The main problems in the mechanical engineering sector and some possible directions of their solution

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Abstract. The article shows the problems of the sector of mechanical engineering in the industrial system in Russia. The author's method of estimating the relative level of risk and the method of determining the de-industrialization degree of the sector based on the aggregated level of adaptability are given. According to them we have analysed the key indicators, such as basic, developed and advanced technologies, and investments in an old or new technology of industrial sectors. The main directions of the impact of industrial policy allowing a change in the current situation in mechanical engineering are given. The results can be applied in practice in formation of directions and actual control actions to improve the overall efficiency of mechanical engineering industry.

1. Modern industrial policy: theoretical aspect
The current situation in the Russian industrial system is characterized by a high degree of dependence on imports of both raw materials and semi-finished products, as well as on means of production, low quality and low profitability of domestic products, the prevalence of resource industries over manufacturing ones.

The reasons for the development of such situation are the decay of existing commercial and technological relations that existed on the territory of the former Soviet Union, a significant decrease in the degree of government influence on the economy, as well as possible errors in the process of adoption and implementation of economic industrial policy. In our view, considerable attention in the analysis of the reasons must be given to the so-called ‘paradox of plenty’ or ‘resource curse’. The so-called ‘resource curse theory’ was first expressed in the work of Jeffrey Sachs to explain the fact that countries rich in natural resources, especially energy, are lagging behind in their development, compared to others. An explanation of this fact is the statement that the sale of resources brings the country more revenue than production activities, and its redistribution is becoming a priority for economic agents.

However, many researchers give different meanings to the concept of industrial policy. In recent years some new terms have appeared, such as industrialization, and reindustrialization or neoindustrialization that have a significant number of interpretations. Hereafter the national industrial policy and industrial policy (according to the Draft of Federal Law № 98281-5 ‘On the national industrial policy in the Russian Federation’) will be referred to as a system of legal and economic measures and actions of subjects of industrial policy (public authorities, local government bodies, legal entities and individual entrepreneurs, organizations, forming the infrastructure of support for industry, non-profit organizations developing an interest to the industrial activity). These measures
originate from the priority to ensure the competitiveness of the national economy, a stable and innovative socio-economic development of the Russian Federation, the Russian Federation subjects and municipalities.

To create a well-functioning industrial policy, in the first place it is necessary to assess the situation in the industry at the moment, to identify the main problems and directions of impact and limitations. It is reasonable to determine the resulting indicators, for which it will be possible to assess the degree of achievement of objectives; the next step is to define the scope, structure and sources of funds for industrial policy. We ought to remember that the same quantity and quality of resources may have different potentials depending on the extent of their use, so we will investigate not only the kinds of resources, but also their ability to produce a beneficial effect.

2. The technology and growth of industries
The rate of growth of the economic system will be higher, the higher is the rate of aggregate investments.

The rate of investment must be greater than the currently generated product and the rate of the change in the share of investment in the product for the growth of any economic system. Thus, we face some problems. On the one hand, investment in fixed assets does not reach the level in the year of 1990 and tends to decrease at the present time (Figure 1). The investments falling to the share of mechanical engineering had decreased from about 15 % to 4 % by 2014 in the total industry volume.

![Figure 1. The rate of investments in fixed assets.](image)

On the other hand, the sources of investments must be analyzed. We had discovered that the proportion of borrowed funds in the mechanical engineering is falling from year to year from 40 % in 2009 to 30 % in 2014. This is the result of, first of all, the excessive cost of credit exceeding the level of profitability in the sector, which makes credits unaffordable for most of the enterprises related to mechanical engineering industry. Secondly, this situation arises due to a significant level of risk, which discourages investments [4].

Our method for specifying the relative level of risk includes determination of coefficient $\beta$ (a general formula is similar to the CAPM method):

$$\beta = \frac{\text{cov}(X_n, Y_n)}{\text{var}(X_n)}$$  \hspace{1cm} (1),

where $\text{cov}(X_n, Y_n)$ – the covariance between $X$ and $Y$, $\text{var}(X_n)$ – variation and the standard deviation of profitability in the sector, %.

The value of the covariance and variation is as follows:

$$\text{cov}(X_n, Y_n) = \frac{1}{n} \sum_{i=1}^{n} (X_i - \bar{X})(Y_i - \bar{Y})$$  \hspace{1cm} (2)
\[
\text{var}(X_t) = \frac{1}{n} \sum_{t=1}^{n} (X_t - \bar{X})^2
\]  

(3)

where \( X_t \) – the value of profitability in the sector per year, \( Y_t \) – the value of return on the average in the industry per year \( t \), \( \bar{X} \) – the average value of profitability in the sector, \( \bar{Y} \) – average profitability of the system.

