
Economic processes management at microlevel

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**TECHNOLOGICAL AND REGULATORY ASPECTS OF QUALITY
MANAGEMENT DURING THE LIFE CYCLE OF INVESTMENT AND
CONSTRUCTION PROJECTS**

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The division of the life cycle of investment and construction projects in four phases, based on their technological features, is proposed in the article. Regulatory aspects of quality management during each phase of the life cycle of investment and construction projects are analyzed. The model of quality management during the phases of the life cycle of investment and construction project is developed.

Keywords: *project management, quality management, investment and construction projects, phases of a project life cycle.*

Introduction. Investment and construction projects from management point of view are among the most difficult, because they last from 1 to 3-5 years and are characterized by high risk level, require significant investments of material, technical, labor and financial resources. According to the Project Management Body of Knowledge (PMBOK) developed by Project Management Institute, basic concepts of project management are processes grouped into five process groups and ten knowledge areas; the life cycle of the project, consisting of a set of phases. The project management knowledge areas are: project integration management, project scope management, project time management, project cost management, project quality management; project human resource management, project communications management, project risk management and project procurement management [1]. Groups of processes do not coincide with the phases of the project life cycle. They can be repeated at different phases of the project. As for the field of study, most of them cover each phase of the life cycle.

Analysis of recent researches and publications. The question of quality management in project management is covered in a number of international standards [1, 2, 3], and in works of such domestic and foreign scientists as I. Mazur, V. Shapiro, S. Titov, S. Bushuiev, E. Veksler, V. Lapidush, V. Lishchynska and others. These authors, as well as V. Hridasov, I. Kaleniuk considered

features of management in different phases of the project life cycle [4, 5, 6]. Nevertheless, for today technological and regulatory aspects of quality management during each phase of life cycle of investment and construction projects are not covered.

Main purpose of the article is a detailed analysis of technological and regulatory factors that influence the quality management during every phase of the life cycle of investment and construction projects.

Results and discussions. In international standards for project management, quality management, and quality management in projects universal principles, methodology and processes of quality management projects standards are reflected. They do not depend on the structure and scope of activities in which the project is located.

The result of the majority of investment and construction projects is built or reconstructed enterprise that will produce the intended in project products or provide certain services. If until 2000 year such projects in Ukraine could be met infrequently, lately they are met more often. They significantly influence the rate of economic development and are characterized by a large number of participants involved in these projects, by significant duration and technical complexity.

Project life cycle is a collection of generally sequential project phases whose name and number are determined by the control needs of organizations involved in the project. Project phase is a collection of logically related project activities, usually culminating in the completion of a major deliverable.

In different standards and literary sources authors propose to divide the project into three, four, five or six phases. For example, in PMI PMBOK it is proposed to divide project into four phases: initiate, organizing and preparing, executing and closing phase of the project. However, variants of one-, two- and three-phase projects are considered [1]. I. Mazur and V. Shapiro divide project into four phases: concept, planning and working-out, implementation, completion [4].

In our point of view, for investment and construction projects the most reasonable is division into such 4 phases: pre-investment phase, working-out phase, implementation phase and completion phase. In the initial phase the project concept is developed and preparatory works that are related to the project foundation and permissive documentation are conducted. During the working-out phase technical project and calculation documentation for future object is developed. During the implementation phase major construction or reconstruction works of the object are performed. During the completion phase the object is put in operation and project close-out is done.

According to PMBOK quality management includes such main processes: quality management, quality assurance, quality control [1]. However, in order to develop the quality management plan for a particular project, it is necessary to take into account the specifics of the project and specifics of the country where it would be realized. Besides the specificity of the project peculiarities of the life cycle phases have to be considered. To ensure the process approach to quality management in such projects firstly it is necessary to examine the technical and regulatory factors of the project. Below we will investigate these factors for investment and construction projects that are realized in terms of legal framework of Ukraine.

