Food technology management based on the implementation of innovative principles and approaches

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Abstract. The domestic food industry was chosen as the object of research in the work, since this sector of the national economy contains the goals and objectives of a nationwide scale. The effectiveness of the functioning of the latter depends not only on economic indicators, but also on social and political ones. The work assesses the trends in the development of the food industry, as well as the level of innovative development of the food industry in Russia; the main directions of innovative transformations, the most relevant for the sphere of domestic food production, are highlighted; the specifics of organizing and conducting innovative management decisions in the real practice of management have been determined; a complex of problems has been formed that hinder the innovative development of food production; analysis of methods of state support for food enterprises in terms of modernization and increasing the level of innovation activity; examines the stages of introducing innovations into a real production process; a list of the most relevant and promising innovative technologies implemented in modern food production is provided; a list of key factors has been determined that have a direct impact on the process of introducing innovative technologies in the field of food production; actual errors were formed in the course of development, testing and implementation of innovative technological solutions in industrial production activities; separate recommendations are given in order to improve the efficiency of the implementation of innovative transformations at food industry enterprises in Russia.

1. Introduction

Currently, the acquisition of competitive advantages by business entities in the context of permanent saturation of markets with goods and services is a top priority. Today, modern companies are using various methods and approaches to improve the efficiency and competitiveness of products. Often, transformations are carried out to optimize and rationalize in the production, technical and technological, organizational and managerial, transport and logistics, marketing, financial and economic and other spheres of management. Sometimes optimization decisions lead to negative synergies, when a decrease in costs and expenses leads to a clear loss of the quality of the finished product, which in the current conditions of organizing the market space is completely unacceptable.
As domestic and foreign practice shows, innovations are currently the key instrument of balanced development in terms of rationalizing and maintaining / improving product quality. Thus, the chosen research topic is relevant and promising.

The purpose of the work is to study the trends in the development of domestic food production in the context of innovative development and to propose solutions to increase the level of innovative activity.

The following tasks were set: to assess the level of innovative development of the food industry in Russia; to highlight the features and directions of innovative transformations for the sphere of domestic food production; to form a complex of problems that impede the innovative development of food production; provide a list of the most relevant and promising innovative technologies implemented in modern food production; give recommendations on how to improve the efficiency of the implementation of innovative transformations at food industry enterprises.

The following scientific methods have found application in the work: description, comparison, expert assessment, idealization, analysis, analogy, synthesis, formalization, induction, deduction, generalization, concretization, abstraction. Among the scientific approaches it is worth noting: systemic; logical; dialectical; process.

2. Materials and methods

Currently in modern scientific literature there are a large number of definitions of the category "innovation". It should be noted that this concept was first used by J. Schumpeter in his scientific treatise "Theory of Economic Development" in 1911. At the same time, this scientific achievement was the result of the formation of scientifically substantiated provisions of the role and significance of innovations in the economic development of individual subjects and objects of management, which were formalized and substantiated by N Kondratyev. In a general sense, this scientist understood innovation as "... fundamentally new combinations and qualitative changes in the development of a particular process (phenomenon)" [16].

P Drucker considered the category “innovation” as a special tool for entrepreneurs to expand and renew their business. In view of the fact that the researcher noted the formation of sales markets (products, services) as the main task of the manager, he referred to the two basic functions of the manager: the implementation of innovative processes (the result is innovation) and marketing activities [5].

B Twiss, as an innovation process, determined the course of transformation of scientific and technical knowledge (innovative ideas) into the directly applied sphere of management. Thus, the final product or service is the carrier of the transformation of knowledge-intensive ideas and transformations [14].

In the Concept of Innovation Policy of the Russian Federation for 1998-2000, the following definition of the concept of "innovation" is fixed - this is the end result of innovation, which has received implementation in the form of a new or improved product sold on the market, a new or improved technological process used in practice “[6].

J Cook and P Myers defined “innovation” as a holistic, continuous and transparent process from the inception of an innovative idea to the production and sale of a finished product (service) [1].

M Dodgson interprets "innovation" as a set of scientific and technical, organizational and managerial, financial, economic and socio-legal activities focused on the production and sale of a new or improved product, as well as on the implementation in practical conditions of a new or modernized production and technological process (equipment) [2].

V Medynsky and S. Ildemenov mean by innovation “... an object introduced into production as a result of a scientific research or a discovery made, qualitatively different from the previous analogue” [9].

