

Development of information support systems for production processes of contractor enterprises through an external electronic archive

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Abstract. The main areas of activity of research and manufacturing associations include the creation of knowledge-based military and civilian products. Having unique competencies in the field of creating knowledge-based products for various fields of industry, research and production enterprises together with cooperative enterprises, including contracting partners, for many years have occupied a leading position in the markets of fuel and energy complex and other industries. Over the past five years, many industrial enterprises have gone from a critical decline in production and bankruptcy to a stable increase in work volumes, while the projects in the field of development of information support systems for industrial production processes have become highly demanded in the process of crisis management.

1 Introduction

The main areas of activity of research and manufacturing associations include the creation of knowledge-based military and civilian products. The PJSC Iskra Research and Manufacturing Association (hereinafter referred to as Iskra PJSC RMA) is not an exception of that kind. Having unique competencies in the field of creating products for the gas industry, Iskra PJSC RMA together with cooperative enterprises for many years has occupied a leading position in the market of the fuel and energy sector (hereinafter referred to as FES).

Projects implemented in the field of information support systems for production processes of enterprises are quite relevant, since after a critical decrease in the volume of work since 2016, the company is facing stable trends in the rapid growth of its market share and, accordingly, the volume of work performed by the enterprise for the fuel and energy sector.

The result of the above trend is an increase in the technical and administrative complexity of projects implemented by enterprises.

One of the main strategic goals of many enterprises, including Iskra PJSC RMA, is to maintain and increase its presence in the markets of high-tech products for the fuel and energy sector and other industries. To achieve this goal, using the existing unique competencies and high scientific and technical potential of employees, it is necessary not only to develop new types of products and win new markets,

but also to increase the volume of products already delivered to existing traditional markets.

To maintain their position, successfully increase the volume of delivered products and develop in conditions of increased competition, the enterprises need to quickly respond to market changes and meet the needs of customers as much as possible.

This clearly requires the introduction of project management at enterprises, improvement of production efficiency, introduction of modern IT technology, professional skills of workers, and effective cooperation.

Today, about 80% of units and systems of products in the fuel and energy sector and other industries are manufactured at contracting enterprises, which in turn increases the risks of the enterprise failing to fulfill orders within the period stipulated by the contracts, and causes significant financial and image damage.

One important factor affecting the performance of the company's obligations by the contracting partner is timely information support of the production cycle with up-to-date documentation.

The goal of most industrial enterprises is to improve the information support system of the production process of the contracting enterprise by creating an external electronic archive (hereinafter EEA) and including up to 70% of contracting enterprises in a single information space.

2 Problem statement

Significant growth of production volumes in the fuel and energy sector and other industries, work with

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cooperation taking into account the existing restrictions imposed in the Russian Federation, such as the Federal Law No. 223-FZ of 18.07.2011 “On procurement of goods, works, services by certain types of legal entities” and the Regulation on the purchase of goods, works, services of the Roscosmos state space corporation require the enterprise to build a new, efficient, unique process of information exchange with the contracting enterprise in terms of providing up-to-date documentation. The fact that contracting enterprises do not follow a single principle of documentation handling and use irrelevant information in the process of manufacturing product components and systems causes problems that directly affect the deadlines of product delivery to the customer.

3 Description of the approach to solve the problem

3.1 EFQM-based approach

The EFQM improvement model is the most acceptable to determine an objective realistic assessment of the current state of the approach, an area for priority changes, and to ensure effective processes in the organization.

Table 1 shows the description of the EFQM-based approach for improvement, enhancement and development, and Figure 1 presents the relationship of the approach to other approaches through criteria and criteria components within the EFQM model:

Table 1. Description of EFQM-based approach.

