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Methods for assessing the economic efficiency of innovative dual-use products

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Abstract. Many important problems for the domestic defense industrial sector can be solved by the development and practical implementation of market mechanisms that allow the commercial sale of innovative dualuse products. The article proposes methods for assessing the effectiveness of innovative dual-use products transferred to the civil sector. In order to conduct an economic assessment, the authors investigated the current methodology state of military-economic analysis for the products created by defense enterprises and proposed the basics of tools for determining limit prices for dual-use goods and technologies, a methodology for their expert evaluation based on clustering, and also assessed the scientific and technical potential of such products. The main results of the study are presented both conceptually and in detail for some of the most important specific applications.

Keywords: defense industrial sector, market mechanism, production business, diversification, sanctions, extra-budgetary financing, innovations, innovative dual-use products, INNOVATIVE military-economic analysis, clustering, scientific and technical potential.

INTRODUCTION.

One of the most important and urgent problems of introducing market economic methods and mechanisms of the domestic defense industrial sector is the development of innovative tools designed for additional (commercial, indirect, etc.) financing of various defense programs and

orders. The need for this type of work is due not only to the difficult conditions for many defense industrial base companies at the present time, the slowly growing GDP, instability and insufficient state funding of defense programs and orders, and sanctions, but also the expanding integration of Russian developers and manufacturers of various defense industrial products (DIPs) into the world market of weapons and military equipment, into its financial and credit organizations. These and some other circumstances require a qualitative and prompt solution of numerous complex tasks and finding sources of additional extra-budgetary financing for defense orders and programs, as well as mechanisms, methods, and forms of attracting resources and funds and their effective use. Based on international and domestic experience, it should be highlighted that the commercial sale of innovative dual-use products (IDUPs) becomes a promising way to obtain additional revenue. Such products are created in conditions of the diversification of defense enterprises. They are produced and actively used not only in the military but also in many civilian economic sectors.

THE CURRENT METHODOLOGY STATE OF THE MILITARYECONOMIC ANALYSIS OF DIPs.

From the point of view of customers and the entire management system for the development and procurement of DIPs, the new situation associated with the spread of IDUPs means the need to develop not only methods of economic evaluation of defense hardware use for civilian purposes but also methods of military-economic evaluation of certain military goods in related defense areas, methods of military-economic evaluation of civilian products use for defense purposes, and methods of comparative and generalized assessment of IDUPs, taking into account both civil and military use. This problem is especially significant and relevant due to the possibility of reducing direct budget costs when financing military research and development (R&D) through the conclusion of various cooperative agreements (within the military sector, between the subjects of the military and civilian sectors). The key in this case is the condition and development stage of the military-economic analysis (MEA) methodology and methods.

In the modern sense, MEA is a field of activity and a scientific direction (scientific discipline) related to the generalized assessment of the quality and effectiveness of DIPs, justification and selection of rational solutions in the areas of development management, creation, procurement, operation, and military use of DIPs, taking into account the indicators of both the achieved military effects and the costs of achieving.

A typical external feature of the MEA development initial stages is the use of DIP decision-making methods, which are based on criteria of combat effectiveness only. Usually, these methods are unrelated or have a weak connection with the consideration of individual DIP types, the use of department-specific and sectoral planning methods for the development of DIPs with an emphasis on actually predetermined narrow lists of possible solutions and resources, with a focus on purely

extrapolation planning from “what has been achieved”, from the requests of private contractors and private entities using financial resources at various stages of the life cycle.

A typical decision-making scheme was as follows: using the methods of operational-tactical, military-technical, and technical analysis – usually without the use of economic criteria – alternatives were formed and possible solutions were selected – usually very close in military-technical parameters, which were then checked for the acceptability of costs for individual works, objects, and stages of the DIP life cycle in comparison with the given assessment base. The established standards, forecast estimates, cost values by analogs, etc. acted as such a base. For acceptable options, the choice was further made according to the criterion of the minimum total costs for the development, production, and use (operation) of DIPs.

If there was a significant difference in military-technical parameters and parameters of combat effectiveness, the decision was usually made only according to the criteria of pure military effectiveness. At the same time, MEA was actually reduced to cost analysis. Its role was, in fact, to check for compliance with certain particular restrictions.

