

The Concept of Integrated Information Technology of Enterprises Project Activities Management Implementation

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Abstract

The analysis of modern software tools for project management is performed. The functional incompleteness of these tools is shown from the standpoint of providing projects with information, resources, finance and permitting decisions. The analysis concluded that it is necessary to create tools for managing the processes of acquisition and delivery of resources under the project plan, budgeting, management of interactions with external management entities, management of operational activities aimed at producing products for projects. Based on this, the objectives and purpose of the study are formulated, which is to develop a concept of project management systems integration with project provision management systems into a single information technology of enterprises project activities management and the allocation of information management core as a tool for information management in enterprises project activities. As a supporting component, it is proposed to use software and information superstructure over project management software tools. The control functions that these systems must perform are given. It is shown that the use of software and information superstructures together with project management software tools requires the creation of an information and control core, which will take over the intersystem information interaction in the processes of project management and project provision management. It is proposed to use the enterprises and projects information management system PrimaNad as such information-control core. The functions of this system are given and templates of the basic processes of enterprises project activity management realization are developed.

Keywords 1

Enterprises project activity, information management, software and information superstructure.

1. Introduction

Trends in the development of project management information technology are aimed at the transition to digital transformation and integration of all aspects of activity. In essence, this means that all management processes are completely transferred to the digital environment. For this purpose, first of all, integration of all tools which are used for information filling of projects, including those which are created for enterprises management is required. This is a requirement of time, a requirement of companies, a requirement of project managers.

Of particular importance in this way is the information support of the project implementation process. In fact, all project management software tools create a particularly valuable resource - new information. But today it is not enough for a project manager to get the timing and cost of the project, the need for resources, determine their optimal distribution, assess the risks, etc. It is necessary to use

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management information technologies that would integrate project management functions with enterprise management functions, primarily to provide projects with finances, resources, information and solutions that are not within the competence of project managers. Usually these functions cannot be implemented in the existing project management tools, as they relate to the operating activities of enterprises. Therefore, there is a need to create matrix information technologies for project management, which reflect the project management processes (planning and monitoring of project tasks), and operational processes aimed at projects provision [1]. And such matrix information technologies should be implemented in the digital space of project-oriented enterprises, where both the tools of information management project systems and the tools of enterprise management systems will be integrated. Therefore, the issue of integration of project management tools with the tools of operational activities automation, in terms of project provision, comes to the foreground in the creation of project management information technology.

2. Analysis of data from sources and problem statement

The modern solution to the problem of project management systems integration with operational activities information systems, in terms of project support should be based on the creation of a single digital environment of the enterprise. Given that part of the digital environment related to project activities will be formed by both project management tools and project provision management tools, it is necessary to analyze these two classes of software.

Today almost all scientific sources in the field of project information technology considers only project management tools. Among them are enterprise resource management systems (ERP-systems) [2]. Enterprise resource management systems are enterprise systems that have project modules. The disadvantage of these systems from the standpoint of project management is their significant cost, as well as the focus of functions "from projects to the enterprise." Although in the presented task of project management systems integration with project provision management systems the orientation of the functions is reversed - providing "from the enterprise to projects".

The range of project management tools is quite wide [3 – 6]. The most popular of them are MS Project, Primavera Project Planner, Open Plan. Their features are:

1. **Microsoft Project** [3]. The world's most popular project management tool. It is most often used along with other Microsoft Office tools. The main advantage is simplicity. In MS Project only the most commonly used project management functions are included. It is most often used for project management in small and medium enterprises.

2. **Open Plan** [4]. Used to plan and control large projects and programs. Has powerful means of resource and cost planning. It allows to organize multi-user work and can be used to manage project activities throughout the enterprise.

3. **Oracle Primavera P6 Professional** [5]. The most professional project management program. Used for resource planning and management. Used to manage medium and large projects in various fields. The peculiarity: allows to manage portfolios of projects and programs.