Quality management during the pre-investment phase of the project. The qualitative result of the project implementation from the investor's point of view and from the point of view of society is a variant that is characterized by: high-quality products; modern technologies; minimal negative impact on the environment; establishment of sanitary conditions for employees; fire security; high profitability. For the investor such project indicators are preferable: economic efficiency, quality of final products, the use of modern technologies; for society – minimal negative impact on the environment, safety of the object for people, who live around it, and arrangement of right conditions for employees in the company.

Quality requirements for the project in terms of society are set up, first of all, by institutions of local governing, and also by numerous public specialized services: department of environmental protection, department of land resources, boards of sanitary and fire control, department of urban planning and architecture, and other specialized services. That is why investor (customer) in order to obtain necessary positive solutions of mentioned above services must follow requirements about the quality of the project for society at each stage of the pre-investment phase of the project. Design and consulting organizations that work out technical and economic documentation for the pre-investment phase of the project must follow these requirements.

Quality management during the working-out phase of the project. The quality of project product is characterized by: high technological level of design decisions; economic efficiency of design object; savings of all kinds of resources; minimal negative impact on the environment. The quality of technical project documentation is estimated dependent on efficiency of technical, economic, technological, space-planning, design and architectural decisions.

To develop documentation that corresponds to requirements mentioned above, it is necessary to perform on a high-level such key project procedures:

- clearly establish with a customer task for projection;
- qualitatively conduct the full range of engineering surveys;
- qualitatively, with the latest scientific achievements, develop the technological part of the project;
- on the basis of technological part, make rational, technically and economically grounded building solutions;
- detailed and fully develop the technology of construction works;
- qualitatively work out complex of budget documents and make technical-economic calculation.

Measures, by which quality development of project documentation is ensured, must have comprehensive approach. They can be divided into the following key groups: organizational, technical, economic.

An important component of quality of the project documentation is its compliance with Unified system for design documentation (USDD) and System of design documents for construction (SDDC).

Implementation of computer-aided design (CAD) could be added to important components of the quality in the development of project documentation. The implementation of such systems allows the developer to resolve such issues:

- first of all – improvement of the quality of project documentation through minimizing design errors related with subjective factor;
- secondly – shortening the term of design estimates development;
- thirdly – cost saving during the development of the project documentation.

During the development of the project documentation Ukrainian developers use own program products and specialized programs:

- “ArchiCAD”, “InterAR”, “Maestro” – to make architectural decisions, 3D designing;
- “AutoCAD”, “Lira”, “Monomakh”, “Kompas” – to make a constructive part of the project;
- “ARS”, “AutoCAD” – to make a sanitarian part of the project;
- “Epos” – to make an electrotechnical part of the project;
- “Investor”, “Tender-Kontrakt XXI vek”, “AVK-5” – to make design estimates in the project.

Quality management during the project implementation phase. Quality of the built object is estimated during taking it into maintenance by the customer and the State Architectural-

Construction Inspection. They consider the following criteria: quality of materials, constructions, products, engineering equipment, construction and installation works, their compliance with standards and norms.

Quality of construction and installation works during the realization of the project is determined by the results of production control. It is estimated according to existing standards for quality rating of construction and installation works.

Production quality control in construction and installation organizations consists of incoming, operational and acceptance control. The results of monitoring must be committed in runtime journals on construction sites.

Quality of materials, constructions, products and engineering equipment must be estimated on enterprises according to branch instructions on the procedure of industrial products certification. Building constructions, products, materials and engineering equipment that are received on building, must be checked by incoming control. They should comply with government standards, standard specifications, passports and other documents confirming their quality.

Operational control should be carried out on construction site after the end of production operations or building processes. It helps to provide timely detection of defects and their causes to carry out measures to eliminate or prevent them.

Structure and content of operational quality control are regulated by a number of regulation documents. These documents establish the general procedure of quality control of construction and installation works during building for various purposes.

Operational control is carried out by executors of the work and foremen, construction laboratories, geodetic services and specialists, who control certain types of work. The control is done in accordance with diagrams of operational quality control of works that are designed for all building and assembly processes that is a part of execution project and is approved by chief engineers of construction and installation organizations. Diagrams of operational quality control are main working documents that control quality of work for responsible contractors, building laboratories, geodetic services, as well as for brigade-leaders and workers.