MEA in the form of the “efficiency-cost” method (more correctly, “effectcosts” or “results-costs”) has really begun to perform the function of a criterion apparatus for choosing and making decisions in ensuring military security, in planning development and managing the processes of creation, procurement, operation, and use of DIPs just a while ago.

The essence of the changes that have occurred with the MEA methods consists in deepening the targeted cost analysis; closer linking of this analysis with the combat (military) tasks performed; development of methods for accounting for various indirect and associated costs related to the development, production, operation, and combat use of DIPs; attempts to measure in cost categories the achieved military effects; transition to the estimation of costs and expenses for DIPs in terms of the reduced costs.

At the early stages, the criterion of the military-economic efficiency of DIPs was the ratio of the total life cycle costs, calculated mainly by summing up the costs of developing, manufacturing, and operating equipment, to the value of the achieved level for combat effectiveness (military effects) in this task. However, in fact, completely different, diverse values were compared: the costs were related only to the peaceful period of the life cycle, and the effects were related to the task itself. With this approach, the fact was ignored that the actual transfer of the peace period cost of DIPs to the combat mission can be very different in cost depending on the resource consumption and losses of DIPs in the combat mission. Moreover, as the analysis shows, for many tasks performed by this type of DIP, spending associated with the manufacturing cost is only a small fraction of the total costs for the task. The other costs are the initiated costs for other types of DIPs,

costs related to the loss of personnel, ensuring the completion of the task, repairs of equipment, etc.

The development in the 1960s–1970s of new methods, models, and statements of MEA tasks revealed numerous fundamental difficulties in their implementation, which at that time were overcome only to some extent.

Overcoming all these difficulties required appropriate improvement of the theory, methodology, and particular methods of MEA. In this regard, a certain turn in the development of methodology and methods of analysis took place in many countries in the 1980s – early 1990s. This turn was related to the further complication of DIPs, the accelerated alternation of generations, the strengthening deficit of budget allocations, the formulation, start, and implementation of military-civilian integration state policy (which required, in particular, the creation of evaluation methods that would allow comparing the relative effectiveness of using the same object in the military and civil sectors). At the same time, the creation and development of computer-aided design systems focused on the multivariate analysis of fundamental decisions at the early stages of R&D, the implementation of the open systems concept focused on the creation of unified and powerful analysis methods for different DIP types, the development of various integration processes, and the use of strategic management methods had their impact.

The essence of this phenomenon, which is very complex and contradictory, is manifested, in particular, in the following main trends:

– in increasing attention to the adequate real level of complexity of DIPs and their tasks, meaningful statements of goals, objectives, and limitations of analysis models, a detailed justification of the criteria used, and methods and procedures for the formation of alternatives and analysis of their internal capabilities and conditions of implementation;

– in the development of research in terms of providing non-specific statements of analysis, coordination of macro- and micromodels, taking into account the multi-purpose nature of DIPs, various risks and uncertainties inherent in the processes of development, production, operation, and combat use, various specific connections of DIPs and the actual implementation of the lost value concept in the efficiency-cost methodology;

– in expanding the MEA tools, in particular, in the development of margin analysis methods, making it possible to identify and evaluate contributions to the final indicators of various particular characteristics of DIPs, variations of external conditions, etc., methods of reverse analysis, making it possible to present the results of the analysis in a convenient form for further use in forecasting subsystems, pricing, financing, etc. when implementing the concept of software management of full life cycle costs, when comparing the effectiveness of IDUPs in the military and civilian sectors.

At present, strict requirements should be imposed on the methods used and on the forms of conducting and applying the results of MEA. This is due to the formation of market relations, relations between customers and contractors of the state defense order, and the new management system for the development and procurement of DIPs in general, taking place against the background of the development of processes and trends in the intra-military and military-civilian integration while maintaining crisis phenomena in the economy [1].

In terms of applying the results of the analysis, it is necessary to highlight the requirements, first, of mandatory detailed and variant justification by economic methods of all decisions related to the allocation and distribution of funds, allocations for the development and procurement of DIPs, and, second, the dominance of economic criteria in decision-making over criteria of a purely technical and military nature.

