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**ON NECESSITY TO INTRODUCE INNOVATIVE PRODUCTION  
PLANNING AT RUSSIAN METALLURGICAL ENTERPRISES**

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**Abstract**

In order to improve their own competitiveness in the domestic and foreign markets, Russian metallurgical enterprises need to work on their production planning system. The key indicator is the shipment discipline in the circumstances of constant production effectiveness. The authors of the paper analyzed the main indicators of Russian metallurgical enterprises business activities for the period from 2012 to 2015. The researchers also thoroughly studied the existing investments in fixed assets of these companies and made a list of basic problems dealt with by Russian metallurgical enterprises (including those in the sphere of production planning). The authors of the paper drew attention to the theoretical aspects of production planning at industrial enterprises and described basic requirements to improving the planning process, including the necessity to use computer and other software. The authors worked out and offered the model of innovative production planning to be used by metallurgical enterprises on the basis of MRP systems and APS. The system of innovative planning is expected to be effective from the point of view of both the short and long term perspectives. The researchers compared traditional production planning system innovations and spoke on the major possible economic outcomes of innovative production planning at a particular metallurgical enterprise. Among them are the discipline of production shipment to the consumers, the optimization of production cycle, the raise of the production effectiveness of the basic equipment, etc.

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**Keywords:** Innovative production planning; shipments discipline; quality of planning; planning of quality of customer service; production planning system; planning cycle.

## 1. Introduction

Metallurgy is one of the fastest growing sectors of the Russian industry. This industry is one of the few sectors, which makes a significant contribution to the economic growth of Russia in the XXI century



(Ordyan, 2014). So, the period from 2012 to 2015 is the period when the share of Russian metallurgical enterprises in the country's GDP was about 5%. Their share in the sphere of industrial production was about 17%. The share in the sphere of export reached 11%, and in tax payments to the budgets of all levels, it reached 9% (Russia in Numbers, 2016).

For domestic economy, metallurgy is one of the most profitable and fastest growing sectors of the industry. At the same time, it is also the most important sector of specialization in the modern international division of labor (Sazykina, & Beschastnova, 2015). This industry is known to be complicated from both the technological and marketing points of view. It is also characterized as one of the most competitive spheres of the modern world market.

China, India, Japan, Republic of Korea and Taiwan are traditionally recognized as the main producers in steel industry. However, the level of capacity of the global metallurgic industry has decreased in late 2014 to 72.7%, which resulted in the increased global competition and the search for new markets, which aimed to ensure the profitability of the industry objectives (Trojanova, & Kembel, 2015).

Thus, at present, in order to improve their own competitiveness Russian metallurgic companies should set strategic goals that best suit customers' requirements. Among their customers are enterprises of such sectors as mechanical engineering, aerospace, energy, construction sector, oil and gas industry, railway transport, and a variety of others. Many of these enterprises operate in a fairly tough competitive environment. Among the values that a metallurgical enterprise can offer to its customers are the quality of the product, the possibility of shipping goods on time, high level of reliability, fast and flexible feedback to all incoming queries as well as a good information service. Therefore, it is clear that the companies are thinking about improving the quality of customer service along with improving the quality of the product (Konvichka, & Solodovnikov, 2015).

Lately, Russian metallurgy has undergone significant changes, both in terms of the scale of production, and the level of technology and the technical condition of manufacturing equipment (Trojanova & Kembel, 2015). Many domestic enterprises have managed to adapt to the current market conditions. Some of the enterprises have revised their strategic objectives and focused on such important indicators as the supply discipline, loss of production reduction, reduction of the production cycle.

It is known that the quality of planning is the key factor for the quality of control. The process or the function of planning has been studied in its scientific aspect for more than a hundred years, beginning with the ideas offered by Taylor (Dean, 1997).

In order to make a production planning process more effective, managers use the principles of scientific, production and logistics management. They also apply MRPI, MRPII, CANBAN, APS systems. Thus, working at the improvement of the production planning process, managers continuously face new challenges and issues to be solved with the help of completely new approaches.