Other manufacturers and other systems are not as powerful as mentioned above. And their set of functions is much poorer than the above programs.

Among WEB systems, the **Clarizen** system is popular and functionally close to MS Project [6]. Of course, systems with WEB access are not as fully functional as above but have the advantage - access to the project from anywhere and at any time.

The means of project provision management can include a number of works on the matrix information technologies creation [1]. They provide methods and tools: enterprises project resources management, administration of events and decisions, coordination of operational and project activities, budgeting of enterprises in terms of project management.

The project resource management system is interesting [1]. While maintaining the project orientation, it additionally implements project resource management. And it essentially combines project management functions with project resource management functions.

Analysis of sources on information technology management and project management has shown that:

1. Project management functions, which are implemented in software tools, do not cover all the functions of the enterprise aimed at the organization and implementation of project management. Therefore, it is necessary to develop software and information superstructures for project management tools that will implement additional functions of project provision management.

2. The integration of project management systems with the project provision management system requires the development of information management technologies and information interactions of these systems. Therefore, there is a need to create an information and control core of project management systems and project provision.

As can be seen from the analysis, much is being done and has been done in this regard. But in most cases, these are disparate tools that are not integrated into a single system for solving functional and supporting project management tasks. As the analysis showed, it is necessary to integrate project management systems with project management provision systems into a single information technology for project management (ITEPAM) on the basis of some information control core - a system that can manage information interaction of all involved in project management and project provision management.

The term "information and control core" is borrowed from the informatization program of the National Academy of Sciences of Ukraine (NASU). In the opinion of the document authors, *the information and control core is a set of engineering and technical solutions and organizational and technical structures and measures that support the management of digital resources of NASU information system* [7].

In terms of the formulated tasks, it is told about the creation of a single information technology for managing digital resources of project management systems and project provision management systems.

But the question arises. How in practice to integrate project management systems with project provision management systems into a single information technology for project management of enterprises? To answer this question, it is first necessary to develop a concept of such integration.

3. Purpose and objectives of the research

The purpose of the work is to develop the concept of integration of project management systems and project provision management systems into a single information technology for project management of enterprises.

To achieve this goal, it is necessary to solve the following tasks:

- to determine the functions of project management that are implemented with software tools;
- to determine the functions of project provision that are implemented with software and information add-ons;
- to develop the concept of integration of project management functions and project provision management functions in a single information-control core of enterprises project activities management information technology.

4. Presentation of the main material

4.1. Information incompleteness of project management tools in terms of project activities

The analysis of project management software tools allowed to identify the functions that are usually implemented in such tools. Such functions include:

1. Project time and cost management.

1.1. Forming works and establishing connections between them. In this function, the main tasks of the tools are to plan the work itself and the responsible people. Namely, determining the sequence of works, their coding at all stages of the project life cycle by stages, sub-stages, responsible, project team, departments and resources. In addition, it simulates the time parameters of the project, network diagrams, taking into account various constraints.

1.2. Definition and analysis of costs.

The information systems display data related to project budget planning and management. Stakeholders receive dynamic information on costs, their forecasting, identification of weaknesses and strengths of funding. And on the basis of this information to make optimal management decisions to reduce or increase costs in each life cycle of the project.

1.3. Cost analysis of project resources.

In this function, information systems are able to implement resource management in terms of determining the required procurement, their cost, availability, analogues for project tasks. Formation of blocks from works stages and necessary resources, models of resources optimization, modeling of behavior of the project at various resources. The result is a calendar of resource needs.

2. Project implementation and control

2.1 Project implementation

Information systems have a list of works and their responsible, fixed funds for each work. Function of executors - fixing of a course of execution, spending the budget, etc.

