Integrated project program management in the nuclear-power engineering as a driver for the interindustrial development of export-based contractors of the Russian Federation

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Abstract. Modern approaches to implementation of nuclear power plant construction projects all over the world are based on a symbiosis of project and process-based management, which are transformed within the conditions of information economy into integrated management that increases the efficiency of the project by combining capabilities and interests of all participants in the investment cycle. In the world market of nuclear power plant construction leading positions of the State Atomic Energy Corporation «Rosatom» create an environment for a highly efficient technology transfer, and also determine fundamentally new opportunities that offered for all high-tech domestic companies. It should be noted that in the context of globalization, participants number limitation of nuclear power plant construction projects’ integrated project management exclusively by structures of the owner, designer and contractor, which often included in «Rosatom» State Corporation, transforms project into an isolated system that does not have the potential for strategic interindustrial development. Under present circumstances, it seems appropriate to consider the process of managing a projects program in the field of nuclear power plant construction, which allows synchronizing strategic activities of domestic high-tech export-based contractors in order to achieve a common synergistic effect and ensure high economic competitiveness and technological leadership of each participant.

1. Introduction

Domestic nuclear energy is one of the leading technological sectors in the country's economy and is actively developing not only in the domestic but also in the international market.

Statistics of contracts of the State Atomic Energy Corporation Rosatom (hereinafter referred to as Rosatom, State Corporation) for the next two decades reports on plans for the State Corporation to implement 36 nuclear power plants (NPPs) in 12 countries. According to this indicator, Rosatom ranks first in the world among all the companies involved in the process of implementing new projects for the construction of nuclear facilities. The achievement of these indicators is due to the historically high technical and technological potential of the enterprises included in the structure of the State Corporation, its systematic desire to introduce modern innovative forms of managing the timing and cost of ongoing projects [1], to improve the used organizational and technological solutions [2], and as
a result to provide integrated product for the construction and maintenance of nuclear power plants, taking into account its safety [3] at all stages of the life cycle.

Participation of a domestic company in the implementation of a series of large-scale investment and construction projects (ICP) both in developed countries (Hanhikivi-1 NPP (Finland)) and in developing countries (El Dabaa NPP (Egypt), Ruppur NPP (Bangladesh) ) allows you to solve not only the issues of development and promotion of the Rosatom State Corporation brand and the enterprises included in its structure, but also:

- gain access to new technologies, management models for the implementation of complex investment and construction projects;
- ensure the influx of finance into the domestic economy from the outside;
- enter foreign markets for energy and infrastructure construction;
- increase the attractiveness of domestic products for foreign customers;
- create conditions for the creation of joint ventures and collaborations in the fields of unique technologies and the introduction of innovations;
- create jobs for young professionals;
- have a positive impact on the image of the Russian Federation (RF) in the world.

Thus, the expansion of Rosatom into foreign markets for energy construction and the transformation of this State Corporation into a growth point for the domestic economy can be considered as one of the priority tasks in developing a national strategy for the formation of an innovative model of the economy [4], based on profit from the realization of the intellectual potential of scientists, researchers and innovators.

2. Methods
To assess the validity of the above ideas, let us turn to the analysis of the current state of the economy of the Russian Federation and the possible export potential of its development [5]. As part of the study, we will try to analyze the existing structure of export of Russian products [6]. To this end, we will consider the performance indicators of the 200 largest domestic exporting companies in 2018, as well as the volume and structure of exports from the Russian Federation in 2018 to 10 groups of goods (in accordance with the Commodity Nomenclature of Foreign Economic Activity of the Eurasian Economic Union (EAEU)) [7,8] dominant in national exports (Figure 1, table 1).

![Figure 1. Export structure of the 200 largest Russian exporting companies in 2018](image-url)
According to the results of the analysis, it can be concluded that at present, the oil and gas industry prevails among the industries in national exports - the annual export volume of products is 257,626.40 million dollars, or 68.87% of the total volume of exported goods [9]. The engineering sector, which is the most technologically advanced and knowledge-intensive, accounts for only 2.55% of exports or 9,528.40 million dollars. It should also be noted the participation in the export of products of diversified holdings, the products of which include high-tech products, however, the share of this category in the total volume of exports is relatively insignificant - 1.82% or 6,796.30 million dollars [10].