This paper discusses the managerial and economic aspects of the implementation of the innovative planning system at metallurgical enterprises with a continuous production cycle based on the new generation of MRP. The system has already been tested in several foreign companies (for example, in such companies as the US company «TimkenSteel» (see the official website of TimkenSteel) and the Czech company «TrinickeZelezarny») (see the official website of TrinickeZelezarny).

## 2. Problem statement

Despite the lack of stability in both the domestic and world economy, the number of operating metallurgical enterprises is constantly growing. Table 1 shows the key performance indicators of the metallurgical enterprises in the Russian Federation.

**Table 1.** Main performance indicators of Russian metallurgical enterprises in 2012-2015 (Russia in Numbers, 2016).

Indicators	2012	2013	2014	2015
The number of active enterprises (by the end of the year)	28502	29918	30976	....
The total of shipped output goods of own production, bln. rub.	4010	3955	4565	5099
Average number of employees, thous.	995	991	954	922
Net financial result (profit minus loss), mln. rub.	284493	147995	94407	601506
Profitability of output products (works, services), %	11.3	9.9	16.4	22.4

Table 1 shows that the number of shipped products, financial results and the index of production profitability for the analyzed period of time has a tendency to grow. The reduction in staff resulted from the optimization of the business processes and the reorganization of certain enterprises, which was caused by the economic crisis, etc.

Table 2 shows the real fixed capital formation of the Russian metallurgical enterprises for the period from 2012 to 2015.

**Table 2.** The level of investments in the fixed capital of the metallurgical enterprises of the Russian Federation for the period from 2012 to 2015 (Russia in Numbers, 2016).

Fixed investment	2012	2013	2014	2015
Metallurgic production and manufacture of finished metal products (bln. rub.)	258.6	250.2	231.6	285.8
- which includes metallurgical production (bln.).	220	207	194.7	240.3
Metallurgic production and production of finished metal goods (% of the total investment volume)	2.1	1.9	1.8	2.0
- which includes metallurgical production (% of the total investment volume)	1.8	1.6	1.5	1.7

So far, in percentage correlation, the total real capital investment in the domestic steel industry remains the same, while there is some growth in absolute terms.

In the estimation of specialists, in connection with the implementation of state development programs, the construction and military-industrial complex would become the main factors of the steel products consumption growth within the domestic market. Thus, the appropriate funds amounted to more than 22 trillion rubles are to be spent in accordance with the Government Program of Development of the Military-Industrial Complex in 2016 - 2020 (Government Program of the Russian Federation).

All the projects of the Program are directly related to the need of development and modernization of the domestic metallurgic industry.

Analyzing the problems of the modern Russian metallurgical sector, the majority of researchers recommend (Ordyan, 2014, Troyanova, & Kembel, 2015; Egorova, & Kuznetsov, 2015).

- to increase production efficiency with the help of the increase of selected units' capacities;

- to upgrade the quality of the metal products;
- to carry out technological modernization aimed to restructure the production process and to mobilize all resources of the metallurgic industry.

All these measures are good enough in theory and are easily understood in terms of economic effects. However, they entail costly long-term investment projects that do not always correspond to the key strategic objectives of companies. The introduction of innovative production planning is an alternative path to be chosen by metallurgic plants because it helps to reduce the payback period of investment costs and it fully complies with the requirements and expectations of its customers (consumers).

### **3. Research questions**

Over the past century, the function of production planning has undergone significant changes associated with the development of industrial enterprises, the development of markets and the introduction of information technologies.

Specific requirements for the planning process emerged in the middle of the 20th century with the introduction of TQM philosophy (Total quality management) - Total Quality Management. Improved product quality led to the individualization of customer requirements, which brought to the development of customer-oriented business philosophy. The immediate impact of this trend resulted in the reduction of the production cycle duration, low stocks, high reliability in meeting delivery or shipping schedules, as well as production flexibility (Sergeev, 2014).