2.2 Monitoring and control of project implementation.

Stakeholders have the ability to track the progress of the project in real time, record project targets and make comparisons with actual indicators. To control the loading of resources, costs, identify weaknesses, model the progress of future work taking into account external and internal influences on the project. The method of the mastered volume is most often used. If necessary, to change the stages responsible for budgeting and procurement. But this practice is the evidence of imperfections in planning.

3. Project risk analysis.

3.1 Risks of project completion.

In project management tools, this feature allows you to reflect the risks of timely execution of both individual works and the entire project. It is based on the calculation of the project completion probability (project work) in a timely manner.

3.2 Resource risks.

Data on the possibility of receiving not enough of the necessary resources is displayed.

4. Interactions between stakeholders.

4.1 Information exchange.

Communications in information systems are formed by means of the local, cloud server, e-mail. Communications are carried out both between stakeholders and between programs. Software is designed to protect information from unauthorized access.

4.2 Information visualization tools.

Communications between stakeholders are realized through documents in the form of plans, reports. The key in such visualizations is time, cost, loading, etc. In software products it is realized in the form of various diagrams and schedules: calendar schedule of works (Gantt chart), grid diagram of the project, histograms of resources loading, etc.

The analysis of project management software tools, in particular the most used and functional ones such as MS Project Professional 2016 [8] and Oracle Primavera P6 Professional [5] showed that these tools provide the ability to develop and monitor project plans, provide information on project progress, responding to changes in the project. Using Microsoft Office Project Professional with Project Server or using Oracle Primavera P6 Professional allows working collaboratively on a project. In particular, these tools allow project managers and business decision makers to view information on projects and resources across the unit or organization as a whole.

But in addition, the analysis revealed some functional incompleteness of these systems. According to the selected functions, it is discovered that in information systems the issues of project provision, in particular resource provision (rather than management of received resources), formation of the enterprise budget in terms of project activity, control over administrative procedures (planning of external events, reaction to events that do not occurred), providing products of operational activities (products of which are required in the projects) remain open.

To implement these functions in the paper [9] the concept of superstructures for software tools is proposed. But the main problem is that the information bases of software and software superstructures are fragmented and there are no means of interaction between them. So, planning to purchase a resource in the NadProject system will not be reflected in the PrimaNad system, and vice versa.

Therefore, there is a need for information interpenetration of these systems in solving problems not only project management but also project provision management. The solution to this problem is proposed through the creation of an information and control core in ITEPAM. But first let's consider the functions of projects provision management information systems, the implementation of which requires the creation of such an information and management core.

4.2. Functions of project management provision information systems

The problem with the implementation of project management information technology is that not all the necessary functions of project management and project provision management are implemented by software tools. This follows from section 4.1. And this is understandable. After all, most functions are focused on the features of each project-oriented enterprise (Fig. 1) and software tools - for use in many companies. And here we are not just talking about the name of the function, but about the features of its implementation. For example, budgeting. It can be performed centrally using previously developed plans (correct, but not often implemented). Or the information for formation of the enterprise budget can arrive in the form of applications from enterprises divisions (not absolutely correctly but is realized practically by all enterprises). In turn, such applications have different structures at different enterprises, are filled in at different time intervals, have different routes of approval. Overhead and administrative costs are calculated differently. Therefore, there are no tools for enterprise budgeting in project management software.

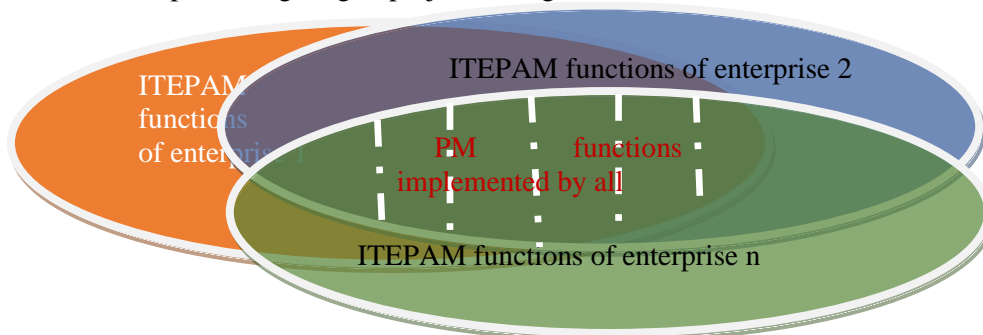


Figure 1: Intersection of project management and project provision management functions of different enterprises