After operational control the acceptance control is done. Quality of construction and installation works that is done by brigades (workers) is carried out.

Construction quality control is carried out by such bodies of state control and supervision: engineering personnel of construction; customer's technical supervision; authorial supervision of project organizations; state architectural control; control of the bank, which finances the construction; state sanitary inspection; state fire inspection; laboratory monitoring of construction companies; geodetic control in construction; special organizations (depending on the specific of technical object).

Designer's supervision as a part of project quality management. To improve the quality, to reduce the construction cost and to enhance responsibility of project organizations for the quality of their buildings and constructions, in Ukraine is done designer's supervision by chief project engineer or, as an exception, by qualified experts of project organizations.

Designer's supervision is conducted by the project organization that made engineering design and working drawings. It is conducted during all period of construction and acceptance of completed object. It covers all types of construction, architectural, assembly, sanitary, technical and other special kinds of work.

Quality management during the completion phase of the project. During the completion phase of the project quality management consists in qualitative performance of such operations: manpower training to run the object; liquidation of defects and unfinished works that were identified by a customer; providing a full after-sales service.

Compliance of the constructed object with quality standards and their acceptance into exploitation is confirmed by the State Architectural-Construction Inspection. For objects that belong to the I-III categories of complexity this confirmation is made in such order: at first customer prepares a declaration of the object readiness for exploitation and then the State Architectural-Construction Inspection registers it. For more complex objects that belong to the IV and V categories of complexity the fact, that accepts accordance of the object to specific requirements is a certificate of readiness. This certificate the inspection gives to the project customer.

Warranty period of object exploitation allows the customer to require from contractors to remove the defects, made through their fault, in the fulfilled works with their own expense during the warranty period.

After consideration of the analyzed above technological and regulatory aspects, the project team can correctly develop a quality management plan, and in the future – its full implementation.

Based on the above-mentioned, we propose a model of quality management of investment and construction projects that considers project management standards, quality management standards and regulatory aspects (fig. 1).