An analysis of the structure of exports from the Russian Federation in 2018 to 10 groups of goods that dominate national exports allows us to verify previously obtained industry values and slightly adjust them relative to the nature of groups of goods. All exported products are divided into commodities and non-commodity groups. A comparison of the 10 groups of goods dominating the exports of China [11], the USA [12], Germany [12,13], Japan [11,14], and Russia (Table 2) also clearly demonstrates the raw material nature of domestic exports, which in percentage terms exceeds more than 4 times that of the United States and almost 32 times that of Germany [15].

The current situation determines the urgent need to increase the share of exports of non-primary commodities from the Russian Federation, which should be the focus of attention of both the state and business. It is possible to solve this problem by relying on domestic companies and corporations that have sufficient potential for development and promotion on a global level. In order to identify possible national “locomotives of growth” and to develop a mechanism for the wide involvement of domestic companies and corporations in foreign economic activity, we will make an industry-wide synthesis of performance indicators for the 34 largest non-oil exporters based on the results of domestic companies and corporations in foreign economic activity, we will make an industry-wide synthesis of performance indicators for the 34 largest non-oil exporters based on the results of 2018 [16], which will allow us to obtain the following picture (Table 3):

- these companies account for less than 3% of all Russian exports;

### Table 1. Export structure of the Russian Federation by industry in 2018

| №  | Industry                        | Export volume in million $ | Industry share in total exports | Number of companies in the Top 200 exporters | Including the number of non-resource-exporting companies |
|----|---------------------------------|----------------------------|--------------------------------|-----------------------------------------------|--------------------------------------------------------|
| 1  | Oil and Gas Industry            | 257,626.40                 | 68.87%                         | 34                                            | -                                                      |
| 2  | Ferrous Metallurgy              | 28,346.40                  | 7.58%                          | 17                                            | -                                                      |
| 3  | Non-Ferrous Metallurgy          | 21,811.20                  | 5.83%                          | 10                                            | 1                                                      |
| 4  | Chemistry/Petrochemicals        | 17,141.70                  | 4.58%                          | 29                                            | 5                                                      |
| 5  | Coal                            | 12,505.10                  | 3.34%                          | 16                                            | -                                                      |
| 6  | Mechanical Engineering          | 9,528.40                   | 2.55%                          | 20                                            | 19                                                     |
| 7  | Diversified companies and holdings | 6,796.30               | 1.82%                          | 4                                             | 3                                                      |
| 8  | Precious metals                 | 6,276.00                   | 1.68%                          | 9                                             | 3                                                      |
| 9  | Forest / Wood / Paper           | 6,002.50                   | 1.6%                           | 28                                            | 1                                                      |
| 10 | Food industry                   | 4,510.70                   | 1.21                           | 12                                            | 1                                                      |
| 11 | Fishing                         | 2,141.00                   | 0.57%                          | 14                                            | -                                                      |
| 12 | Power industry                  | 695.90                     | 0.19%                          | 1                                             | -                                                      |
| 13 | Construction Materials          | 340.60                     | 0.09%                          | 3                                             | -                                                      |
| 14 | Tobacco                         | 220.00                     | 0.06%                          | 2                                             | -                                                      |
| 15 | Polygraphy                      | 135.00                     | 0.04%                          | 1                                             | 1                                                      |
| Total: |                                | 374,077.20               | 100%                           | 200                                           |                                                        |

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- these companies account for less than 3% of all Russian exports;
• leading products in non-primary exports are engineering products and products of enterprises that are part of diversified holdings.

