

## **Project Management Issues of Formation of**

# **Engineering Companies' Architecture**

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**Abstract:** The article is devoted to projects concerning some aspects of enterprise architecture development in Russian engineering companies, e.g., reengineering of business processes and organizational reform. Implementation of project management standards and ongoing reengineering processes to improve the organizational structure of project management activity is supposed to provide opportunities to meet the growing needs of the business.

**Key words:** project management; enterprise architecture; business processes; engineering company **JEL codes:** L220, M100, Y800

### **1. Introduction**

#### 1.1 Project Management and Enterprise Architecture in Russian Engineering Companies

The Russian market nowadays offers ample opportunities for companies of different industries. In particular, the market of engineering services is growing rapidly due to the rapid development of industrial and civilian construction and modernization. In these circumstances, many engineering companies are experiencing problems related to the fact that the existing enterprise architecture does not allow companies to grow at a pace set by the growing market. The aim of this paper is to develop approach to the formation of enterprise architecture of engineering company based on the principles of project management to meet growing business needs.

The change in approach to running a business in today's information society results in the fact that the advantage is enjoyed by that participant of the market who is better adapted to the changing environment and provides innovative solutions to meet the challenges of the market. The volume of economic activity that can be organized as a routine operation is becoming less, the modern economic environment implies a constant work with the changes. In these circumstances, many companies show a growing interest in project management as a method by which a business unit can work with unique challenges both for organization and implementation of the core activities.

On the one hand, many companies are aware of the need to revise the management system in order to bring

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into compliance business processes and strategic business objectives to provide an adequate level of performance. Such a change of the management system requires a special project (or complex of projects), aimed at reforming the enterprise architecture. The implementation of such projects is oriented to forming a balanced management architecture.

On the other hand, many companies are project-oriented in their nature, and their activity can be considered as a portfolio of projects in various stages of execution. Project-oriented companies can be found in such industries as engineering, construction, IT-sector, machinery manufacturing, consulting, banking, and many others. Such companies need to implement a unified corporate standard for project management in order to provide the quality of each project and effective management of a portfolio of projects as a whole. Implementation of a unified project management standard in such companies is a prerequisite for competitiveness, and project management principles are to form a foundation of the organizational management system of the company.

A classic example of a project-oriented company is an engineering company which serves primarily the needs of construction and manufacturing industry. In the past two decades, Russia has experienced a significant growth in the demand for engineering services caused, in turn, by the rapid growth of industrial and civil construction, the need for the reconstruction and modernization of outdated facilities. Russian engineering companies are currently going through a specific stage in their development when the projects are relevant to them in both perspectives: individual projects for re-engineering their business architecture and projects as a form of servicing each customer order.

#### 1.2 Current Status of Engineering Industry in Russia

As a separate form of commercial operations, *engineering* provides certain types of services such as design, construction and commissioning of the facility, the development of new production processes, improving existing production processes by one party (consultant) to another one (the customer) (Modern Engineering, 2013). As the definition indicates, engineering includes the provision of a whole range of services of industrial, commercial, scientific and technical activities. It determines the characteristics of the engineering projects: they are complex projects that require the involvement and coordination of the various types of resources (material, financial, human, etc.), the interests of all involved project stakeholders and the conditions of the institutional environment as well as high-quality IT-support at all stages of project realization.

The development of engineering industry in Russia has had its specific path. During the last 20 years, Russia shows the dynamic development of both building new facilities and reconstruction and modernization of outdated ones. Russia is a large and attractive market from the point of view of engineering services.

Western engineering companies (so-called, full cycle engineering companies), as a rule, include several divisions or subsidiaries involved in the provision of certain types of engineering services: surveying and engineering design, engineering and supply of set of machinery and equipment, installation of equipment at the facility, commissioning, supervision, financial consultation.