In our opinion, the opinion of the following group of scientists (D. Messi, P. Quintas, D. Wild) deserves close attention, who note that the category “innovation” has a binary nature and should be considered from the position of two semantic points of view. In accordance with the first position, this
concept is used to describe a specific practical application of a new product (service). The second position is used to describe the process (design, justification, material and technical support, trial production, serial production, mass production of a new product (service)). The final position is often interpreted as an "innovation process" [10].

Thus, making a generalization of the presented scientific opinions and interpretations, it is legitimate to assert that an innovation (innovation) is an advanced idea clearly worked out from the standpoint of technical, economic and socio-legal substantiation, which has a specific material form in the form of a test sample, but does not have applied increment to any production and economic activity, and innovation (innovation) is the result of intellectual and production-technological labor, which has a pronounced practical embodiment of scientific and technical (technological), organizational, economic, production and other innovation, which has a specific qualitative and quantitative effect.

3. Research question

Currently, the modern domestic food industry is developing at a fairly steady pace, the principle of balance and efficiency is maintained [4]. According to Rosstat, in 2019 the food production index was 110% compared to 2017, with the planned value of 105.9% set in the State Program. In particular, products belonging to a socially significant group and having priority in matters of import substitution are of particular importance (table 1) [12].

Table 1. Production of the main types of import-substituting products in the Russian Federation, thousand tons.

| Types of products / Period | 2017 | 2018 | 2019 | 2019 in % to 2018 | 11 months 2020 | 11 months 2020 in % by 11 months 2019 |
|---------------------------|------|------|------|-------------------|----------------|-------------------------------------|
| Beef and veal (steamed, cooled or chilled) | 205  | 227  | 242  | 106.8            | 224            | 101.8                               |
| Beef and veal (frozen)    | 56.7 | 71.4 | 66.6 | 93.4             | 65.5           | 109.4                               |
| Pork (steamed, cooled or chilled) | 2171 | 2415 | 2491 | 103.1            | 2535           | 112.3                               |
| Pork (frozen)             | 233  | 254  | 323  | 127.3            | 315            | 107.6                               |
| Poultry (chilled)         | 3014 | 3070 | 3246 | 105.8            | 3003           | 101.6                               |
| Poultry (frozen)          | 1303 | 1273 | 323  | 80.6             | 873            | 92.8                                |
| Sausage products          | 2259 | 2282 | 2282 | 100.0            | 2150           | 103.2                               |
| Fresh or chilled marine fish other than fish farming | 855  | 847  | 827  | 97.7             | 723            | 96.2                                |
| Frozen fish               | 3057 | 3056 | 2989 | 97.8             | 2758           | 99.5                                |
| Processed liquid milk     | 5390 | 5457 | 5425 | 99.4             | 5028           | 101.3                               |
| Cream                     | 133  | 150  | 163  | 108.4            | 171            | 114.6                               |
| Cottage cheese            | 486  | 501  | 469  | 93.5             | 450            | 105.0                               |
| Butter                    | 270  | 267  | 269  | 101.0            | 259            | 104.8                               |
| Cheeses                   | 464  | 467  | 540  | 115.7            | 518            | 105.7                               |
| Condensed milk product, mln conventional cans | 837  | 806  | 717  | 88.9             | 659            | 100.5                               |
| Fermented milk products (except cottage cheese) | 2896 | 2819 | 2793 | 99.1             | 2542           | 98.7                                |

According to the information provided by the Ministry of Agriculture of Russia, in 2019, in many food items, the threshold values of food independence (self-sufficiency) of Russia were reached or even
exceeded. There are also food categories for which the level of self-sufficiency has not yet been fully achieved, but based on trends and already existing results, this issue will be completely closed in the near future (2-3 years). The main indicators of food independence (self-sufficiency) are shown in Figure 1.

### Figure 1. The level of food independence (self-sufficiency) of Russia [11].

It should be noted that one of the key factors in the successful development of the domestic food industry (achievement of targets, import substitution indices, the level of self-sufficiency and efficiency (profitability)) is the implementation of innovative transformations.

At present, innovations have begun to play an exclusive role in increasing the efficiency and competitiveness of economic entities in various sectoral segments of the country’s economy, but still we will focus on the field of industrial food production. The content of Table 2 contains data on the volume of innovative goods, works and services in the food industry.