### Table 2. Commodity and non-commodity goods in Russian exports

|                          | EU  | China | USA  | Germany | Japan | Russia |
|--------------------------|-----|-------|------|---------|-------|--------|
| Total exports in 2018    | 2300,00 | 2490,00 | 1660,00 | 1560,00 | 738,00 | 451,00 |
| (in billions of $):      |     |       |       |         |       |        |
| The volume of exports of | 215,00 | No data | 255,00 | 33,00  | 42,30 | 290,80 |
| commodities (in billions of $): |     |       |       |         |       |        |
| The share of exports of  | 9,35% | No data | 15,36% | 2,12%  | 5,73% | 64,48% |
| commodity groups in      |     |       |       |         |       |        |
| total exports            |     |       |       |         |       |        |

### Table 3. Sectoral structure of exports of the 34 largest non-resource-exporting companies by the end of 2018

| №  | Industry                        | Export volume in millions $ | Number of companies in the Top 200 exporters |
|----|---------------------------------|----------------------------|---------------------------------------------|
| 1  | Mechanical engineering          | 8 638,50                   | 19                                          |
| 2  | Diversified companies and holdings | 2 646,80                   | 3                                           |
| 3  | Chemistry / Petrochemicals      | 928,70                     | 5                                           |
| 4  | Non-ferrous Metallurgy          | 581,50                     | 1                                           |
| 5  | Precious Metals                 | 448,00                     | 3                                           |
| 6  | Food Industry                   | 143,10                     | 1                                           |
| 7  | Polygraphy                      | 125,50                     | 1                                           |
| 8  | Forest/Wood/Paper               | 71,50                      | 1                                           |
| Total: |                                | 13 512,10                 | 34                                          |

According to the results of 2018, the largest enterprises of the Russian machine-building industry included in the Top-34 non-resource exporters include defense enterprises (Rosoboronexport, Tactical Missile Weapons Corporation), subsidiaries and regional representative offices of foreign companies (GE Russia / CIS), automobile holdings (AvtoVAZ, KamAZ, Gruppa GAZ), as well as power engineering enterprises such as «Silovyye mashiny» («Power Machines») and «Ob"yedinennaya dvigatelestroitel'naya korporatsiya» (the United Engine Corporation).

It should also be noted that such a diversified holding company as the State Atomic Energy Corporation Rosatom and the Renova Group of Companies have a high share in the export of high-tech products.

A significant part of the products exported by the four last mentioned companies relates, in accordance with the HS of the EAEU, to goods of group 84 - nuclear reactors, boilers, equipment and mechanical devices; parts thereof [17]. A comparison of the volume and share of the products of this group in the export of the leading five world exporting countries with a similar value in Russian exports forms the following picture:

• in terms of exports of these products, Russia is 47 times behind China, 22 times behind the United States, 29 times behind Germany and 14 times behind Japan;
the share of goods of this group in national exports to the Russian Federation is 8.5 times lower than in China, 6 times lower than in the USA, 8 times lower than in Germany and 9 times lower than in Japan [18].

However, the products of 84 groups in a relatively small volume ($ 9.19 billion in 2018) have been exported from Russia for a long time, which demonstrates the presence of basic conditions and the potential for the development and promotion of national brands producing products of this group in foreign markets. The overall performance indicators of the above-mentioned non-resource-exporting companies producing 84 groups of products in accordance with the EAEU FEAC according to the results of 2018 are presented below (Table 4).

Table 4. Performance indicators of non-resource companies included in the list of 200 largest Russian exporters by the end of 2018 and producing products of 84 groups in accordance with the EAEU FEAC

| №  | Non-oil companies included in the list of 200 largest Russian exporters by the end of 2018 | Industry                  | Export volume in million $ | Share of export in revenue (%) | The volume of non-oil exports in 2018 in $ million | Share of non-oil exports in total volume in% |
|----|-----------------------------------------------------------------------------------------------|----------------------------|-----------------------------|--------------------------------|-----------------------------------------------|---------------------------------------------|
| 1  | Rosatom State Corporation                                                                     | Diversified companies and holdings | 2 438,8                     | 19,9                           | 2 345,9                                       | 96,2                                        |
| 2  | United Engine Corporation                                                                     | Mechanical engineering        | 2 297,9                     | 59,3                           | 1 542,6                                       | >99                                         |
| 3  | Renova Group of Companies                                                                     | Diversified companies and holdings | 312,6                      | No data                        | 232,7                                        | 74,4                                        |
| 4  | «Power Machines»                                                                              | Mechanical engineering        | 78,9                        | 17,5                           | 77,3                                          | 98,0                                        |

3. Results

The analysis allows us to assume that the development of the national economy by stimulating the export of high-tech engineering products can be based on the consolidation of the activities of such companies as Rosatom State Corporation, United Engine Corporation, Renova Group of Companies, Power Machines around the implementation of large-scale projects by these companies abroad. The obvious conclusion follows that the implementation of the NPP construction project by the State Corporation Rosatom naturally involves other specified companies in foreign economic activity, and the State Corporation itself becomes a “locomotive of growth” [19].