We calculated the relative risk level in the mechanical engineering and mining sector of the Russian industry for the period of 2003…2014 using this method.

The risk in the mining depends very much on the price of oil, which is at a very low level nowadays, but in spite of this fact the level of the relative risk is 1.3 times higher in the mechanical engineering than that in mining industry.

Figure 2 also shows the average level of profitability in the industrial system of the Russian Federation in 2003…2014, so we can note that the profitability in mining industry is more than 3 times higher than that in the mechanical engineering, which shows that the excess return in commodity sectors is more than 3 times higher than the yield in manufacturing. As a result of this structural change there is a skew appeal of the sectors to investors.

![Figure 2. The rate of risk and profitability in mining and mechanical engineering industry.](image)

So, the growth of mechanical engineering and industry as a whole depends on the combination of new and old technologies. However, as it has already been noted, it is unreasonable to conduct the identification borrowed from the obsolete technology (though in terms of borrowing, costs may require fewer resources than creating a new proprietary technology, but this method is not suitable for all countries and this is not always an objective truth).

With increasing speed of diversion of resources and creation of a new resource, the increase of the technological level will accelerate the pace of the economic growth.

We can make the following changes in investments in old and new technologies depending on the parameters of diversion speed of resources from old technologies (\( \alpha \)) and creation of a new resource (\( \mu \)) [2],[5].

An important aspect of analysis of the production system is the evaluation of resources and sources by its growth. According to the theory of industrial advancement developed by Sukharev O S [1], the ratio of the basic and emerging technologies occurs as a change in the structure of the system and the overall rate of its growth. In our research the amount of expenditure on technological innovation was taken as the cost of new technologies, \( I(t) \), and the total value of expenses in fixed assets - as all investments, \( I(t) \), the difference between the value of total investments in fixed assets and the cost of technology innovation - as the costs of old technology, \( I_s(t) \), (Table 1).
As we can see the total amount of investments in the sector is growing, the rate of investments in technological innovation is increasing in absolute terms, their share in the structure increases as well. The analysis of the used technologies and the number of new advanced technologies in the sector indicates the total drop in the number of technologies to 11398 units in the period of 2009–2014 in absolute terms, or by 19.92%. Thus, despite the overall positive trend of growth in the value of investments, their total amount is not sufficient to improve the technological level.

Structural indicators calculated using the value of fixed assets and the amount of employment in the sector show a general increase in the cost of fixed assets in each of the analyzed sectors and a reduction in the number of employees in the whole industry. The value of investments and sectors attractive to investors are also showing a gradual decline in the manufacturing sector, compared to mining industry, and their movement in the opposite direction, increasing a raw material basis for economic growth and the country's industry. Therefore, the structural policy must include, first, the proportion of the structural changes in the economic system and economy as a whole and in the large-scale industry. A second aspect of the structural policy should cover the distribution of resources and factors of production optimally or approximately. In addition to the obvious misallocation of resources used in the structure there is a problem that the quality of the resources used is of minimum necessity. Unfortunately, the statistical data do not currently contain a residual value and the average age of the equipment used in the production, which makes an objective assessment of value assets impossible. Experts estimate that the average age of used fixed assets is approximately 20 years, reaching a number of economic activities equal to 25, and the value of physical depreciation exceeds 40%.
The technological level is reduced in all sectors analyzed, the maximum reduction in mechanical engineering is an indicator of the economic activity. Based on empirical data, the situation in the manufacturing sector is the most negative, the situation of the sector is number 5, which describes the classical situation of de-industrialization. Measures to change the structure of the industrial system will be discussed below.

3. Problems of the industrial policy in the region

The process of implementation of industrial policy at the regional and municipal levels is closely related with investment activities, budget and tax policies.

A support for large regional companies, making a significant contribution to the gross regional and domestic products of small and medium-sized enterprises has the advantage of quick adaptation to rapidly changing market conditions. It is the main form of industrial policy at the regional level.