### Table 2. Volumes of innovative products produced in the domestic food industry, mln rubles [12].

| Indicators                                      | 2017        | 2018        | 2019        |
|------------------------------------------------|-------------|-------------|-------------|
| Shipped all goods, completed works and services | 3823114.2   | 4153948.5   | 4543616.2   |
| Innovative products, works and services         | 291811.8    | 272304.3    | 258561.5    |
| Share of innovative products,                    | 7.63        | 6.56        | 5.69        |
The results of the analysis show that the share of innovative products in the field of food production is relatively small and tends to decline. In fact, this indicator for this sphere of economy is not decisive and is not of high significance due to the fact that for food products, it is not their innovation that is more important, but quality, safety, physical and economic accessibility. The indicator of the level of innovative activity has a much higher priority and importance for assessment (Figure 2).

![Figure 2. The level of innovative activity in food production in Russia (Li) [12].](image1)

It should be noted that the level of innovative activity is not high enough and is decreasing, which indicates the presence of negative trends in terms of innovative development of domestic food production. This trend is due to many factors, but the main ones are:

- firstly, the insufficient level of motivation on the part of the management level and the work collective (material and non-material);
- secondly, the lack of financial resources in terms of ensuring long-term innovative transformations in various areas of the economy (food production);
- thirdly, insufficient level of state support for innovation processes;
- fourthly, the low level of development of sectoral domestic science in terms of technical, technological, organizational and management support;
- fifth, the high cost of foreign innovative (progressive) technologies and equipment;
- sixth, insufficient elaboration (imperfection) of the mechanism for transforming innovative inventions into an applied (sectoral) sphere of activity (a low level of integration and cooperative interaction between science and production);
- seventh, the lack of a clear understanding of the directions of applied scientific research.

Next, we will consider the share of costs for innovative activities in food production in the total volume of goods shipped, work performed, services (Figure 3).

![Figure 3. The share of costs for innovative activities in the food production of the Russian Federation (SCI) in the total volume of goods shipped, work performed, services [12].](image2)

It should be noted that the share of costs for innovative activities in the domestic food production in 2019 amounted to 1.3%, which is higher than the level of 2018 and 2017; nevertheless, this is a rather low indicator compared to the data of foreign industry segments (food production). So in some countries this figure reaches the level of 10-15%.
Figure 4 shows the share of domestic industry organizations implementing technological innovations. The data indicate that the share of industry organizations implementing technological innovations in 2019 amounted to 16.1%, which is 0.3 percentage points above the level of 2018, but by 0.5 p.p. below the value of 2017.

![Figure 4. The share of domestic industry organizations carrying out technological innovations (SIO) [12].](image)

In general, it can be said that the number of Russian food enterprises implementing technological innovations can be determined as satisfactory. Thus, it should be noted that more and more food enterprises are focused on the development and implementation of technological innovations, which will allow them in the future to ensure the required level of profitability and competitiveness.

At the moment, among the key factors / incentives for the activation of innovative processes at enterprises of the domestic food industry, it should be noted:

- firstly, the strengthening of import substitution trends;
- secondly, the prospects for increasing export potential;
- third, improving the quality and competitiveness of finished products.

These target settings are very important and promising in terms of innovative and sustainable-balanced development of the entire food segment of the national economy, but the successful implementation of the latter is hampered by a number of problematic factors that have already been noted earlier.

In the course of the study, the main directions of innovative transformations were identified, which are most necessary for the sphere of domestic food production, illustrated in Figure 5 [7, 8].

The study found that in the process of implementing innovative processes in the sectoral conditions of management, they are characterized by a permanent aspect of updating the product range. In general, it can be noted that the implementation of technical and technological innovations at large business facilities takes place in conditions of clear strategic planning, which includes various aspects and manifestations (organization, motivation, control, investments, logistics, installation and commissioning of equipment, feasibility study, planning forecast indicators). For food production, the time interval from substantiating an innovative idea to its implementation at a specific production site is 1-1.5 years. Large business entities in the system of the organization, as a rule, have specialized functional and technological services, which are directly involved in the implementation and promotion of innovative projects. This makes it possible to significantly increase the efficiency of innovative transformations (time of development, search and implementation of innovations, their justification, adequacy of application in a real production process, payback, level of profitability, etc.). It also takes place in practice, the existence of a separate production program of innovative transformations and modernization, which in real conditions organizes work on innovative projects of various organizational and functional divisions of the enterprise, but this approach is less effective and difficult to implement in practice compared to the previous one [13].
Figure 5. The main directions of innovative transformations, the most necessary for the sphere of domestic food production.