Criterion 5 : Processes, products and services	Component of criterion 5a: Processes are designed and managed to create the added value for stakeholders
Component of the criterion: Perfect organizations manage a set of interconnected processes, including processes outside the organization, determine process owners and their roles and responsibility in developing, operating and improving processes	
APPROACH	
Name: Improvement of the information support system of the production process of the contracting enterprise through the creation of EEA. The purpose of the approach is to improve the existing process of production information support of the contracting enterprise for unconditional fulfillment of obligations on the terms and quality of the delivered products to the Customer. Implementation: creating EEA and involving 70% of contracting enterprises in the new process. The result of this approach is that the contracting company has up-to-date structured information for the organization of the production process. The approach is aimed at implementing one of the main strategic goals of the enterprise: – maintaining and increasing the presence of the enterprise in the markets of high-tech products for the fuel and energy sector and other industries in the interests of ensuring the	

energy security of the Russian Federation.
Stakeholders outreach: Interest of owners in profit-making, leadership – in development of the enterprise and maintaining the company image, consumers – obtaining finished products of the appropriate quality within the specified time frame.
Relation to criteria: The diagram (Figure 1) presents the relationship of the approach to other approaches through criteria and criteria components within the EFQM model.
Through criterion 5 : Processes, products and services the processes are designed and managed to create the added value for all stakeholders by managing a set of interconnected processes, including processes that exceed the organization limit (component of criterion 5a), the leaders ensure organization flexibility and effectively manage changes (component of criterion 1e), develop a strategy that is based on the understanding the needs, expectations of stakeholders and the external environment (component of criterion 2a), as well as the understanding of internal activities and capabilities of the organization (component of criterion 2b), ensure coordinated personnel activities, involve and empower, while recognizing that innovations may be applied to products, processes, marketing, organizational structure and business models (component of criterion 3c). Then, the management of relationships with partners and suppliers on a mutually beneficial basis and working together to achieve a mutual benefit and increase the added value to relevant stakeholders, providing each other with expertise and resources (component of criterion 4a) will improve perceptions and performance indicators for society (components of criterion 8a, 8b), personnel (components of criterion 7b), consumer (components of criterion 6b) and as a result, key business results (components of criterion 9a, 9b).

DEPLOYMENT

Responsibility for the approach lies with the heads of units involved in the formation of a set of necessary information. The approach is implemented through the involvement of units, while each unit generates and monitors information arising from its activities. Regulatory documents governing the approach are the corporate standard 061-2014 “QMS. Design, process and standardization documents. Accounting, storage, handling and modification procedures” and others. The achievement is that the contracting company has the necessary and sufficient information to organize the production process.

ASSESSMENT AND REVISION

The approach appeared in 1959 due to the need to organize interaction with the contracting company in the production cycle. The approach is regularly improved, the last stage in improving the approach was the electronic archive of technical documentation and a system for synchronizing databases of electronic archives of different enterprises at the enterprise. Similar approaches have been implemented at all leading foreign and domestic enterprises producing high-tech products. The approach is ranked as one of the most important for the effective implementation of projects in the enterprise, while in the process of implementation the approach may be supplemented.

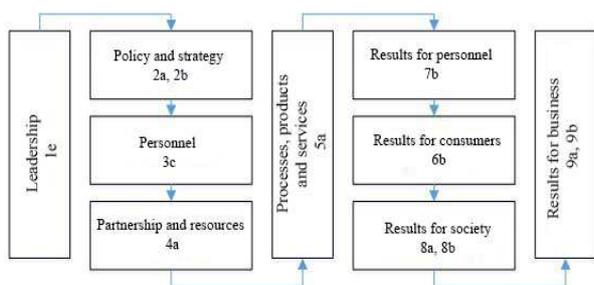


Fig. 1. Relationship of the approach to other approaches through criteria and criteria components within the EFQM model

Figure 1 shows that the considered approach “Improvement of the information support system of the production process of the contracting enterprise through the creation of EEA” is closely related to other approaches through the criteria and components of the criteria under the EFQM model. Thus, this approach is important for the company’s performance and its improvement may significantly affect the final results of its activities.

3.2 RADAR-based assessment

Assessment by RADAR technology prior to the implementation of the project on information support of the production process of the contracting enterprise is presented in Table 2.