In general, the experience of implementing information technology project management in domestic enterprises, the research of the functions of project management systems is described in section 4.1 and the analysis of sources allowed to identify functions that are implemented in management or project management, but not implemented in software. These are the functions:

- formation of the budget of the project-oriented enterprise (instead of the project budget, which is well implemented in almost all software), including the distribution of overhead and administrative costs of projects;
 - administration of events and decisions that are not within the competence of the project manager;
 - production management, the products of which are the resource of projects (production for projects);
 - order, acquisition and delivery of material and technical resources management;
 - management of the resources manufacturing process, which is distributed over the various works of the project;
 - information management of projects and project portfolios at the enterprise (maintenance of documentation archives, document flow, formation and approval of plans and applications for resources in operational activities, products of which are used in projects, budgets of different levels, control of permits and project documentation, etc.).

Thus, there is a functional and information gap between project management and management of project-oriented enterprise in terms of project provision. It is proposed to eliminate it with the software and information superstructures for the implementation of these functions. Some tools of

such superstructures were developed to perform various functions in project management and are given in [1, 9]. These are systems:

PrimaNad. The software package "Corporate Project Resource Management Information System (PrimaNad)" is designed to collect, store, process and use information to solve problems of budgeting and management of logistics (MTR) and labor resources, as well as time in projects at different levels of functional and project-oriented activities of manufacturing companies. It is used, first of all, for the decision of operational problems in project-oriented activity of modern industrial enterprises. It increases the efficiency of manufacturing companies functional units by creating a relevant information environment for projects and enterprises.

PrimaLib. The automated information system of planning and administration of projects is intended for formation of the information environment of projects management providing the solutions of problems of decisions planning and administration on projects through time management, management of financial and labor resources (using the modified method of critical chains), conducting documents and results of works, control of tasks on projects. It is used, first of all, for administration of actions on projects which are essence of the solved tasks (performed works) and connected with coordination, reception of permissions, support of documents of projects, instructions (external, concerning competences of the head of the project decisions), etc. It increases the efficiency of functional units by creating a matrix information environment for projects and enterprises. It can be used in conjunction with MS Project due to the integration of functional program environments based on a single information base. At the same time, MS Project is entrusted with the function of visualizing the information environment of the system and is also a graphic editor when plotting projects.

NadProject. This is a set of IT tools designed to provide information support for project management in the company. Improving the quality of project work with material and technical resources through the use of planning and monitoring of operational activities aimed at providing projects with various products. NadProject receives information from the project management system on the distribution of the necessary material and technical resources over time and forms a plan of operational activities in such a way as to produce the necessary material and technical resources for the projects in a timely manner. It is relevant for machine-building, aircraft-building, instrument-making and other enterprises that combine design and operational activities. In essence, this superstructure provides managers with up-to-date information of project participants, the creation of a single information space between design and functional units.

But the requirements of the digital transformation of project-oriented enterprises is the creation of a single digital space, which would be formed by various software and information superstructures. Thus, there is a need to create and apply the information core of such integration - information management systems of enterprises and projects. Such a system will take over the functions of information exchange between various information superstructures, operational activities management tools of a project-oriented enterprise and project management tools in a single information technology of enterprises project activities management.

Based on this, it is proposed to move away from the traditional scheme of information technology project management implementation (Fig. 2 - upper part) and develop information technology of enterprises project activities management, which would integrate projects and enterprises databases (in terms of project provision) in enterprise and projects information management systems (Fig. 2 - lower part). Let's consider the functions of such an information-control core of ITEPAM.