This circumstance predetermines the need for an approach to the implementation of international projects for the construction of nuclear power plants as a system of interconnected processes, providing for the need for high project and inter-project coordination of participants, the formation of organizational structures for ICP based on the reflective-adaptive paradigm [20], as well as the high importance of timely and objective assessment reliability of ICP participants as elements of the organizational structure [21-23]. Consideration of each specific project for the construction of a nuclear power plant as a separate one will inevitably lead to the impossibility of full strategic planning, the problems of accumulating intersectoral communication experience, as well as the ineffective linking of financial flows and flows of human resources.
It becomes possible to solve this problem by combining nuclear power plant construction projects into a program that will allow for temporary and resource linking of projects, if necessary, combine interconnected projects into subprograms, provide for the efficient distribution of material and human resources, develop systems and models of inter-project communication, import and distribute to all participating companies the most modern international experience. In this case, we are not talking about the formation of a foreign investment portfolio of projects of the State Corporation [24], which has been done for quite a long time. The emphasis is on the need and feasibility of addressing the issues of intersectoral coordination of the leading technological enterprises of Russia in the implementation of international projects for the construction of nuclear power plants.

The application of a strategic program approach to the implementation of a series of projects for the construction of modern nuclear power units using an integrated management model [25] will make it possible to link not only structural divisions and subsidiaries of Rosatom, but also all possible project participants, each of which will be involved in a single structured process creation of value [26] (of a specific nuclear power unit), and will also have the opportunity to launch its products, goods, services or expanding your presence in a particular region.

The process of constructing a nuclear power unit in the context of the coordinated activities of enterprises and organizations that are part of the previously mentioned engineering and diversified holdings is presented below (Figure 2).

The program approach in this case is designed to ensure interagency coordination, the definition of strategic priorities and the search for resources needed at a particular point in time. At each stage of the project, not only the enterprises of the State Corporation structure are interacting, but also a large number of engineering, instrument-making enterprises, non-industry building and assembly organizations, research and production and development associations. Each enterprise involved at the same time in several projects for the construction of nuclear power units is forced to formulate a business strategy and develop tactical and operational plans, carry out contract activities in the absence of information, which often does not allow achieving a synergistic effect from the joint detail of participating companies of various profiles.

An example of the urgent need for coordinated and coordinated actions by a large number of ICP participants of various profiles is the creation of the infrastructure of a future project. The insufficient attention of the developers of the NPP construction project to the issues of creating effective conditions for the implementation of the project, such as the construction of a powerful construction installation base, a reliable temporary power supply system for the construction site, construction of a temporary residential village, provision of qualified working and managerial personnel, as well as focus on biased goals, inevitably lead to increase the terms of the project, reduce its economic profitability. When implementing the project for constructing a nuclear power unit outside the Russian Federation within the framework of this stage, the project participating organizations will inevitably encounter the same organizational and technological difficulties: organizing a logistics system, attracting personnel, planning and modeling the required work front workload saturation [27], creating conditions for temporary residence. Under these conditions, only coordinated, consistent and time-bound joint actions will ensure the achievement of positive results not for individual, but immediately for all project participants.

