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ANALYSIS OF THE PROBLEMS OF MANAGING BUSINESS PROCESSES OF ENGINEERING COMPANIES IN THE IMPLEMENTATION OF INVESTMENT PROJECTS

Об'єктом дослідження є система управління бізнес-процесами інжинірингових компаній. В роботі розглянуто існуюча система взаємодії проектних інститутів, інжинірингових компаній та виробничих підприємств, що впроваджують інвестиційні проекти. Зокрема, визначено відмінності побудови бізнес-процесів у раніше діючих проектних установах та сучасних інжинірингових компаніях. Методологія дослідження спирається на теоретичний та методологічний аналіз наукової літератури, статистичні методи, а також спостереження, порівняльний метод, опис, вимірювання. Використання наукових методів дослідження дозволило виявити слабкі місця та протиріччя у системі управління бізнес-процесами.

Результати даного дослідження свідчать, що розробка, перевірка, узгодження та затвердження проектно-кошторисної документації є основним бізнес-процесом інжинірингових компаній. Доведено, що окреслені бізнес-процеси є невід'ємною складовою інвестиційного проекту. Тому для успішної реалізації проектів компанії замовники залучають велику кількість зовнішніх підрядних організацій – проектні, інжинірингові, будівельні компанії. Збільшення числа учасників інвестиційного процесу значно ускладнюють побудову бізнес-процесів, що призводить до зростання строків розробки, перевірки, узгодження та затвердження проектно-кошторисної документації.

Проведення аналізу дозволило виявити причини виникнення невідповідностей при роботі з документацією. Основними причинами збільшення часу перевірки є системні проблеми організації взаємодії учасників проекту. Визначено, що раніше існуючі держателі архівної проектно-конструкторської документації, які надавали комплексні послуги «під ключ» практично зникли з ринку. На їх місці з'явились підрядні організації, виокремлені зі складу великих профільних проектно-конструкторських організацій. Створені підрядні організації працюють у різних версіях програмного забезпечення, тому створені ними комплекти документів мають різний ступень деталізації проектних рішень. У цілому, рекомендовано оптимізувати стикування документів між учасниками інвестиційних проектів. Реалізація запропонованих заходів стає можливою за умов впровадження інформаційних технологій, заснованих на спільній командній роботі зі створення електронної моделі.

Ключові слова: *інвестиційний проект, операційна діяльність, проектно-кошторисна документація, оптимізація процесів, інформаційні системи управління, планування діяльності.*

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1. Introduction

In recent years, the Ukrainian manufacturing industry has experienced complications and a decline in some indicators. Markets in which manufacturers felt quite comfortable felt a marked decrease in demand, which led to a drop in production and influenced a decrease in the number of investment projects. A decrease in the volume of construction and modernization of industrial facilities has led to crises. Design institutes, building trusts and commissioning departments felt significant problems, specialized in implementing investment projects [1, 2]. As a result of the systemic crisis, a significant number of these enterprises and institutions completely ceased to exist, and some fell into separate design, construction and engineering companies with a narrow specialization of the performed work. Engineering departments of industrial enterprises, traditionally responsible for the implementation of investment projects, also underwent significant reductions and reorganizations.

The current situation indicates that large industrial associations are forced to create their own engineering units that are able to be responsible for the whole range of work during the implementation of the investment project. Along with this, engineering companies have been created that do not have complete sets of project specification and are forced to involve dozens of external contracting organizations, including design ones [3]. The increase in the number of participants in the investment process significantly complicates the construction of business processes of

engineering companies, which can be seen in the increase in the terms of development, verification, approval and approval of design and estimate specifications.

Issues of managing business processes are given attention in [3–5], in which the authors proved the possibility of creating highly efficient production at a new level. A constant analysis of the revealed patterns allows scientists to determine the conceptual foundations of the organization of business processes. The study of the nature and characteristics of business process management is further developed. Thus, the authors of [6–8] help to adapt the theoretical views of business process management with modern market requirements. At the same time, the practice of managing business processes indicates the existence of procedural problems in the conditions of engineering companies. Therefore, the issues of managing business processes are relevant and require further study.

