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**SOME ISSUES OF THE FORMATION
OF ENGINEERING COMPANIES' ARCHITECTURE**

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**ВОПРОСЫ ФОРМИРОВАНИЯ АРХИТЕКТУРЫ
ИНЖИНИРИНГОВЫХ КОМПАНИЙ**

The article states a problem of correspondence between system of management business processes and organizational structure of the engineering company and its strategic goals and growing business interests. Authors proposed the approach for restructuring of enterprise architecture based on reengineering of management business processes and reforming of organizational structure to provide business growth.

ENTERPRISE ARCHITECTURE. ORGANIZATIONAL STRUCTURE. PROJECT MANAGEMENT. BUSINESS PROCESS. ENGINEERING COMPANY.

Сформулирована проблема обеспечения соответствия системы бизнес-процессов управления и организационной структуры инжиниринговой компании её стратегическим целям и растущим потребностям бизнеса. Предложен подход к перестройке корпоративной архитектуры на основе реинжиниринга бизнес-процессов управления и реформирования организационной структуры для обеспечения роста бизнеса.

АРХИТЕКТУРА КОМПАНИЙ. ОРГАНИЗАЦИОННАЯ СТРУКТУРА. УПРАВЛЕНИЕ ПРОЕКТАМИ. БИЗНЕС-ПРОЦЕСС. ИНЖИНИРИНГОВАЯ КОМПАНИЯ.

Engineering is a specific activity related to the provision of services for the creation and exploitation of infrastructure facilities (according to the definition of the United Nations Economic Commission for Europe) i. e. industry, energy and transportation systems, civil engineering etc.

Initially the key process of engineering is production technology development. As a rule Western European engineering companies include several key departments (or subsidiary companies) which are specialized in engineering and development, construction, supply and installation of equipment, project management, technical supervision, engineering support of investment projects, subsequent works (repair, service, maintenance, etc.). Engineering companies in Russia develop their organizational structure as well and build different functional departments. At the same time they have inherited result-oriented approach for projects after soviet engineering institutes despite of the dynamic and rapidly growing market of engineering services.

Authors of the article suppose that the current stage of Russia engineering companies'

development is caused by the engineering institutes experience which were a source of highly qualified experts who now represent top management of present engineering companies.

Many of contemporary Russian engineering companies were founded on a base of soviet engineering institutes which served specific needs of particular branches of industry or even single industrial objects according to the state order. Intensive development of construction business in post-soviet Russia caused the increasing demand for engineering services and engineering companies started to enlarge. The former approach to organization of engineering business inherited after soviet engineering institutes caused the fact that many engineering companies with high quality of project execution have the level of project management organization that does not completely provide business interests of the company and does not allow to use completely the opportunities of the growing market of engineering services. As a result, many companies of the industry have started to pay serious attention to the need of organizational structure reforming, which means management architecture restructuring in the mean times.

Some issues of the formation of management architecture

The main reasons of the need of architecture restricting based on the projects of business processes reengineering and organizational structure reforming are the following:

1. Absence of the precise strategy of management architecture development.
2. Absence of an integrated architecture adaptability to market conditions.
3. Discrepancy between the organizational structure and increased business demands.
4. Discrepancy between the organizational structure of companies and organizational structures of projects.
5. Absence of a common corporate standards of project management.
6. Absence of precisely prescribed roles and responsibilities in the current organizational structure.
7. Absence of detailed and transparent business processes.

Enterprise architecture is a system view of the key structural sections (certain key components and their relationships), applied for various practical problem solving of the organization [1]. The feature of the enterprise architecture is its heterogeneous composition – organizational structure, functions, processes, information technology, etc.

While forming the enterprise architecture it's necessary to solve the following tasks in coherent and interconnected manner:

1. Mission and strategy of the company, strategic goals and objectives;
2. Business architecture «as is» and «to be» for the following sections:
 - a) organizational structure;
 - b) business processes structure;
3. System architecture «as is» and «to be» for the following sections:
 - a) Information system;
 - b) data bases;
 - c) technical tools and solutions;
4. Developed projects for transition from its current state («as is») in the planned state («to be»), including:
 - a) projects for business processes reengineering and organizational structure reforming;
 - b) projects for ISO standards implementation (ISO 9000. ISO 20000 and others).