Full cycle engineering companies are still forming in Russia. This process requires a careful study of the approaches and principles for the formation of enterprise architecture of a particular industry. When forming an enterprise architecture it is necessary to consider both technological process of a particular service, determined by the nature of the industry, and the specific characteristics of the environment in which business is run. Both Russian engineering companies and the Russian market environment have their own characteristics and differences from the European and American markets.

The development of engineering services in post-Soviet Russia was based on the Soviet design institutes. Their activities, on the one hand, are characterized by rich traditions, strong theoretical background, involvement of qualified professionals, and as a result, high-quality execution of projects On the other hand, the processes of commercial and management activities are not completely integrated with the best practices worldwide, often there is no unified corporate approach to project management, organizational structure is not always balanced in terms of responsibilities distribution. In the meantime, the implementation of engineering projects which are usually information- and knowledge-intensive, and therefore require a high level of automation, in Russian companies do not have sufficient IT-support: partial and patchy process automation often takes place. As a result, many growing engineering companies are now at the stage of their development when the structure of their internal environment ceases to meet the growing needs of the business, does not allow taking advantage of market opportunities and, factually, becomes an obstacle to further development.

The Russian market in general and particularly the market of engineering services has a high degree of uncertainty, which is determined by the nature of the institutional environment. That is why Russian companies should have a sufficiently flexible management structure, pay great attention to risk management and provide a mechanism for making decisions under uncertainty. Russian companies are generally well adapted to the external changes, but lose to foreign companies in the maturity level of project and process management.

The features enlisted above explain why many Russian companies today are seriously focused on the problem of enterprise architecture formation. The first step towards the enterprise architecture formation is a project to reform the business architecture.

#### 2. Method

#### 2.1 Some Issues of Enterprise Architecture Formation Based on Project Management

Engineering activity is factually the process of managing dynamic portfolio of orders for engineering projects execution. Parallel execution of multiple projects requires the cross-functional and cross-departmental involvement of specialists with different skills and belonging to different levels of the hierarchy of organizational structure. In such circumstances, there should be a clearly-established procedure of interaction of all participants during project execution and project management, as well as clearly defined roles and responsibilities and clear lines of authority for making key decisions at different stages of the project execution, and finally the allocation of the strategic management level for controlling the entire project portfolio. The organizational structure with the properties mentioned above will optimize project performance and project management, will standardize some processes of project management, will allow including strategic business goals into the portfolio during its forming and, therefore, would increase the number of projects executed by means of the rational allocation of administrative and executive functions between all organizational elements. From this perspective, current function-oriented organizational structures of many engineering companies in Russia do not always meet business interests, and often do not allow companies to take full advantage of the opportunities provided by the growing market of this type of service.

As engineering industry is project-oriented, it seems reasonable to implement project management in engineering companies not just as a common standard used for execution of each particular project, but put some project management principles at the basis of the business architecture. The project of bringing the business architecture in compliance with the strategic goals of the business is the first step towards the formation of the

enterprise architecture. While implementing such projects it is important to take into account features of the business processes system and features of a particular industry.

The organizational structure of an engineering company, on the one hand, should match the system of its business processes, providing its effectiveness, and, on the other hand, it should match the accepted system of project management, the standard of which should be the same for the entire company. For effective project management it is necessary to implement a project management approach that would allow creating 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.

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 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;
- (8) Need for the implementation of the enterprise information system.
- The project approach to business management has the following features:
- the project is considered as a unique combination of project delivery processes;

• rights and responsibilities for delivering the project results belong to project manager and project management team;

• a fixed budget of the project;

• implementation of a specific project organizational structure and motivation of project management team members;

• development and implementation of specific standards of performing project processes (Kondratiev, 2007).

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 (Projects in a Controlled Environment) 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 have 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 at delivery of project results.(OGC, 2009).

PRINCE2 method is a flexible tool for project management the elements of which can be and should be "tailored" for a specific company, a specific project. This principle—tailoring to the environment—has allowed realizing a project to reform the organizational structure of a particular engineering company.