4.3. Functions of ITEPAM information-control core

In accordance with the proposed scheme (Fig. 2) functions related to the information interaction of project management systems and operational management systems of enterprises, in terms of project provision management, are transferred to the information core - software and information system, which must perform functions:

1. Processing of incoming, internal and outgoing documents on project management and project provision management, as well as documents coming from information systems.
2. Automatic redirection of documents (the order and rules of redirection are set by the user).

3. Encryption of documents.
4. Ensuring simultaneous work with the information and control core of any number of project teams.
5. Logging of all actions of project teams with information.
6. Automatic distribution of project documents by categories: not executed, executed, closed, created, templates, canceled, archived.
7. Ensuring work with information as a correspondent (to whom the document is sent), but also project managers and coordinators, who can work with all project documents working under their login.
8. Setting the procedure for reviewing documents, with return, clarification, redirection, etc.
9. Maintaining a digital archive of documents, messages, letters, tasks, etc.
10. Creating groups of recipients for simultaneous information processing.
11. Monitoring the implementation of tasks that are in the documents.
12. Processing of both project documents and documents of operational activities related to project provision.
13. Control of passage and storage of information.
14. Diagnostics of digital project environment.
15. Providing different modes of work with information.
16. Creating, adjusting and maintaining the structure of documents in a digital archive.
17. Obtaining "tasks" from project management systems, or software and information superstructures for approval of documents related to project management and project provision management. Execution of these "tasks" with the transfer of execution results to the appropriate information systems.
18. Management of information (documentation) passage routes at solving of functional problems of projects management and projects provision management (through templates).

To perform the functions of the information management core, it is proposed to use the system enterprises and projects information management PrimaNad [10]. This system allows to centralize the process of information and document processing in project management systems and software and information superstructures, as well as provides a single digital archive of the enterprise. In particular, the system allows you to configure document templates and their routes of approval and signing to perform the functions of software and information superstructure:

- order, purchase, receipt of material and technical resources[11,12];
- formation of the enterprise budget in terms of project activities;
- distribution and control of tasks on projects and operational activities aimed at providing projects with material and technical resources manufactured at the enterprise;
- approval and signing of documents required for projects legalization;
- address archiving of documentation.

These functions are based on templates for processing and passing information in the digital space of the enterprise. For example, the procedure for ordering and receiving material resources (when used for project planning MS Project) is performed according to the following template:

1. Determining the timing of material and technical resources use (from the plan of work in MS Project).
2. Checking the availability of material and technical resources in the warehouse, and the possibility of using them in the planned project (PrimaNad).
3. If the material and technical resources can be obtained from the warehouse, the deadline for the MTR obtaining application is set (PrimaNad). Go to item 10.
4. Calculation of the term of material and technical resources order procedure initiation (PrimaNad).
5. If the deadline has not come - suspend the procedure.
6. Selection of a template a) purchase, b) order, c) tender procedure. Formation of documents for approval. Start of approval (PrimaDoc).
7. Monitoring the activities of persons who must approve documents: sending a notice of the need to approve the document; timing control; reminder; tracking the forwarding of subordinates; control of non-approval and return of documents (PrimaDoc).
8. If the documents are processed go to item 10.