Given the foregoing, *the aim of research* is to study the existing problems of managing business processes of engineering companies. *The object of research* is the business process management system of engineering companies.

2. Methods of research

Management of the business processes of engineering companies involved in the implementation of investment projects provides for the creation of a system of relations between the customer and design, construction, installation and engineering organizations [4]. The concepts used by engineering companies differ from highly specialized and individual design. As a rule, an engineering company is part of several large enterprises or holdings, each of which carries out various functions: design, construction, equipment supply and installation, installation work, project management, technical supervision, engineering support of investment projects, the following works (repair, service, maintenance, etc.). At the same time, such companies, performing turnkey work, have the status of formally independent, capable of providing services simultaneously in several areas [3, 6].

The most common types of engineering companies are companies operating in the field of construction, information technology, as well as related fields. At the same time, companies carry out full management and maintenance of technical projects, namely:

– planning a place for placing objects;
– solution of legal issues regarding the placement of facilities;
– engineering inventions;
– design;
– building;
– examination;
– supply and maintenance of equipment;
– commissioning [7].

The main feature of management in engineering companies is a systematic approach and the cooperation of various methods. Therefore, their main priorities are building a perfect system of business processes and professional implementation of innovative solutions [8].

One of the most important business processes of an engineering company is «Design», associated with the development of design and estimate specifications (DES) [9]. At this stage, high requirements and quality standards are applied in relation to the adopted technical solutions, as well as their coordination in the framework of the entire project. Ensuring high quality design and estimate specifications is traditionally achieved through a multi-level cyclic verification system. A cyclic verification provides for the coordination of individual sets of specification and a comprehensive verification of related ones (Fig. 1).

In practice, this procedure involves the preparation of an explanatory note, the main drawings and functional diagrams of basic engineering, a master plan in accordance with the requirements of state standards and building codes. Verification of design and estimate specification provides for the integration of adjacent sets of drawings, verified by specialists from different departments and organizations. Data acquisition is accompanied by the constant interaction of a large number of participants in an investment project [10]. This greatly complicates the design process due to controversy. The repetition of verification cycles is exacerbated by the problems of implementing investment projects (Fig. 2).

The increase in working time with specification occurs due to the appearance of unforeseen approvals and an increase in the number of iterations. As a result of the quality control of design and estimate specification, specialists form a list of comments that reflect the comments and suggestions for adjusting the design and technical decisions that were identified during the audit. The design organization considers the received letters of comments and provides a written response to each sent comments. The answer contains agreement or disagreement with the comments, explanation or justification of the reasons for the design decision (for example, it may be special requirements of state standards or industry normative documents for this technological unit or special operating conditions, etc.).

After coordinating the answers of the design organization's specialists to the comments made by the specialists of the relevant departments of the engineering company, the design organization proceeds to adjust the design and estimate specification. After the completion of this process, the corrected specification is sent for re-verification and approval. The indicated procedure is repeated until the comments are completely eliminated. In some cases, the number of matching iterations can reach 5–7 pieces. At the same time, the average duration of the review process, the elimination of comments and the approval of the final version of the set of design and estimate specification are from 2 to 10 weeks. The duration of this business process directly depends on the qualifications of the contractor's specialists involved, the current workload of the contractor's specialists and other uncontrolled factors. The calculation of the total time spent on DES set verification, it is advisable to calculate by the formula:

$$T=t_1+t_2+t_3+t_4+t_5+t_6,$$

where T – the total time spent on DES verification, days; t_1 – time for sending DES from the developer to the chief project engineer (CPE), days; t_2 – time for processing received files sent to profile specialists of the design, engineering and construction department, days; t_3 – time to verify received files by specialized specialists, days; t_4 – time for execution and approval of a letter of consideration of specification, days; t_5 – time to processing letter, referral to the contractor by the CPE, days; t_6 – reaction time of the contractor to the letter of consideration and DES adjustment, days.