Almost at the same time (1950s), there was a system planning of the supply requirements in materials of the first generation MRPI (Material Requirements Planning), which is also known as one of the most popular logistics concepts. Due to the rapid development of information technology in the 1970s, the MRP system has undergone a new milestone of development (in the scientific literature it is also known as MRPII).

One of the important trends in the development of production in the last decades of the last century was the effect of the speed of reaction to market changes as long as to the process of marketing products and services, etc. Those were the times when the concepts of Lean Production, Just-in-Time and some other companies were formulated. Later, production planning gradually became more and more related with logistics, a part of which is also known as production logistics.

In the early 90s, the company «I2 Technologies» gained its popularity due to the new system of planning and scheduling, which later became known as Supply Chain Management» (Supply Chain Management - SCM). This system presupposed the formation of a distribution network, which stands for the delivery of the required raw materials or goods to the right place at the right time and at the least possible cost (Voronin, & Korolev, 2014). The systems of production planning (Advanced Production Planning - APS) are also well known all over the world. There are many examples of successful implementation of this type of systems in different industries, the result of which is the high business value for the enterprise data. In general, these technologies presuppose the usage of computer software and hardware, which allows the company to change the process of planning, scheduling, forecasting and distribution as well as to interact with customers and suppliers. However, there is a chance to come across a company where the expectations from the implementation of APS standard technologies have not led to

the expected results, and sometimes have even worsened the situation (Konvichka, & Solodovnikov, 2015).

To make innovative planning system undergo effective adaptation, one should take into account many external and internal factors associated with a particular company and should create an integrated planning environment, the involvement of the team and so on.

#### **4. Purpose of the study**

The purpose of this study is to show the need to introduce the innovative production planning model at Russian metallurgic enterprises based on improving the quality of production with the help of the updated version of the APS and MRP systems and the discipline of shipments, which remains to be one of the main key performance indicators, which can ensure the efficiency of production.

One of the main problems of the existing planning system at Russian metallurgical enterprises is the instability of the production plans. A high-quality plan can be obtained only in the short term. The innovative scheduling system offered by the authors of the article is expected to allow enterprises to adjust the medium-term plans and to achieve more effective work with orders.

Let us consider the basic steps of the system.

*1 stage - Promise of orders.* This stage is a part of the general planning system. With its help, it is made possible to determine whether the current orders of the company correlate with the sales strategy, whether it is possible to deliver the goods in a timely manner, etc. When the order of the client goes through all the stages of order confirmation, it become a fully-fledged order.

*Stage 2 – Supply Selection.* The decisions taken in the framework of the supply selection process are to undergo the approval at all stages of production. The process of production does not start from the very beginning, which helps to reduce possible time loss.

*Stage 3 - Production planning and schedule of specialists' layout.* The smelting of metals (or fusion) is one of the most important stages of production at metallurgical enterprises. However, if to speak of the long-term production planning area, all orders in smelting enterprises are grouped on the basis of certain rules. These smelting are automatically recalculated every day, as the overall situation in the long term is rather changeable.

In the mid-term, the existing smelting orders can be added to new orders. In order to adjust the plans, layout specialists tend to track their planners (planners) and include a production program, which can be adjusted to the plan. Short-term planning is completely closed to changes. At this stage, production targets are formed on the basis of production schedules. Restrictions of any kind (for example, such as technological routes and the sequence of metal casting, available capacity, availability of resources, etc.) are to be analyzed on a regular daily basis.

Changes in production require a new planning cycle. This means that in order to create a new version of the plans and schedules and to synchronize them with each other, it is necessary to be guided by the global objectives of the shipment discipline, resources loading, and inventory levels. Supply selection is also a part of the daily planning process, since this process can also become the source of changes. Assignment of free stuff from the stock may shorten the production cycle and to offer the capacity for

other orders. A distinctive feature of the innovative production planning system is that in most cases users can work with the planning system at any time convenient for them.