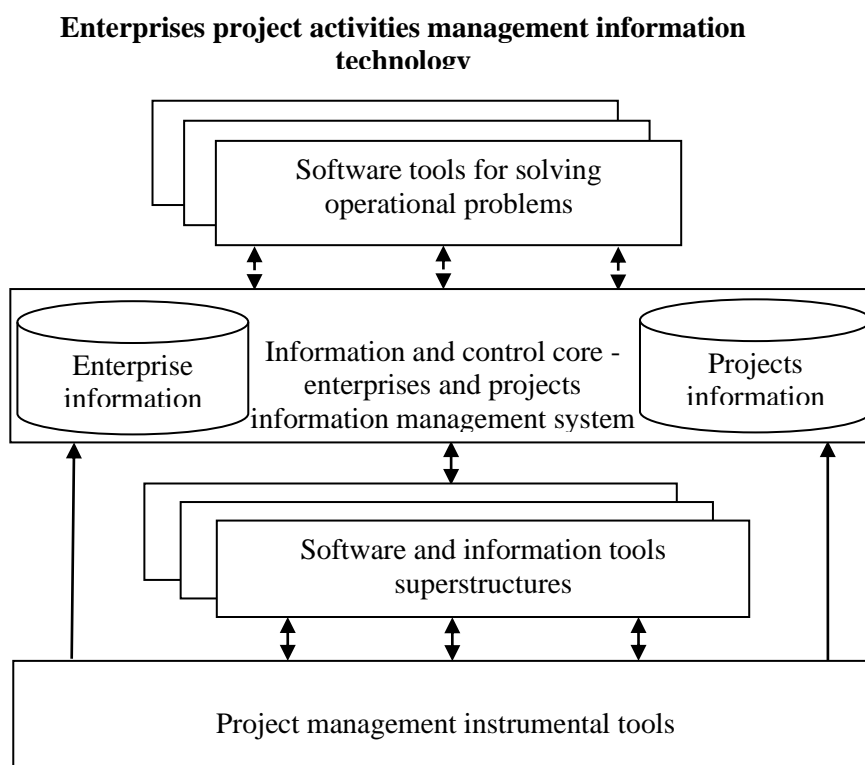
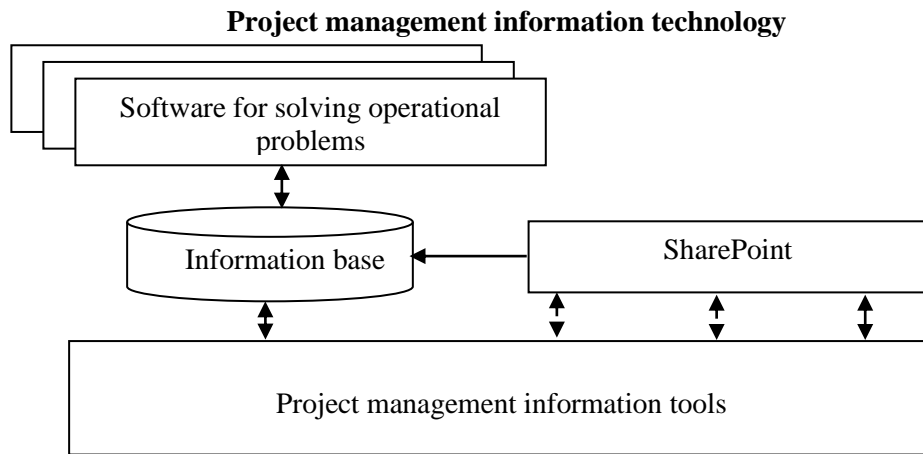


Figure 2: Comparison of structures of IT project management and IT management of enterprises project activity

9. Making changes to the project plan (source of information - PrimaDoc, implementation - MS Project). Suspend the procedure.
10. If the deadline for receiving the MTR from the warehouse has not come - suspend the procedure.
11. Start of implementation of the template for receiving MTR from the warehouse (PrimaDoc).
12. Monitoring the activities of persons who must approve receiving the MTR from the composition: sending the application; timing control; reminder; control of non-approval and return of the application (PrimaDoc).
13. If the application is processed - completion of the procedure.

14. Making changes to the project plan (source of information - PrimaDoc, implementation - MS Project). Suspend the procedure.

Three systems are integrated in this procedure: MS Project, PrimaNad and PrimaDoc. The PrimaDoc system receives information from the PrimaNad system and implements the process of approval and signing of all necessary documents to ensure that material and technical resources arrive at the project on time.