Table 2. RADAR Technology Assessment

Elements	Approach			Deployment			Assessment and Revision			Total score
	Sound	Integrated	Total	Implemented	System	Total	Measurement	Study	Improvement	
0%			0			0			0	0
			5			5			5	5
			10			10			10	10
25%			15			15			15	15
			20			20			20	20
			25			25			25	25
			30			30			30	30
			35			35			35	35
50%			40			40			40	40
			45			45			45	45
			50			50			50	50
			55			55			55	55
			60			60			60	60
75%			65			65			65	65
			70			70			70	70
			75			75			75	75
			80			80			80	80
			85			85			85	85
100%			90			90			90	90
			95			95			95	95
			100			100			100	100

3.3 Areas for improvement

Thus, according to the EFQM model, the assessment of the approach “Improvement of the information support system of the production process of the contracting enterprise through the creation of EEA” before the project is implemented makes 50%.

Strengths:

- approach exists, is standardized and regulated;
- approach supports the strategy to increase the efficiency of the strategic objective “Maintaining and increasing the presence of the enterprise in the markets of high-tech products for the fuel and energy sector and other industries in the interests of ensuring energy security of the Russian Federation”.

Areas for improvement:

- insufficient indicators to measure the implementation of the approach;
- existing information support system does not ensure the timely transfer of up-to-date documentation to the contracting company;
- approach has several implementation options and does not allow for a flexible response to external changes.

The RADAR assessment made it possible to identify the areas for improvement. The implementation of the project to increase the efficiency of the information support for the production process of contracting enterprises in the manufacture of component parts of products will make the approach more flexible and adapted to external factors, as well as ensure the speed in providing up-to-date information to the contracting company.

4 Project

4.1 Project objective and tasks

Project objective: To increase the efficiency of the information support for the production process of contracting enterprises in the manufacture of component parts of products.

The main tasks of this project are as follows:

- 1) To analyze the current processes of providing contracting enterprises with up-to-date documentation;
- 2) To identify drawbacks of current processes and develop a new process;
- 3) To deploy EEA;
- 4) To perform initial loading of product components into EEA;
- 5) To organize and carry out pilot operation of the new process with 3-4 enterprises and contracting companies;
- 6) To put the process into industrial operation with the involvement of up to 70% of contracting enterprises.

Table 3 shows the assessment of the project objective for compliance with SMART criteria:

Table 3. SMART assessment of project objective

S	Specific	Increase the efficiency of the information support of the production process of the contracting enterprise in the manufacture of components of products by creating an external electronic archive
M	Measurable	Reduction of information transfer period to the contracting company by 75%
A	Achievable	By involving 70% of contracting enterprises in the new process
R	Relevant	The project is aimed at creating an “ecosystem” that unites contracting enterprises with common rules, integration standards and information resources
T	Timed	Project implementation period – 10 months

4.2 Project activities

As part of the task “To analyze the current processes of providing contracting enterprises with up-to-date documentation”, only those contracting enterprises that produce units and systems for Iskra PJSC RMA within the fuel and energy sector were selected (63 enterprises) from the total number of contracting enterprises. Further, the schemes of existing processes “as is” of existing processes of document transfer to contracting enterprises were built: in hard copy – 33 enterprises, in soft copy using the FTP server – 29 enterprises and in soft copy using the synchronization of databases of electronic archives of enterprises – 1 enterprise.

As part of the task “To identify the drawbacks of current processes and develop a new process”, the main drawbacks of existing processes were identified, the project team analyzed the alternatives and possible options for the new process. The new process “as must be the case” was proposed and created: EEA using a system for synchronizing databases of electronic archives and providing enterprises with an access to certain product components for contracting enterprises.

As part of the task “To ensure EEA deployment”, the analysis of the necessary software for EEA organization was carried out. Procurement procedures were carried out, contracts for the supply of software were concluded, software was delivered and installed on the selected hardware platform.

As part of the task “To perform initial loading of product compositions in EEA”, the EEA software and hardware platform was configured, product components with documentation sent earlier to contracting enterprises were selected and exported, import of product components into EEA was carried out, and a database synchronization system was set up.

As part of the task “To organize and conduct pilot operation of the new process with 3-4 enterprises and contracting enterprises”, 4 contracting enterprises were selected, instructions for work with EEA were developed, preliminary training was conducted, and access to the necessary product components was provided. At this stage, proposals for necessary improvements and automation were collected, the need was discussed and the corresponding measures were taken.