Architecture development strategy for engineering companies

The mission of the company as the main objective of its development defines the strategy, including the strategy of architecture development management. The first step in the formation of the system architecture is the reengineering of business processes and the subsequent formation of the organizational structure. The organizational structure of the engineering company, on the one hand, should match the system of its business processes, providing its effectiveness, and the other hand – it should match the accepted system of project management, the standard of which should be the same for the entire company. This is determined by the nature of engineering business, which means project orientation of the company.

The basis of the business of engineering company is the portfolio of contracts for execution of engineering projects. To form the efficient portfolio of contracts the real option approach for contract system management can be used [4]. For effective project management it is necessary to implement a project management approach that would allow to create a flexible, effectively-managed and controlled system of execution of single engineering projects and the portfolio of project as a whole, and would establish unified procedures project delivery and monitoring at various stages and levels.

Project approach for business management has its features:

- the project is considered as a unique combination of project delivery processes;
- rights and responsibilities for project results delivery belong to project manager and project management team;
- certain budget of the project;
- implementation of specific project organizational structure and motivation of project management team members;
- development and implementation of specific standards of project processes performing [1].

One of the possible effective project management standards that can be implemented in engineering companies, is the PRINCE2 method, which is known worldwide and acknowledged by the International Project Management Association (IPMA). PRINCE2 (**P**rojects **i**n a **C**ontrolled **E**nvironment) is a structured method of project management based

on thousands of best practices of successfully realized projects. This method has the following advantages:

- 1) includes the best practices that has proved its effectiveness;
- 2) can be implemented for any kind of the project;
- 3) is widely known and provide the common language for all the members of the project;
- 4) is oriented on strategic goals achieving;
- 5) sets certain roles and responsibilities for project management;
- 6) is oriented on delivery of project results.

Basic principles of project management according to PRINCE2 are:

- continuous business justification;
- learning from experience;
- defined roles and responsibilities;
- management by stages;
- management by exceptions;
- focus on products;
- tailoring to the environment.

For the purpose of architecture forming of engineering company based on the revision of management processes and organizational structure, the principle of defined roles and responsibilities is particularly important. PRINCE2 allows to create a system of hierarchy and interaction of the participants of the project which form a well-functioning structure that takes into account the interests of the three interested parties in the project – business, future users and suppliers. Such a structure provides certain subordination levels of project management, each of which controls the interests of different levels, ultimately subordinate to the strategic goals of the business (Fig. 1).

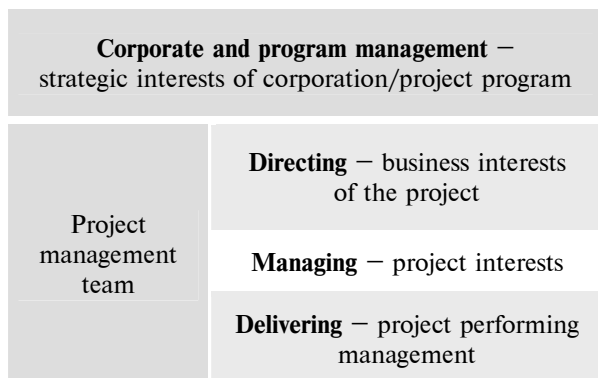


Fig.1. Project management levels (according to PRINCE2)

Responsibility delegation to the higher level is performed according to the «management by exception» principle. This provides the lower levels with more management freedom and the higher ones are not involved into routine processes of lower level processes.

In addition to the distinction between levels of project management, the organization of the project team according to PRINCE2 implies specific roles and responsibilities, which allow to avoid function duplication, to provide a clear procedure of project control at all stages, as well as ongoing expert and administrative support to the project management team.

Practical experience of business processes and organizational structure reengineering

The top management of engineering company (hereinafter referred as a Company) initiated a project of management processes optimization in one of the divisions of the company – Engineering Department. This division provides a key service of complex engineering service – designing of infrastructural objects. Initially, the company was completely focused on the execution of orders of key industry customer. While developing, a positive business reputation has caused a growing demand for the company services by other customers.

Engineering Department as an independent business unit faced the classic problem of growing companies: the existing business processes and roles and responsibilities do not allow to meet the growing demand for the services of the company, and therefore slow down the growth of the business. Roles and responsibilities in the existing organizational structure were designed to provide the quality of single projects. In the mean time it was a lack of attention to management level of the division as a whole, where company’s business interests are defined and controlled.

The top management of the company has identified the *goal* to revise the existing business processes and organizational structure in order to optimize management processes to provide the continued growth of the business. This objective implies a re-engineering of business processes and reforming the organizational structure, which on one hand would provide compliance

with the principles of the organizational structure of project management, on the other hand – would create conditions for the further optimization of business architecture based on several criteria: the exclusion of redundant business processes and their segmentation within the various organizational units, minimizing organizational interfaces, improved internal and external communications, increasing flexibility on the market.