MEA methods at the present stage should, in particular, provide:

– the possibility of an objective comparative assessment of the use effectiveness of various hardware and technologies in both military and civilmilitary sectors when performing tasks in the military field (a specific military task or a set of military tasks);

– the ability to compare the relative efficiency of using the same object (sample, technology, etc.) in various military and civilian tasks; – the possibility of obtaining generalized integral estimates of the effectiveness of equipment and technologies for potential dual use on a full set of tasks (both in military and civilian areas);

– the possibility of evaluating the effectiveness (military-economic itself, generalized) not only of the IDUPs themselves but also of decisions made by DIP customers at various stages of a product life cycle in relation to forecast prices, financing conditions, product requirements, and the results of R&D, taking into account the impact of these decisions on the final effectiveness of the IDUP [2].

RECOMMENDATIONS FOR CONDUCTING AN ECONOMIC ASSESSMENT OF THE IDUP TRANSFER.

Possible typical situations when conducting the economic assessment of innovative products on the part of DIP customers in order to organize extrabudgetary financing of defense programs could be the following:

– transfer of product from the defense to the civilian sector (spin-off processes) in the form of product sales, licenses, technical documentation, rental of equipment and products, provision of engineering services;

– transfer of products from the civilian to the defense sector (spin-on processes) in similar forms;

– conclusion and implementation of various cooperative agreements in the development of IDUPs (joint works, financial contribution, etc.).

The general procedure for conducting a preliminary (pre-investment) assessment of the prospects for the sale of IDUPs can be summarized as follows: data are prepared, preliminary examination of possible objects of sale is carried out to identify the most promising ones; preliminary analysis of the selected objects of possible sale is carried out; general marketing research of sales prospects is carried out, taking into account the prospects and profitability for various buyers of IDUPs, various markets; budget and economic analysis of sales prospects for DIP customers is carried out. When transferring (selling) products from the civilian to the defense sector, the following conditions must be met: conducting a detailed analysis of possible areas and tasks of military use for the considered products and technologies; conducting a comparative analysis of IDUPs and purely military products with the calculation of limit prices and indicators of their relative military-economic efficiency; taking into account the risks and uncertainties inherent in the specific type of product or specific type of tasks; conducting profitability analysis on the purchase of specific IDUP types, taking into account the expected military-economic efficiency of their use, various risks and uncertainties; determination of the expected profitability of the IDUP purchase for the military budget. It should also be noted that the practical fulfillment of these conditions will contribute to innovative progress in the knowledgeintensive and high-tech sectors of the domestic economy [3, 4].

Let us emphasize that, as in the case of the "pure" transfer of the IDUP from the military to the civilian sphere, or, vice-versa, from the civilian to the military, the assessment of the IDUP effectiveness should be carried out mainly by methods specific to the consumer spheres. The thing in common here is that the assessment of the profitability for the sale or purchase of IDUP should be carried out by similar methods based on the application of derived performance criteria based on the use of limit price indicators and marginal costs.

The situation with the preparation and conclusion of cooperation agreements on the development or financing of IDUP developments is much more complicated [5]. In some cases, DIP customers can approximately calculate the limit prices of R&D for a specific IDUP object for a particular consumer, based on the profitability of the use of products intended for development expected for this possible consumer and taking into account the possible risks of development, the risks of commercial and organizational implementation for the project. On the basis of these limit prices, they can offer possible civilian co-executors of projects for the IDUP development some acceptable quotas for direct participation or financial contribution in the IDUP development. In many other cases, it is necessary to calculate the comparative and generalized effectiveness of projects in the civil and military sectors in order to determine reasonable and effective quotas and conditions for each joint project participant. This is of particular importance due to the need for effective targeted state support for measures to disseminate IDUPs in the form of tax, credit

benefits, etc. In this case, the availability of comparative and generalized assessments of the IDUP effectiveness in the military and civilian sectors is extremely necessary.

The need for a comparative assessment of the IDUP use effectiveness in the military and civilian spheres may arise both at the national level and at the level of private entities in the military and civilian sectors of the economy.