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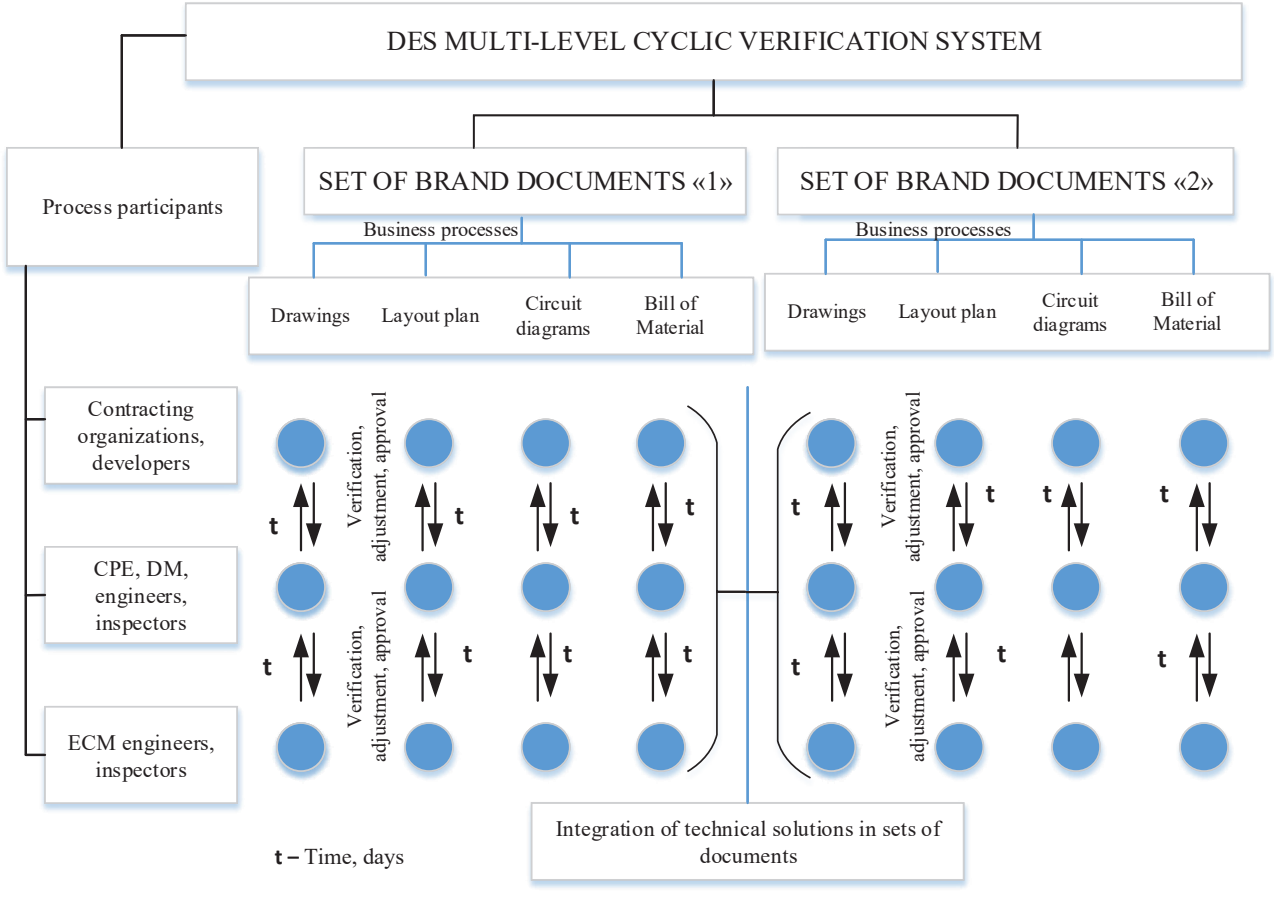