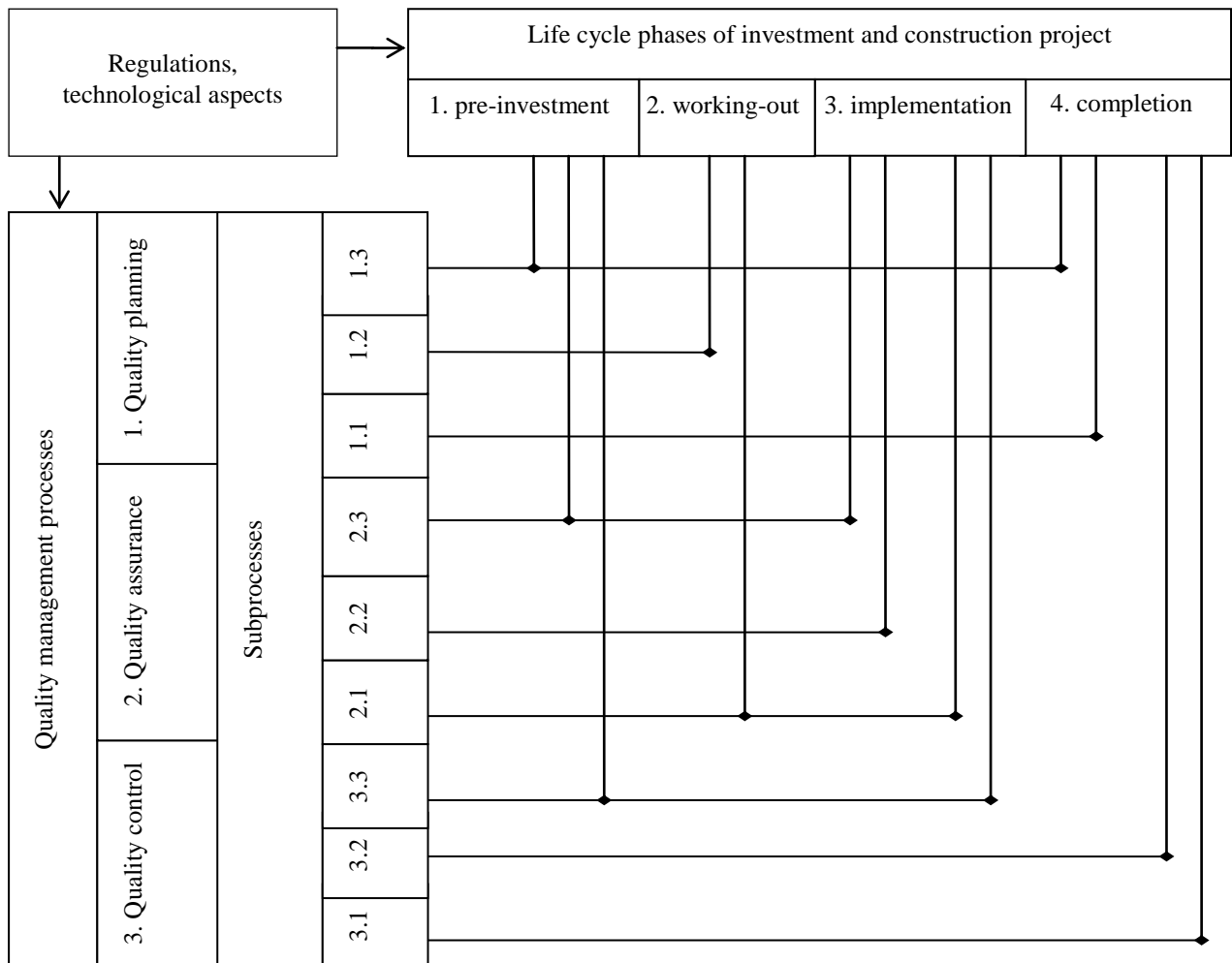


Fig. 1. Model of quality management of investment and construction projects that considers project management standards and regulations
 Source: authors' development

Conclusions and further researches directions. To ensure high quality of projects and products of investment and construction projects it is important:

- to study the existing legal framework that regulate requirements to the project and to the projects product;
- to develop the project management model with considering each of the phase of the project life cycle;
- to develop a quality management model during each phase of the project life cycle according to PMI PMBOK techniques, taking into account the individual characteristics of the project.

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ТЕХНОЛОГІЧНІ ТА НОРМАТИВНО-ПРАВОВІ АСПЕКТИ УПРАВЛІННЯ ЯКІСТЮ ВПРОДОВЖ ЖИТТЄВОГО ЦИКЛУ ІНВЕСТИЦІЙНО-БУДІВЕЛЬНИХ ПРОЕКТІВ

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У статті запропоновано розділити життєвий цикл інвестиційно-будівельних проектів на чотири фази, виходячи з їх технологічних особливостей. Проаналізовані нормативно-правові аспекти управління якістю впродовж кожної з фаз життєвого циклу інвестиційно-будівельних проектів. Розроблена модель управління якістю впродовж фаз життєвого циклу інвестиційно-будівельного проекту.

Ключові слова: управління проектами, управління якістю, інвестиційно-будівельний проект, фази життєвого циклу проекту.

ТЕХНОЛОГИЧЕСКИЕ И НОРМАТИВНО-ПРАВОВЫЕ АСПЕКТЫ УПРАВЛЕНИЯ КАЧЕСТВОМ В ТЕЧЕНИЕ ЖИЗНЕННОГО ЦИКЛА ИНВЕСТИЦИОННО-СТРОИТЕЛЬНЫХ ПРОЕКТОВ

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В статье предложено разделить жизненный цикл инвестиционно-строительных проектов на четыре фазы, исходя из их технологических особенностей. Проанализированы нормативно-правовые аспекты управления качеством в течение каждой из фаз жизненного цикла инвестиционно-строительных проектов. Разработана модель управления качеством в течение фаз жизненного цикла инвестиционно-строительного проекта.

Ключевые слова: управление проектами, управление качеством, инвестиционно-строительный проект, фазы жизненного цикла проекта.