To realize this goal the following consequence of *objectives* was set:

1. Modeling and analysis of business processes and organizational structure («as is»).
2. Roles and responsibilities analysis including defining of non-core responsibilities.
3. Modeling of business processes («to be»):
 - a) business processes reengineering (optimization of business processes on the criteria of business growth on the basis of review of the roles and responsibilities);
 - b) organizational structure improvement to provide the growth of business.

4. Implementation of the updated system of business processes and organizational structure in order to provide business growth.

The result of the implementation of defined objectives should be: optimized system of management business processes, reformed organizational structure, development and implementation of a standardized approach to project management.

Modeling of company activity based on staff interviewing, analysis of the existing organizational structure (Fig. 2) and general scheme of processes based on Diagram of added value chain [2] (Fig.3) helped to analyze and put in order management processes, main and supporting business processes of the division, to identify «bottlenecks» in terms of duplication and inconsistency of prescribed responsibilities for different roles in the business process management.

Note:

– CPE – Chief Project Engineering

Analyzing the existing organizational structure and current roles and responsibilities it was

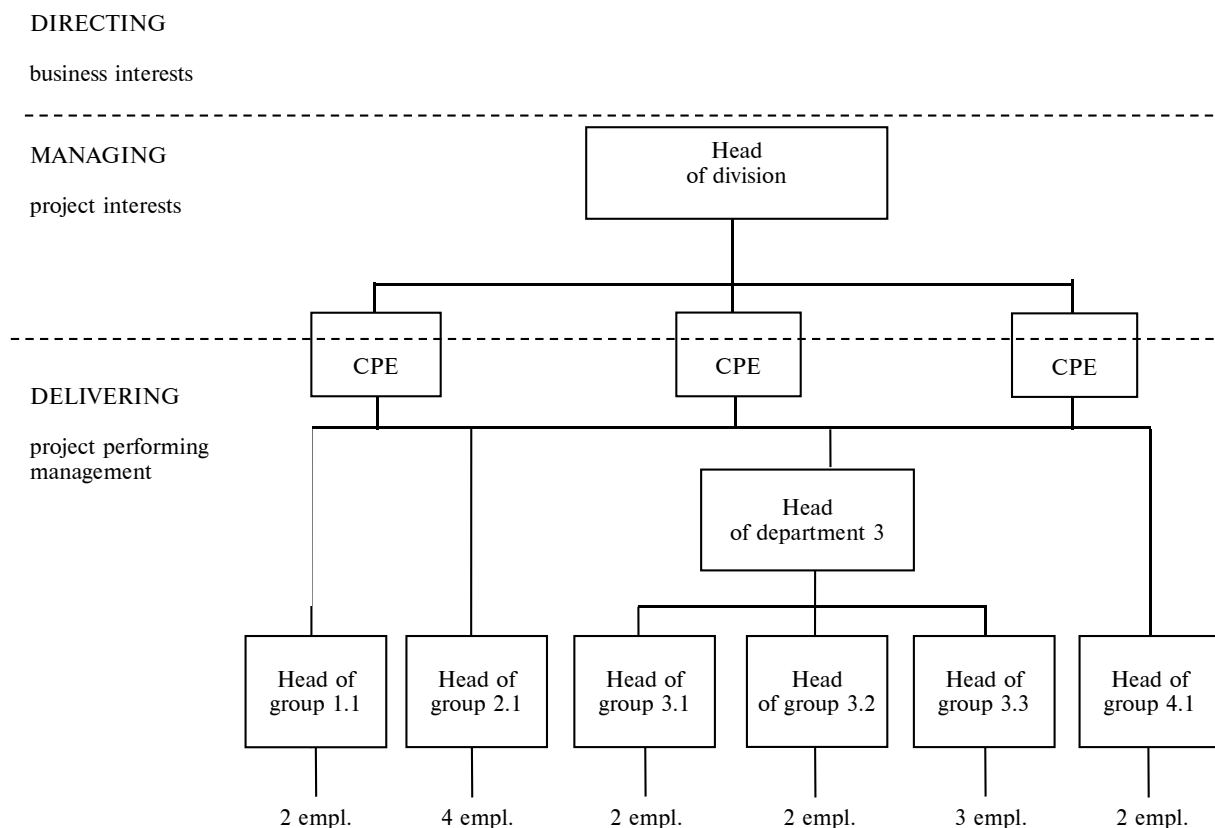


Fig.2. Organizational structure «as is» according to project management levels

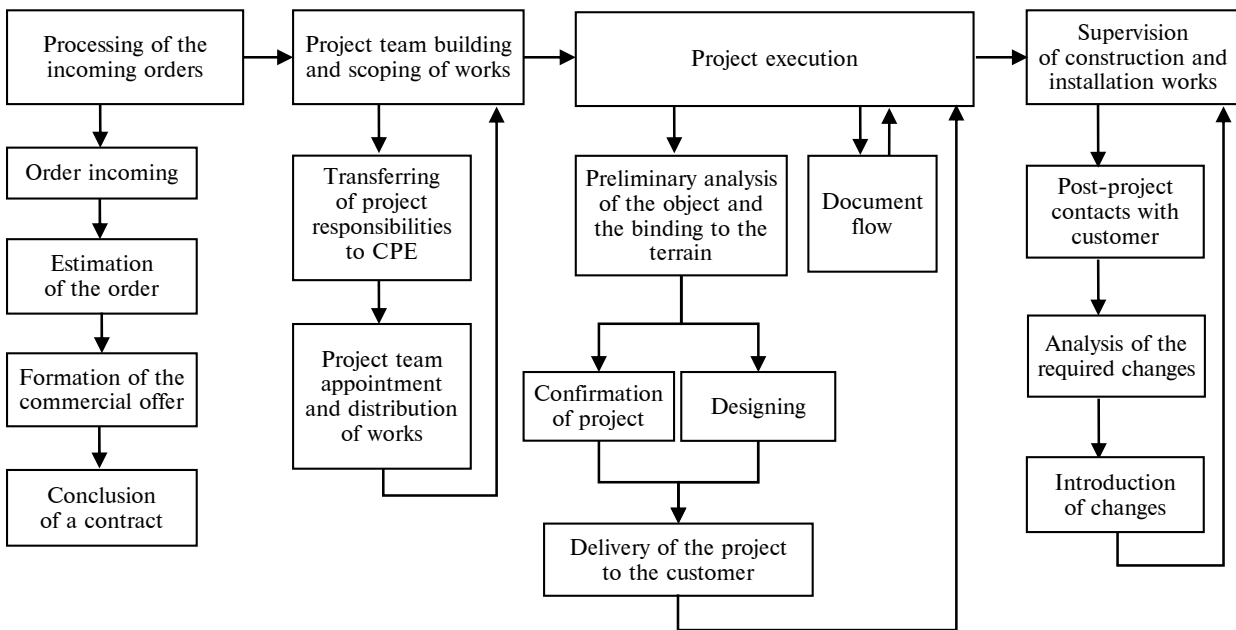


Fig.3. General scheme of processes based on Diagram of added value chain

