shows Generation of scenario employee report and (Tab.2) shows a scenario of generating a draft report.

Table 1. Generating script employee report.

Number 1	**Create employee report**
Characters	User system
The initial state	The user is on a Report Page
The final state	System generated reports about the employee
Scenario	1. The user selects the type of report; 2. The system displays the field attributes for the detail of the staff report; 3. The user fills in the attributes and presses the button «Start»; 4. The system generates and displays a report in the next step.
Error messages, warnings	All fields must be filled.

Table 2. Generation of scenario projects report.

Number 1	**Create project report**
Characters	User system
The initial state	The user is on a Report Page
The final state	System generated reports about the project
Scenario	1. The user selects the type of report; 2. The system displays the field attributes for detail project report; 3. The user fills in the attributes and presses the button «Start»; 4. The system generates and displays a report in the next step.
Error messages, warnings	All fields must be filled.

Prioritization of tasks in a set can be a system, however, in the test data, we have the following set:

- Blocker: High importance of the tasks they affect the operation of the customer as a whole;
- Critical: Critical challenges that impede the customer, but not blocking his work as a whole;
- Major: Medium priority tasks, the problem which arises from the customer several times per week;
- Normal: the lowest priority.

Further testing was performed according to the scenario forecasting module displayed in (Tab.3).

Table 3.- Creation script on the employee prognosis.

Number 1	**Creating a prediction about the employee**
Characters	User system
The initial state	The user is on the prediction page
The final state	The system has generated a forecast about the employee
Scenario	1. The user selects the type of prediction; 2. The system displays the field attributes for detailed forecasting of staff; 3. The user fills in the attributes and presses the button «Next»; 4. The system generates and displays a prediction in the next step.
Error messages, warnings	All fields must be filled.

The system analyzes the existing problem and the employees in a list of projects with a similar set of challenges. Searching for the best candidate for the job based on the task of applicants using trend generated by the prediction unit. The module also includes employees who are represented in the system only for a certain period of time and will be able to become as mentors for newcomers.

The obtained results of testing modules very accurately show the performance of the developed solutions and meet the requirements of the final product.

Conclusion

The proposed method analyzes and introduces a new way to support project management based on previously examined the issue of information systems ERP large enterprises. The proposed new module of decision support in project management allows to increase the quality of project and this decision support is a promising direction in project management.

Literature analyses show that the implementation of decision-making in the management of projects by the decision maker poorly uses information technology. The analysis identified the main processes in which decision support is needed, as well as their positive impact on the final decision making a more accurate estimate of the project solution.

We developed a model information system based on the allocated requirements and algorithms. A software solution to support decision-making in project management problems was implemented.

Testing of the support system developed by these results proved that the use of decision support system leads to improvement of quality indicators of decision-making.

Using this information system provides the following advantages:

1. increasing the speed of decision-making;
2. receiving different types of messages quickly;
3. possibility to work remotely;
4. automated interaction with external systems for timely updating of information in the local database;
5. rapid detection of trends using predictive methods.

Therefore, establishing a company with a large number of employees and a large number of tasks, supporting the decision-making of the information system in project management problems is effective and appropriate.

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