At the national level, a comparative assessment of IDUP use in the military and civilian spheres should be carried out in order to develop effective targeted support and stimulate the most effective use of this product type. At the level of private entities in the military and civilian sectors of this economy type, a comparative assessment can be carried out, for example, in connection with the tasks of organizing cooperation in conducting and financing research for the development of IDUPs.

Quotas of financial contribution and "physical" participation for military and civilian sector entities in dual-use R&D may be various and may depend on many reasons: distribution of development risks, forms of cooperation, forms of using the R&D results by various subjects, scarcity of financial resources for each of the subjects. Decisions on these quotas should be reached through negotiations.

From the point of view of private entities, the general principle for the distribution of quotas for participation in R&D should be the distribution, which is approximately proportional to the values of the R&D limit prices for each of the subjects (provided that the limit price of R&D exceeds the price of R&D for each of the subjects).

From the point of view of the state (public efficiency), it is also important to ensure the rules of the game – a system of relations between subjects using tax, credit, information benefits, etc. – in order to maximize the difference between the amount of limit prices and the prices of R&D for all subjects (taking into account the criteria of public efficiency, i.e. calculation minus transfers, etc.).

Regarding the issue of evaluation, the economic justification of sales and license acquisition should take into account two features that distinguish them from serial products as objects of evaluation:

1) the economic effect of acquiring a license should be determined not for one year, but for the entire planned period of production under the license (use of the license). The need for this is due to the fact that, on the one hand, the economic advantages of the licensee are limited by the period of technological obsolescence, and on the other, the use of the license is associated with payments, the amount of which, usually, varies significantly over time;

2) the rule of identity for the compared variants according to their naturalmaterial composition cannot always be complied with in the process of evaluating the effectiveness of acquiring a license. This is the reason why the economic effect of using the license should be considered,

taking into account the difference between absolute effects (net profit) from the production under the license and production using the manufacturer's own R&D base.

METHODOLOGY OF IDUP EXPERT ASSESSMENT.

When enough data are accumulated, the need for a periodic examination of dual products and technologies arises on the part of customers and developers. This examination is carried out in order to determine and clarify the prospects for the commercialization of such products. The reasons for this lie, first, in the wide variety of possible areas and conditions for the use of such products, which does not allow the use of unified and at the same time detailed forms of their economic description in the data bank, which causes the vagueness of this description, and, second, in the significant variability of external and internal political and economic conjuncture, leading to the need for constant refinement of economic assessments of the prospects for the sale of IDUPs and their use in the civil sector. The main purpose of the examination in these conditions should not be a direct detailed economic assessment of the IDUP as the basis for making decisions on its commercial distribution and sale, but rather a preliminary classification of products and technologies, grouping in terms of conditions and mechanisms of their possible sales, commercial distribution, conditions and modes of additional financing of defense purposes at the expense of the IDUP. Much deeper and more detailed evaluation methods that take into account the characteristics of each product, each situation of sale, distribution, and use can be further used on the basis of this classification or grouping.

From the customer's point of view, taking into account the peculiarities of the current economic situation, the most important features of such a classification and grouping of IDUP can be the following:

– the amount of investment required for the sale of products in some form suitable for commerce – in the form of patents, licenses, finished serial products, etc.;

– the volume of possible additional financing of defense orders due to the commercial distribution of a specific IDUP;

– expected rates and conditions of profitability from the commercial use of the IDUP;

– one-time or long-term mode of obtaining financial resources, profitability from the commercial distribution of the IDUP;

– risks and uncertainties associated with the work on the implementation of the IDUP (in technical, financial, and commercial terms).

IDUP clustering.

The examination at the first stage should ensure the ranking of IDUPs as objects of evaluation for each of these features and, ultimately, the allocation of clusters (groupings) for further in-depth

analysis by specific methods with the refinement of initial data, the preparation of detailed business plans, etc.