For projects of business architecture reforming in engineering companies, related to the alignment of the

organizational structure and the defining of principles for the distribution of management authority within this structure, principles, that declare a clear definition of roles and responsibilities and management by exception are particularly important. And the principle named "tailoring to the environment" allows taking into account the peculiarities of the particular industry and the particular company.

### 2.2 Practical Experience of the Organizational Structure Reforming Project in the Engineering Company Based on PRINCE2 Method

The top management of an engineering company (hereinafter referred to as the *Company*) initiated a project of management processes optimization in one of the divisions of the company (hereinafter referred as the *Division*). *Division* provides designing of infrastructure objects as a key service from engineering services complex. While developing, a positive business reputation has caused a growing demand for the *Division*'s services by the customers. The *Division* as an independent business unit faced the classic problem of growing companies: the existing business processes and roles and responsibilities did not allow meeting the growing demand for the services of the company, and therefore slowed down the growth of the business. Roles and responsibilities in the existing organizational structure were designed to ensure the quality of individual projects. In the mean time it was a lack of attention to the management level of the division as a whole, where a company's business interests are defined and controlled.

The top management of *the Company* has decided to implement a project to revise the existing business processes and organizational structure of *the Division* in order to optimize management processes to enable the continuous business growth. This objective implies such a re-engineering of business processes and reforming the organizational structure that will:

• provide compliance between the organizational structure and project management principles;

• create conditions for the further optimization of business architecture based on different criteria (such as 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);

• create conditions for distribution of the approaches developed during the project for formation of business processes and organizational structure in other business units of the *Company*.

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

(1) Modelling and analysis of business processes and organizational structure ("as is");

(2) Roles and responsibilities analysis including definition of non-core responsibilities;

(3) Modelling 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: an optimized system of management business processes, a reformed organizational structure, development and implementation of a standardized approach to project management.

For the purpose of architecture forming of an engineering company based on the revision of management processes and organizational structure, the principle of defined roles and responsibilities is particularly important.

PRINCE2 allows creating 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 all stakeholders of the project (OGC, 2009). 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 (see Table 1). 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.

| Corporate and program management-strategic interests of corporation/project program |   |  |  |  |
|---|---|--|--|--|
| Project management team   | Directing-business interests of the project |  |  |  |
|   | Managing-project interests                  |  |  |  |
|   | Delivering-project performing management    |  |  |  |
| Project execution   |   |  |  |  |

#### Table 1 Project Management Levels (According to PRINCE2)

#### DIRECTING





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 avoiding 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.

Interviewing of personnel of the different management levels has allowed describing, modelling and analyzing the existing organizational structure (see Figure 1), general scheme of processes based on Diagram of added value chain (Bekker, Vilkov, Taratukhin, Kugeler, Rosemann, 2010) (see Figure 2) and detailed schemes of each business process. These activities made it possible to analyze and put into order management processes, as well as main and supporting business processes of the division, and to identify "bottlenecks" in terms of duplication and inconsistency of prescribed responsibilities for different roles in the business process management (Gareis, 2005).



Figure 2 General Scheme of Processes Based on Diagram of Added Value Chain

The *Division* provides construction designing work in four areas: heating systems, electrical systems, ventilation and drainage, instrumentation and automation (see Groups 1-4 in Figure 1). A customer order for the *Division*'s services can include any set of works from this list. Thus each project executed by the *Division* according to customer's specifications, requires the involvement of one to four project performing groups.