| Description                                                                                     |
|-----------------------------------------------------------------------------------------------|
| Creation of new types of products and / or services                                             |
| Implementation and development of a new technological process                                   |
| Improvement of already produced types of products and / or services                              |
| Improving the marketing system in order to promote products on the market                       |
| Improving the level of qualifications of the management and the work collective                 |
| Transformation of the existing technological process in the aspect of increasing resource efficiency and quality of finished products |
| Technological re-equipment and preparation of production for the release of new or improved products |
| Development of testing programs for new products and determination of its quality level          |
| Improvement of the organizational and managerial aspects of the economic activities of industrial enterprises, in order to increase the level of efficiency and controllability of the latter |

Regarding small business entities, it is worth noting that for them the process of innovative changes is more complex and laborious. For the most part, their innovation strategy is implemented only at the expense of their own (internal) resources and reserves. Small enterprises are characterized by relatively small scale of innovative transformations, which are characterized by higher risks.

In food production, innovative changes are mainly implemented only at a certain stage of the organizational, managerial and production process due to limited resources and minimizing the risks of transformational changes.

An important condition for a successful innovation policy at any enterprise is the availability of qualified personnel. In this regard, at present, the most progressive companies resort to the support of third-party organizations in order to conduct various courses / trainings to improve the qualifications of personnel. This approach is considered very promising today and allows, in a fairly short time, to form an innovation-oriented structure of the working team for a more flexible use of not only human resources, but also other types.

As noted above, one of the most significant constraints on the innovative development of food production is the lack of financial and economic resources. In these circumstances, many enterprises are forced to take out foreign currency loans from commercial structures to purchase imported equipment, which, given the instability of the ruble exchange rate, leads to significant risks and problems. It is very difficult to resolve these problem situations without proper support from the state.

In the context of the latter, it should be noted that a mechanism of financial state support for innovative transformations in food production is currently being implemented, firstly, through targeted funding; secondly, preferential lending; and thirdly, through various competitions and grants. Many sectoral enterprises participate in state tenders in order to purchase innovative equipment on preferential terms. Among the most important criteria for the adequacy of this mechanism, it is worth noting: transparency, utility, simplicity and versatility.
It should be noted that, to a greater extent, state support is aimed at the implementation of complex innovations, which have not only a high economic effect, but also social in terms of preserving and increasing jobs, increasing tax and social payments from the enterprise to the local, regional and federal budgets [4].

Taking into account the sectoral features of food production, in our opinion, the introduction of innovative technologies into the production process should be considered in several stages, shown in Figure 6.

**Figure 6.** Stages of introducing innovations into a real production process.

If we consider directly the sphere of food production, then we can single out two key factors that directly determine the level of demand for innovative technologies:

- firstly, this is the growth in demand for high quality products with high consumer properties;
- secondly, the high need to optimize the final cost of products.

The current moment actualizes the need to improve the system for ensuring and controlling the quality of finished products through innovative tools. Traditional methods and approaches are outdated and require significant changes in the aspect of approbation and application of modern information and analytical technologies. The latter are able not only to bring the quality program to a completely different level, but also to very significantly optimize (increase the level of rationalization) of all internal corporate processes. However, the implementation of such initiatives is very costly and requires rather significant investments in the long term, which is difficult for most modern industrial enterprises, and for some it is completely impossible. All this actualizes projects in the field of digital economy and management, implemented on the basis of state support. Innovations and digital technologies are closely correlated with each other and in this context there is a high need for the adaptation of digital technologies to industrial production in terms of organizing specialized functional units for project management, even in small entities (enterprises) [3].

In the course of the study, a list of the most relevant innovative technologies implemented in modern food production was formed (Figure 7).

Of course, the presented list of technologies is rather limited and in practice there are much more of them, but most of them are aimed precisely at improving quality indicators, the level of consumer properties and reducing the cost of the final product. All this, ultimately, should lead to an increase in the overall competitiveness of domestic industrial food production [15].
Today, socio-cultural and personal beliefs are an important factor in determining specific industry trends. In particular, the modern food industry began to take into account such areas as: environmental friendliness of production and food; non-animal products; healthy and functional nutrition; specialized diets for people with diseases of modern society (anemia, diabetes, obesity, allergies, etc.). Thus, it is simply impossible to achieve high indicators in the development of food production and the industry market without high-quality and effective application of innovative methods and approaches.