The number of allocated main clusters with a sufficiently large number of evaluation objects, as experience shows, should not usually exceed 612 (otherwise, problems often arise with the semantic (meaningful) interpretation of the allocated groupings and, especially, with the assignment of evaluation objects to specific clusters). The fundamentally possible number of clusters when using five main independent features and identifying three possible states for each of them (low, medium, and high levels of the feature) is 243 (35), which is unacceptable from a practical point of view. In these conditions, it is necessary, first, to reduce the main cluster-forming features from five to three, and, second, to reduce the allocated possible states for each of them to two (low and high levels). As the main features under consideration, it seems appropriate to take the following three: the volume of necessary investments, the amount of possible financing, and the pace and conditions of profitability from the distribution of the IDUP. It makes sense to consider the influence of variations in other characteristics (the mode of obtaining funds, the level of risk and uncertainty, etc.) within the framework of the selected main clusters.

Thus, for the grouping of IDUPs during their examination, it seems appropriate to allocate eight main clusters.

1. Products that require a small initial investment, promising a quick profit and a large amount of revenue for the customer (the most optimistic option). Proven and sufficiently promising products and technologies of wide application can be attributed to this class. Usually, such products would have a full set of technical documentation, patents, and licenses or great prospects for concluding cooperative agreements without serious regime restrictions on distribution and with high sales prospects.

2. Products that require a small initial investment, promising a quick profit, but a relatively small amount of revenue in additional financing for the customer. This case is quite similar to the first one, but differs either in the breadth of distribution and applicability of the IDUP, the possible volume of sales, or the conditions for exercising the ownership rights.

3. Products that require a small initial investment volume, promising a significant amount of additional funds for the customer, but at the same time – receiving profit from the investment will take time, and the rate of receiving additional funds will be low. This class includes IDUPs similar to those included in the first class, for which, however, the R&D cycle has not been completed and the prospects for concluding cooperative agreements with the civil sector for joint work and co-financing are not quite clear.

4. Products that require a small initial investment, but promise relatively small amounts of revenue for the customer, and receiving profit from the investment will take a lot of time. This case is quite

similar to the previous one, but differs in the breadth of distribution, the applicability of the IDUP, or the conditions for exercising the ownership rights.

5. Products that require a large initial investment, but promise a quick profit and a large amount of possible additional revenue for the customer. This, for example, may include IDUPs attributed to the first cluster, for which, in addition to the direct sale of patents and licenses, it is possible and advisable for the customer to participate widely in the further sale of products, in the serial manufacturing process and joint work with license users.

6. Products that require a large initial investment, promising a quick profit, but a relatively small amount of revenue for the customer. This class may include IDUPs similar to products and technologies of the previous class, however, there is a small customer's share in investments and not many opportunities to use the licenses and patents.

7. Products that require a large initial investment volume, promising a large amount of possible revenue for the customer, but at the same time, there is no chance to get a quick profit. In this cluster, for example, IDUPs similar to cluster 5 products and technologies can be considered, for which, however, the R&D cycle has not been completed or investments with a long implementation period are required (large construction, etc.).

8. Products that require a large initial investment, but at the same time promise relatively small amounts of revenue for the customer and receiving profit from the investment will take time. This case is generally similar to the previous one, but differs either by a smaller share of the customer's participation in the serial manufacturing of the IDUP or by a lower level of profit from it. The customer's participation in the sale of products and technologies in such situations is possible under the condition of minimal technical, commercial, and financial risk.

It is necessary to emphasize an important feature of the procedures for classifying and assigning IDUPs to different clusters: the same product, depending on the possible degree of the customer's participation in its implementation and financing of its development, can simultaneously be assigned to different clusters and then be considered independently.

Allocation of IDUPs to the clusters.

The grouping of IDUPs by clusters should be carried out by experts taking into account the following parameters: the estimated level of production (breakthrough, high, medium, traditional); the expected level of its applicability (narrow applicability in one sphere, industry, for a certain limited class of tasks; applicability in several spheres, industries, for various tasks; wide applicability for spheres, industries, and tasks); development stage (unfinished research, completed research, unfinished or completed development work, availability of prototypes, patents, and licenses, the level of patent protection, bringing the IDUP to the stage of industrial implementation); estimated deadlines for the completion of product development and sales, return

on investment, the required amount of investment, including by stages; types of effects obtained (economic due to increased productivity, saving raw materials, energy, etc., social, environmental, etc.); current restrictions on common IDUPs; possible buyers of products and technologies (domestic commercial sector, domestic public sector, foreign commercial sector, foreign public sector); availability of preliminary agreements, approvals, market assessment.