The decision about the feasibility of each project is made by the *Head of Division*; he is responsible for the success of each project and the success of the *Division* as a whole. After signing the contract for the project, the responsibility for the ongoing monitoring of its execution is transferred to one to CPE (CPE—Chief Project Engineering). Depending on the type of engineering services that constitute each project, the number of project performing groups is defined; all the activities of each group are directed by the *Head of the group*. Thus, after having agreed with the customer, each contract is distributed between management and executive levels of the organizational structure of the *Division*, depending on the composition of each project. Being really complex, engineering projects generate a large and complexly structured document flow and communications that require extensive consulting and administrative support. In the existing organizational structure these functions are

distributed between different management and execution levels of the project, and, factually, are non-core activities for the personnel who performs it.

The distribution of the project authority within the *Division* described above allows associating positions in the existing organizational structure and the roles and responsibilities proposed by PRINCE2:

| Position in the existing organizational structure | PRINCE2 role                      |  |
|---|-----------------------------------|--|
| Head of Division                                  | Executive, User project assurance |  |
| Customer  | Supplier project assurance        |  |
| CPE   | Project manager                   |  |
| Head of group/department                          | Team manager                      |  |

| Table 2 | Assignment of PRINCE2 roles to    | Positions of the  | Division's Org  | anizational Structure |
|---------|-----------------------------------|-------------------|-----------------|-----------------------|
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After having analyzed the existing organizational structure and current roles and responsibilities in the *Division*, the inconsistency in distributing responsibilities between the management levels and the discrepancy between the management organizational structure and project organizational structure were found. On the one hand, there is a lack of proper control from the point of view of strategic business objectives ("empty" *Directing* level—see Figure 1); on the other hand, there is duplication of functions and control at lower levels (double representation of management functions on the *Managing* and *Delivery* levels—see Figure 1).

#### 3. Results

In response to the identified shortcomings of the existing management processes the following corrective actions concerning distribution 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 upper level (Head of Division) and giving more management authority for individual projects to the middle-level managers (CPE);

(2) To increase the number of managers in the "Managing" level (CPE) to enable the execution of a 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 to the organizational structure after revising the existing roles and responsibilities, a new "to be" model was performed (see Figure 3). Thus a clear management hierarchy was formed, around which key roles and responsibilities of the appropriate management levels are allocated.

The proposed model of the 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

• Forms the organizational basis for further growth of the company in accordance with the strategic goals of the company

The current paper describes the authors' approach to the formation of enterprise architecture of

project-oriented company (based on the engineering sector example) on the basis of the principles of project management. This approach offers the opportunity to analyze and reengineer the system of business processes and build the corresponding organizational management structure. The basis of the proposed organizational structure is the revised system of business processes and the principle of roles and responsibilities allocation according to the project management approach. This will enable the top management of the *Company* to fill each management level with appropriate set of responsibilities, to ensure that the management processes and the organizational structure are in compliance with the *Company's* strategic goals and increasing business demands, both now and in the future. In addition, such system changes create the conditions for:

- further business processes optimization;
- the spread of this practice to other units of the Company;
- implementation of a corporate information system.





Note: CPE-Chief Project Engineering

In this paper, the authors consider an example of the company, whose primary objective is to reform of the enterprise architecture in accordance with the requirements and market opportunities. To solve this problem it was necessary to build a new organizational management structure, which was made by means of implementation of certain principles of PRINCE2 project management method—the principle of defining roles and responsibilities and the principle of management by exceptions. In the future, the implementation of other principles and aspects of PRINCE2 project management method. The authors suppose that for engineering industry in Russia particularly relevant aspects of PRINCE2 are risk management and change management aspects. As engineering projects are associated with a wide range of stakeholders and involve resources from different sources, the main

risks (and therefore, the need for further implementation of changes in relation to the original agreed plans) are related to the lack of consistent information and consensus on the engineering objects and the lack of assigned responsibility for project management between the participants of the project. Implementation of risk management and change management aspects, as well as other aspects of project management and the "tailoring" them to the Russian engineering market environment is the subject of a separate study.

The approach of the formation of the business architecture of engineering company based on the project management principles proposed in this paper with the appropriate adjustments may be relevant not only for the engineering industry, but also for other project-based activities.

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