In this case, the main problem the local authorities face is the problem of the budget execution. If funding is insufficient, it is impossible to suggest the performance of programs supporting the industry. As a result of activities involving the modernization of production, additional payments to the budget do not come, and due to implementation of a new investment project, the result of which is to create a new object, the city's budget receives only 0.1 % of its total income. Besides, changes were made in the amount of an interest tax on personal income, fines for violating immigration laws involving incomes to a greater extent in the regional and the federal budget.

The existing and widely used tax incentives granted for a long-term practice are not currently used. The analysis showed that a number of companies receiving tax breaks and subsidized interest rates on loans had not brought additional tax revenues, which generally reduces their value.

Another issue is the aspect of the land owned by the city and the region; the city administration is unable to dispose of the land of the city, which increases transaction costs and time-consuming, violates the principle of ‘one window’, forcing potential owner to address the issues in the city administration (for example, in the Office of the construction and development of the areas of the Bryansk city in the department of architecture) and the regional administration.

The almost total lack of tax revenue of the city limits resources for industrial policy at the municipal level does not create conditions for the commitment of local authorities to change the current situation. This raises the problem of reforming the existing institutions of local industrial policy, changing the legislation regarding management of tax revenues of the city and the region, as well as adjusting the federal industrial policy, and other similar problems of local governments.

All of the above-mentioned problems can be defined as a dysfunction of the industrial policy in the city of Bryansk. As it is known, the solution is considered to be optimal if the problem solution process is higher than the level of problem origin. Therefore, in order to overcome these contradictions it is necessary to address the developmental level of the whole country. Only in the coordination of federal executive authorities and municipalities, revision of the existing situation becomes possible.

Thus, whereas the necessary technology (related to updating of the physical and human resources) and structural (related to the transformation of the industrial structure) changes are sufficiently clear and unambiguously defined, the institutional problems of industrial policy are not fully identified and, of course, unresolved at the local, regional and federal levels. The main directions of overcoming the dysfunction of industrial policy at the regional level, in our view, are the following.

First, the creation of a single integrated contract system, which is the event of legal, institutional and economic measures, is aimed at ensuring the state and municipal needs through a comprehensive implementation of the interrelated stages of forecasting, planning and procurement (including the execution of contracts), as well as monitoring, surveillance, control and audit. An effective use of this system will allow linking all the activities included in the industrial policy of the state with other state regulation forms of social-economic development of the country and the region. In this case, attention should be focused not only on new industries using innovative advanced manufacturing technologies, but also on the restored base of stereotypical, classic productions (‘conservatives’) and technology [3].
Second, the promotion of enterprises’ associations of different forms of ownership belonging to different types of the economic activity in individual holding companies, will resume economic ties within the region and the country as a whole.

Third, the re-establishment of pre-existing programs of scientific and industrial research, undertaken jointly by companies and universities, included by means of training of diploma students, doctoral and post-graduate practical work, contractual work of the teaching staff in higher education institutions, will intensify efforts in increasing the amount of intellectual capital and facilitate an access to the results of research and development.

Fourth, the adaptation of programs will support the industry at the regional and local levels, taking into account the possible and necessary interaction of industrial systems of different regions.

Fifth, the process of redistribution of resources between regions with regard to their specificity and investment attractiveness, strengths and weaknesses should form a unified state tool of the new industrial policy.

Harmonization and reasonable distribution of functions between the regional and federal institutions, sharing of responsibilities and the resources are to be used to achieve the goal of the efficiency increase of industrial systems at all levels of management, beginning from an enterprise and ending with the country as a whole.

So, the situation in the Russian industrial system and in the engineering sector requires urgent management activities in three basic directions - economic reform, institutional reform and an activity aimed at improving the technological level of the industry.

Economic reforms must be directed at the increase of domestic demand in order to increase the investment in fixed assets. Therefore, the tax system and the credit system must undergo reformation; the cost of loans and taxes should be different for various sectors of the industry.

Institutional reforms must clearly share responsibilities. It is necessary to define the implementation of the industrial policy, consolidating certain institutions to determine their areas of competence, possible management impacts and the amount of available resources.

Actions aimed at improving the technological level of the industry must increase the efficiency of production resources and factors, including renewal of fixed assets, advanced training, development and introduction of new and existing technologies. It is necessary to highlight the fact that there are main production lines, such as machine tools, where Russia has a competitive advantage over other countries. Expanding these sectors allows reconstructing the destroyed production chains.

Thus, there is a hope that the entire set of proposed actions will make it possible to increase the competitiveness of the engineering industry and the entire industrial system as a whole.

References

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