Fig. 1. The system of multi-level cyclic verification of design and estimate specifications (DES):
CPE – chief project engineer; DM – design management; ECM – engineering and construction management

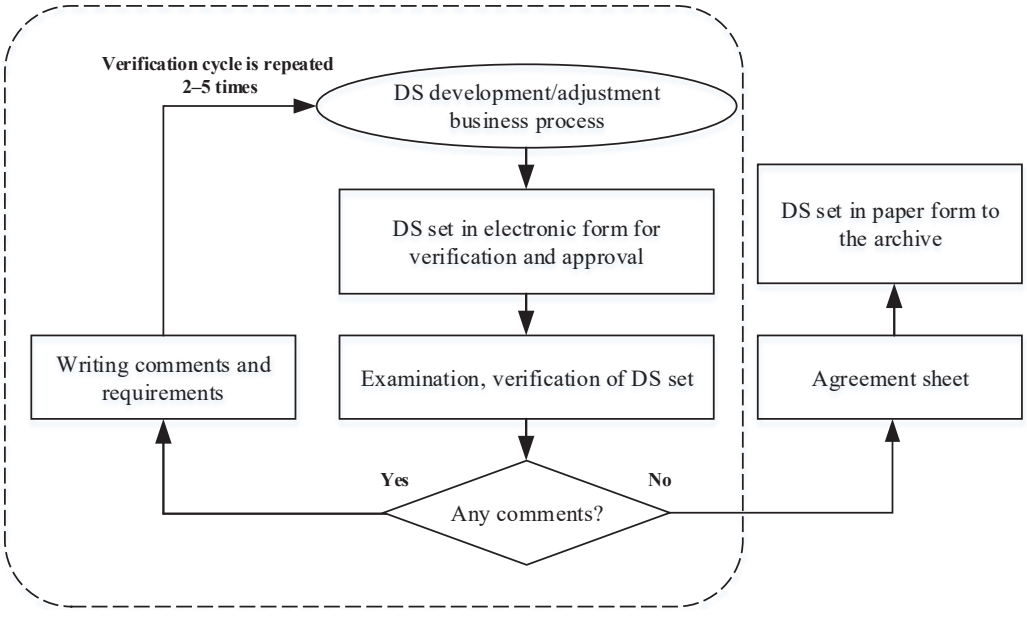

Fig. 2. The verification flowchart of the set of design and estimate specifications: DS – design specification

3. Research results and discussions

The main reasons for increasing the verification time are systemic problems in organizing the interaction of project participants. This is confirmed by the fact that external companies that previously were holders of archival design specification for reconstructed objects and provided comprehensive services for the design of large turnkey investment projects almost disappeared from the market. In their place appear contractor organizations that have been singled out from the composition of large specialized design organizations.

At the same time, the created contracting companies specialize in certain types of design and development work and develop individual brands of design specification. Each individual contractor provides the result of its work in the form of separate sets of specification of the corresponding brand. The work performed in different versions of the software has varying degrees of detail of design decisions. At the same time, the situation is complicated by a significant shortage of qualified design specialists with the necessary skills and experience in implementing large investment projects. All this increases the time of working with documents and imposes risks of increasing the cost of investment projects.

4. Conclusions

The study shows that in connection with emerging problems it is necessary to improve the business process management system, namely:

1) optimize the integration of documents by ascertaining the features of the location of technological objects in the design areas;

2) eliminate DES errors, bring it into line and form a unified information database.

The practical implementation of the proposed recommendations should be accompanied by the introduction of the latest information programs that will optimize business communications and facilitate the DES verification. Improving the integration quality of layout decisions made by various contractors can be achieved through the cooperation of project participants in a common team and a single information space. The predicted effect is able to reach 20–30 % of current indicators due to a decrease in the total cost of investment projects.

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