As part of the task “To put the process into industrial operation with the involvement of up to 70% of contracting enterprises”, it is necessary to evaluate the results of pilot operation of the new process, decide on the transfer of the process into industrial operation, as well as to adjust existing regulatory documents.

4.3 Project risks

The likelihood of risks affecting the project was assessed and the necessary preventive measures were developed.

The results are shown in Table 4:

Table 4. Project risks

Event	Likelihood	Severity of consequences	Risk	Activities
Non-compliance of information systems capabilities with the stated requirements	0.2	0.1	0.02	Fit and gap analysis of system capability
Unwillingness of the contracting enterprise to work in the new process	0.5	0.1	0.05	Inclusion in P019 Regulation and contractual documents of work requirements in this process
Contractors do not have qualified personnel to work in the new process	0.5	0.1	0.05	Detailed instructions on how to work in the process, training and consultations
High workload of project team members	0.4	0.2	0.08	Connection of administrative resource, additional motivation
Lack of financial capacity to purchase the software package	0.8	0.5	0.4	Outreach to financial decision makers
TOTAL:		1	0.6	

4.4 Project performance assessment

The economic impact of the project was assessed. The payback factor was chosen to reduce the number of additional agreements to be executed due to the reason “Due to the change in the scope of work (adjustment of design documentation was made)” after procurement procedures and concluding contracts with contracting enterprises for the manufacture of units and systems of gas compressor units.

In 2020, additional agreements were concluded for the above reason with enterprises and contracting enterprises in the amount of 6,681 thousand rubles, which was provided for in the main contract. Thus, this amount may be considered the lost income for Iskra PJSC RMA.

As part of the project it is planned to involve 70% contracting enterprises in the new process, the lost volume of product sales could amount to 4,676,7 thousand rubles. As a result, the profit loss could amount to 2,745,7 thousand rubles.

The average payback period of projects to increase the efficiency of information support of production process of contracting enterprises is 1 year.

Based on the obtained efficiency data, it may be concluded that such projects are viable.

The RADAR assessment after the project implementation is presented in Table 5:

Table 5. RADAR Technology Assessment

Elements	Approach			Deployment			Assessment and Revision			Total score	
	Sound	Integrated	Total	Implemented	System	Total	Measurement	Study	Improvement		Total
0%			0			0				0	0
			5			5				5	5
			10			10				10	10
			15			15				15	15
25%			20			20				20	20
			25			25				25	25
			30			30				30	30
			35			35				35	35
50%			40			40				40	40
			45			45				45	45
			50			50				50	50
			55			55				55	55
75%			60			60				60	60
			65			65				65	65
			70			70				70	70
			75			75				75	75
100%			80			80				80	80
			85			85				85	85
			90			90				90	90
			95			95				95	95
		100			100				100	100	

Thus, according to the EFQM model, the assessment of the approach “Improvement of the information support system of the production process of the contracting enterprise through the creation of EEA” after the project implementation will be 80%.

5 Conclusion

The study provided the analysis of the current state of the EFQM-based approach and identified the areas

for improvement, developed a project solution for improving the approach and carried out the analysis of the cost-effectiveness of its implementation, as well as the analysis of risks and their impact on the new approach.

Expected project outcomes:

1) Improvement of the approach according to the EFQM model calculated according to RADAR technology – 80%.

2) Reduction of the time to transfer up-to-date information to contracting companies by 70%.

3) Exclusion of hard-copy paperwork from the information support of the production process of contracting enterprises.

4) Improvement of the quality of manufactured units and systems at contracting enterprises due to the “ecosystem” of Iskra PJSC RMA, which unites 70% of contracting enterprises with general rules, integration standards and information resources.

5) Reduction of the cost of manufactured products within the fuel and energy sector.

The introduction of EEA and the involvement of contracting enterprises in the process will increase the number of projects implemented on time and within the budget, which, in turn, will lead to an increase in the competitiveness of the enterprise and an improvement in its image in conditions of fierce competition.

The implementation of the proposed project solution “Improvement of the information support system of the production process of the contracting enterprise” using the example of Iskra PJSC RMA is extremely relevant.

This solution may be applied to a given enterprise and to other industrial enterprises.

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