It should be noted that the development of the production plan at a large metallurgical enterprise with a few redistributions channels cannot be performed with the help of only one scheduler. The innovative planning system presupposes collaborative teamwork of 10-12 specialists.

For metallurgical plants, where production phases are closely linked with each other, the planning system can include the solutions for the cases when some production steps or activities can be postponed because of the breach of the timing schedule. The layout specialists should understand that the quality of the production planning might suffer.

The innovative planning system allows planners or layout specialists to systematically track conflicts and resolve them. For this purpose, it is always of help to support the operations with the group of planners (that is the main function of the planner), whereby the overall planning process makes it possible to assess the work of each individual plan participant.

Table 3 provides a comprehensive comparison of the traditional and innovative production planning system.

**Table 3.** Comparison of traditional and innovative production planning system.

ComparisonParameter	Traditional planning system	Innovative system of production planning
1. Planning Base	The use of a single universal design module to create a production plan	Combining several modules estimated to account for different restrictions
2. The ability to make changes in the planning process	Change of the basic algorithms, or the development of additional algorithms in the planning process is not possible	Scenario analysis makes the function change (return) possible and helps to achieve high accuracy and realism of the planning model
3. Integration of the Planning Processes	Separation of production plans and schedules, reducing the possibility of integration and automation	Production plans and schedules can become fully integrated. It would help to see a complete picture of production operations and activities at the planning horizon
4. Teamwork	Conventional planning systems do not fully support the planning in team work. As soon as the number of system users grow, the effectiveness of production planning decreases.	A multi-user environment allows for flexible planning to solve conflict issues directly in the system, to prevent divergent actions planners
5. Planning Process management	There are no tools to manage the team of the layout specialists	It allows one to manage the activity of the planning group, which includes the support for monitoring and the evaluation of layout specialists' activities.

## 5. Research methods

The authors of this paper used a variety of theoretical and empirical research methods. Thus, for example, the study was carried out with the help of such theoretical methods as analytical and deductive methods. Analysis of different production planning systems demonstrated the possibility and the need to implement innovative planning system at Russian metallurgical enterprises.

Empirical methods included the methods of observation and comparison, which were used to identify the major economic trends and the patterns of activity of the Russian metallurgical enterprises. To evaluate the forward-effects of the introduction of innovative planning, the authors also used the measurement method.

## 6. Findings

Implementation of innovative production planning at a particular metallurgical enterprise may result in some certain economic results, which are described in Table 4.

**Table 4.** Key economic results of introduction of innovative production planning.

Basic economic characteristics of innovative production planning introduction	Expected outcomes
1. The required amount of investments to implement the innovative planning process	From 0.3 to 0.7% of the actual (depreciated) value of fixed assets of the enterprise
2. Shipment discipline	The increase of this indicator up to 85-90%
3. Optimization of the volume of the work in progress	Reduction of the amount of the work in progress without breaking the rhythm of production (percentage work in progress reduction largely depends on the goals of the company and the characteristics of the technological cycle)
4. Reduction of the production cycle with the help of reducing non-productive time loss	15-20% of the time
5. The increase of the output volume without the increase of the production capacity	Depending on the needs of the market
6. Performance of the basic equipment	Increase of equipment utilization rate up to 15-20%
7. The payback period for the implementation of innovative planning system	The average payback period duration 1 - 1.5 years

Of course, these calculations are predictive in nature and depend on many external and internal factors as well as on specific technological features of the metallurgic plant.

## 7. Conclusions

In order to increase competitiveness and to better satisfy consumers' needs and demands, Russian metallurgical enterprises need to improve their production planning system. The current planning systems have a number of drawbacks and limitations of technical and administrative character. If compared to alternative models, the proposed model of innovative production planning based on the updated MRP and APS systems would allow one to receive economic benefits in a comparatively shorter period of time. Further studies may be associated with a more detailed study of specific stages of the innovation production planning, as well as human resource management issues in the framework of this activity.

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