Let's consider the procedure for planning operational activities, the products of which are required in the projects. Template:

1. Calculation of the need in terms of terms of operating activities products use of the enterprise in projects (from the plan of work in MS Project).

2. Formation of the operational activity plan part relating to projects (NadProject).

3. Start of the template implementation for approval of the operational plan (PrimaDoc).

4. Monitoring the activities of persons who must approve the plan: sending a notice of the need to approve the plan; timing control; reminder; tracking the forwarding of subordinates; control of non-approval and return of the plan (PrimaDoc); sending to approval.

5. If the plan is not approved, making changes to the project plan (source of information - NadProject, implementation - MS Project). Suspend the procedure.

6. Start of implementation of the template for issuing tasks for the production required for projects (PrimaDoc).

7. Monitoring of tasks implementation (PrimaDoc).

In this procedure there is an information interaction between three systems: MS Project, NadProject and PrimaDoc. And the PrimaDoc system concentrates on itself all information streams and transfers the necessary information to executors. And then it monitors whether the performers have considered these tasks, and whether they are performed. Another particularly important procedure for development projects is obtaining building permits. Template of this procedure:

1. Calculation of the maximum and desired time of occurrence of events related to administrative procedures, such as external decisions. In particular - obtaining building permits from public authorities (from the plan of works in MS Project).

2. Calculation of terms of the beginning of actions which will allow to execute administrative procedures in time (PrimaLib).

3. If the term has not come - suspend the procedure.

4. Start of implementation of the template for administrative procedure (PrimaDoc).

5. Monitoring the activities of administrative procedures executors: sending a notice of necessary documents provision; control of documents receipt; approval of documents; control of terms of documents passing; reminder; control of non-approval and adjustment of documents; referral for approval; control of consideration on the statement (PrimaDoc).

6. If the administrative procedure ended in failure - adjustment of the project plan and the transition to item 2 (adjustment - MS Project).

The implementation of the procedure relies on the PrimaDoc system, which concentrates all information flows in this procedure. In project management and project provision management information technology, there are many procedures for which PrimaDoc templates can be developed. The implementation of these templates provides the formation of the information and control core of ITEPAM processes, which, in turn, becomes available to project management systems and software and information superstructures, and management systems of operational activities of the enterprise. This is fully consistent with the concept of information and control core in project management and project provision management systems.

5. Conclusion

The fragmentation of different information systems in project-oriented enterprises leads to a gap in the technology of solving project problems - from providing activities to project implementation. Therefore, the paper proposes the concept of integration of systems involved in project activities, in particular project management systems MS Project Professional 2016 [8] or Oracle Primavera P6 Professional, with project management systems (PrimaNad, PrimaLib, NadProject) and proposes to

create on this basis an integrated information technology of enterprises project activities management. When creating this concept, a number of scientific and technical problems were solved:

1. The project management systems functions that are implemented in tools are defined. The analysis allowed not only to accumulate knowledge of the functions implemented by popular project management tools, but also to identify those functions that are not implemented by them. The implementation of such functions is entrusted to the project provision management system.

2. The functions of project provision management systems are defined. In particular, these are the functions of providing projects with financial, material, information resources, products of enterprise operating activities and decisions, the adoption of which is not within the competence of the project manager. To implement these functions, it was proposed to create software and information superstructures over project management instrumental software: PrimaNad, PrimaLib, NadProject.

3. The functions of enterprises and projects information management system are presented, which will integrate the information environments of project management systems and project provision systems into an integrated information technology of enterprises project activities management.

The proposed approach, structures, templates and schemes of supplementing project management software tools with software and information superstructures that implement the project provision functions, and enterprises and PrimaDoc projects information management system tools formed the basis of a new concept of building an integrated information technology for project management. It indicates the achievement of the purpose of the work.

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