So, for example, the formation of an efficiently functioning construction and installation base for a nuclear power plant under construction cannot be ensured only by the efforts of enterprises that are part of the Rosatom management circuit. Both non-industry contracting organizations and various machine-building enterprises producing construction machines and mechanisms, electrical equipment, as well as pre-fabricated buildings and structures are systematically involved in this task. The imposition on these conditions of the fact of the participation of the main performers at the same time in several projects now leads to their high inconsistency and partially disinterest in joint actions necessary for the successful implementation of the project, but negatively affecting the individual effectiveness of the participant.
Figure 2. The process of implementing the project for the construction of a nuclear power unit
4. Discussion
In the circumstances, it is the programmatic approach that will provide all participants in the project portfolio with the necessary information, predetermine the achievement of a higher quality of strategic, tactical and operational planning, as well as create the conditions for the full management of organizational and technological (operational) risks [28]. The identified and structured hierarchy of goals [29] of the program and each project separately, updated depending on the stage of project implementation, will allow directing available resources to the most significant events, increasing both the reliability of individual ICP participants [30,31] and the effectiveness of a particular project and programs in general.

It should be noted that the introduction of a program approach to the implementation of projects for the construction of facilities for the use of atomic energy will allow to realize the full potential of its participants and achieve a synergistic effect only when achieving a high determinism of the conditions for the implementation of each specific project, which should be focused on both scientists and researchers, and managers and civil servants involved in the contracting process of the State Corporation.

References
[1] Fomenko N, Khairova D 2019 J. Journal of Economy and entrepreneurship 7(108) 795-9
[2] Morozenko A, Voronkov I 2014 J. Industrial and civil construction 10 74-9
[3] Pantelei D 2019 J. The Eurasian Scientific Journal 11-2 39
[4] Starkova Y 2019 J. Sustainable development of science and education 6 16-21
[5] Shamrai Y 2010 J. Open Education 1 102-13
[6] Shirokova E 2019 J. Scientific bulletin of the Southern Institute of Management 2(26) 49-55
[7] Federal State Statistic Service 2018 Russian Statistical Yarbook (Moscow: Information and Publishing Center Statistics of Russia) p 694
[8] Fedotova G 2019 J. The North-West Institute of management 10-3 (40) 42-52
[9] Aleinikova A, Mileta V 2019 J. Siberian Financial School 5(136) 24-27
[10] Tinitskaia O, Makarova G 2019 J. Bulletin of the Belgorod university of cooperation, economics and law 4(77) 156-71
[11] Beliaev S 2019 J. Bulletin NGIEI 4(95) 28-37
[12] Smirnov V, Mulendeeva A 2019 J. Economic journal 2(54) 113-27
[13] Komarova A, Lushchik M 2019 J. Russian Foreign Economic Journal 1 52-62
[14] Sukhodelov IA 2019 J. Baikal research journal 10-3 11
[15] Gladkov I 2019 J. International Trade and Trade Policy 3(19) 34-43
[16] Simonova L, Dorokhova A 2019 J. Tyumen State University Herald. Social, Economic, and Law Research 5-4(20) 169-87
[17] Vyborova E 2018 J. Finance and Credit 24-12(780) 2723-39
[18] Kilina I 2016 J. Customs and foreign economic activity of companies 1(1) 2
[19] Simonova Y, Smirnova 2015 J. MIR (Modernization. Innovation. Research) 6-2-2(22) 77-82
[20] Morozenko A 2016 J. Industrial and civil construction 9 57-60
[21] Morozenko A, Voronkov I 2017 J. Science review 12 123-8
[22] Voronkov I 2018 J. Bulletin of MGSU(MSUCE) 13-2(113) 249-57
[23] Voronkov I 2019 J. Bulletin of BSTU named after V.G. Shukhov 11 137-45
[24] Vasilkova S 2019 J. Energy law forum 4 20-5
[25] Morozenko A, Voronkov I and Kuzmin N 2019 Organizational and management activities in the construction of nuclear power plants (Moscow: MISI - MGSU publishing house) p 116
[26] Mironenko A 2018 J. Matrix of scientific knowledge 5 19-25
[27] Pergamenshchik B, Undozerov V 2018 J. Economics of Construction 5(53) 25-34
[28] Grabovyi P, Berezka V 2019 J. Real estate: economics, management 3 6-16
[29] Iurlov F, Ivanov A 2015 J. Modern problems of science and education 2 321
[30] Morozenko A, Voronkov I 2014 J. Industrial and civil construction 12 30-2
[31] Morozenko A, Voronkov I 2018 *J. Scientific and Technical Volga region Bulletin* **8** 27-9