На основе проведенного анализа была сформирована группа ключевых факторов, оказывающих непосредственное влияние на процесс внедрения инновационных технологий в сфере пищевого производства:

- firstly, the system of market organization and trends in its development;
- second, the prevailing macroeconomic circumstances;
- third, the level of demand for products from target consumers;
- fourth, the effectiveness of the introduced innovative technologies (the ratio of costs and potential results (effect));
- fifth, the duration of the cycle of innovative transformations;
- sixth, the availability of highly professional personnel capable of implementing innovative projects;
- seventh, the level of resource provision and the availability of their reserves;
- eighth, other factors, the degree of load of which depends on a variety of socio-economic and production-technological conditions [15, 13].

The study of the practice of innovative transformations made it possible to form a range of the most urgent mistakes that were made in the process of development, testing and implementation of innovative technological solutions in the sectoral production activities of food enterprises (Table 3).

The presented list of errors is rather limited, but the aggregate of the most relevant is determined by many factors (type of activity, scale of production, geographical location of the facility, availability of resources and reserves, level of competition, stability of demand, etc.).

An important specific feature of innovative solutions in food production is the need for the integrated application of the latter (marketing, organizational and managerial, process, production, socio-legal, financial and economic, etc.). Only when positive synergy is achieved is it possible to speak of sustainable development of industrial enterprises.

So, based on the use of new technologies, it is possible to develop a new product line both through the use of existing types of raw materials, and new ones.

New products should be made taking into account promising market trends and consumer needs, thus, based on marketing technologies, it is possible to stimulate demand, improve methods and delivery methods, and also distribute products to the target audience as fully as possible. All this,
ultimately, will allow achieving high levels of competitiveness, filling the market with the necessary resources and increasing the efficiency of core activities.

Table 3. Volumes of innovative products produced in the domestic food industry, mln rubles [12].

| Typical error | Essence |
|---------------|---------|
| Insufficient elaboration of issues in terms of choosing the type of innovation processes / transformations | Before using an innovation, it is necessary to justify the need for its implementation in production processes. For the rational use of technological innovations, it is required to establish internal corporate innovation management |
| Improperly organized marketing, insufficiently substantiated technical and economic description of an innovative solution | A product or service presented on the market must meet consumer needs. Marketing must provide answers to consumer needs and expectations. Failure to take these factors into account will lead to the production of unnecessary goods |
| Poorly taken into account the question of the target audience | To maximize returns, it is necessary to take into account the target group for which the products and services produced were designed. Too large coverage of consumers without choosing the target audience can lead to unnecessary costs and other costs, which can negatively affect the final economic effect (profit) |
| Insufficient elaboration of the mechanism for promoting development and entering target markets | In the context of constant transformation of the market organization system and market relations, it is required to determine the most effective tools for delivering information to the target audience |

An important area of digitalization is the widespread introduction and use of lean management. As the research practice shows, this direction is able to significantly increase productivity and optimize (reduce) production costs (direct and / or indirect). In the practice of developed countries, there are many tools, methods and approaches to the implementation of this kind of initiatives, but it is innovations that, due to resource-saving production, are able to bring an enterprise to a qualitatively new level of development. In our opinion, the introduction of this kind of innovative technologies in the food industry in Russia will significantly rationalize production processes and reduce costs [3, 4].

4. Conclusion
The results of the study prove that without innovation it is impossible to ensure high competitive development of the domestic food industry in the domestic and foreign markets. At the same time, innovations should be aimed: first, at qualitative changes in technological processes; secondly, for the development of new types of products, since it is these areas that will make it possible to achieve sustainable development of domestic food production in the long term. Despite the high role and initiative of the state in the formation of the innovative potential of the industry, it is modern commodity producers that create the market environment, and their innovative development should be based on the high innovative activity of individual economic entities and private investors. Unfortunately, in domestic practice today there are serious problems in the field of intensification of innovation and activation of innovation processes. This circumstance is primarily due to the low investment attractiveness of the industry segment and the presence of a large number of risks inherent in the national economy of Russia.
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