identified the inconsistency of responsibilities distribution between the management levels and the discrepancy between the management organizational structure and project organizational structure. As a result, on the one hand there is a lack of proper control of the division from the strategic business objectives point of view, on the other hand – duplication of functions and control at lower levels. Thus, managers, responsible for the overall management and coordination of the work of the design («Directing» level) in reality is involved not only in the management of individual projects («Managing» level), but also in the control of the projects' execution («Delivery» level). At the same time, the CPE («Managing» level) factually does not have sufficient authority to carry out project management and is substantially involved in the control of direct execution of projects («Delivery» level).

The analysis of the «as is» data, formalized as a model of organizational structure and process diagrams, revealed the drawbacks of existing management processes. The following changes to the organizational structure and system of roles and responsibilities were proposed:

1. To define clearly the project management roles between the «Directing» and «Managing» levels, prescribing responsibility for the business

interests control to the manager of the first level (Head of division) and giving more management authority for individual projects to the second-level managers (CPE);

2. To increase the number of managers the «Managing» level (CPE) to enable the execution of greater number of projects;

3. To introduce the role of administrative support of the project (Project Support) which is not performed in the existing structure in the centralized form and is dispersed among managers at all three levels

4. To introduce the role of expert support of the project (Project Assurance) which is not performed in the existing structure in the centralized form and is dispersed among managers at all three levels

Taking into account all the proposed changes for organizational structure after revising the existing roles and responsibilities, a new «to be» model was performed (Fig. 4).

The proposed model of organizational structure «to be» has a number of advantages:

– it enables the use of common and proven approach to project management (such as PRINCE2);

– provides a basis for distinguishing between the roles and responsibilities in the project management team and the organizational structure of the whole unit;

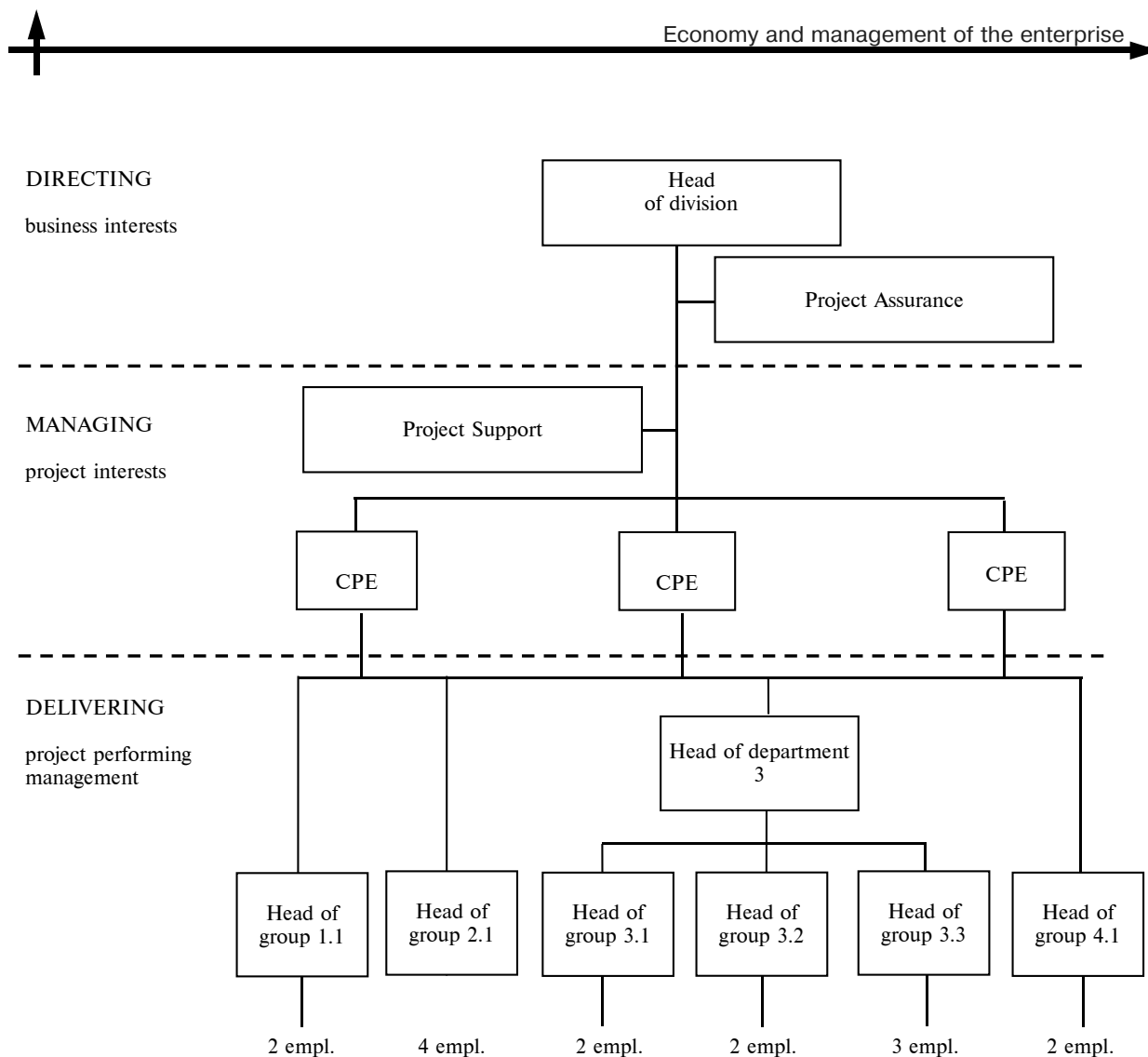


Fig. 4. Organizational structure «to be» according to project management levels

– forms the organizational basis for further growth of the company in accordance with the strategic goals of the company.

The approach for enterprise architecture formation proposed for the engineering company in this article means using of project management methods for reforming of management business

processes and organizational structure. This will allow to fill different management levels with real responsibilities, to provide correspondence between system of management business processes and organizational structure of the engineering company from one hand and its strategic goals and growing business interests from the other hand.

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