Grouping of IDUPs according to these parameters can be carried out both directly and with the use of formalized methods.

With the direct grouping of IDUPs, the expert, using the reported information on the above parameters, assigns the technology to certain clusters based on his/her own formal and informal methods. When grouping technologies using formalized methods, the expert is entrusted only with checking the source data and indicators for the considered IDUP. The attribution of products to certain clusters goes further on the basis of features common to all products and technologies.

For example, the combination of great parameters, a wide range of fields for use of the product, the availability of patents, licenses, and serial samples, and high chances of expected profits automatically mean that this product will go to the first and fourth clusters. The additional data provided on secondary areas of application, on sales opportunities, and the conclusion of cooperation agreements with foreign economic entities mean that the product or technology may be considered for inclusion in the third and seventh clusters as well.

On the other hand, the combination of great parameters, the limited range of IDUP possible use, and the incompleteness of R&D should generally mean that this product has to be assigned to the second, third, fourth, sixth, or seventh clusters.

Based on the conducted grouping of technologies, in-depth expert assessment can be carried out further, taking into account the factors of prospects for the development of cooperative ties, the factor of technological and commercial risk, various uncertainties in the initial data, indicators of specific volumes of necessary investments, etc.

Such an expert assessment of IDUPs at an early stage of analysis can significantly clarify and concretize the prospects for their further commercialization, set directions, and specify methods and conditions for further analysis.

ASSESSMENT OF THE SCIENTIFIC AND TECHNICAL POTENTIAL OF IDUPS.

In some cases, the examination may also be aimed at obtaining some generalized characteristics of products and technologies both as a whole and within groups, in addition to the tasks of direct grouping of IDUPs for the purpose of their further in-depth analysis within the selected groups. The parameters of the overall estimated technical potential of the IDUP, its current technical and commercial potential can act as such characteristics.

For example, the following way of assessing the overall technical potential of the IDUP is possible: each of the evaluated product levels is assigned its own rating (for example, breakthrough – 4, high – 3, medium – 2, traditional – 1); similarly, estimates are assigned to possible areas of technology distribution (for example, narrow – 1, limited – 2, traditional – 3). Then an expert multiplies the coefficient of the product level rating by the coefficient of the possible areas of its distribution, which gives an assessment of the overall technical potential of the IDUP (for example, high-end products with a wide range of use would have an assessment "9", breakthrough products in a narrow field – "4", etc.).

Depending on the actual current level of IDUP development, an assessment of its current potential can be further obtained taking into account its overall technical potential (the coefficient of the overall technical potential rating here will be multiplied by the coefficient characterizing the actual stage of development).

Further, estimates of the total and current commercial potential can be obtained using data on the total and current technical potential of the IDUP, taking into account additional data on the required volume of investments, the expected ROI level and rate, and possible sales markets.

Examination of IDUPs requires, of course, the creation of automated expert systems and automated workplaces of technology assessment experts due to the large number of IDUPs, as well as due to the sufficient complexity of their assessment.

The tasks of these expert systems should be the grouping of technologies according to the conditions of their possible and prospective commercialization, the assessment of the technical and commercial potential of the IDUP both as a whole and within each of the selected groups, and the selection of most promising IDUPs within each group for further economic and marketing assessment by special methods.

CONCLUSION.

The problem of increasing the economic efficiency of IDUP production is becoming particularly important and relevant in the conditions of financial instability and large-scale sanctions from many foreign countries [6]. Therefore, the comparison and comparative assessment of the relative effectiveness of IDUP practical use in the military and civilian sectors should be carried out according to the following criteria: the ratio of possible limit prices and the ratio of the maximum allowable costs to the expected costs that must be calculated for each individual sphere of hardware and technology use (including military). At the same time, both averaged estimates (maximum, minimum, average, etc.) and differentiated ones can be used for the civil sector.

The development and implementation of methods to improve the effectiveness of the IDUP concept requires the scientific development of methodology and tools for assessing the military-economic potential of innovative DIP samples. The scientifically based methods proposed in the

article make it possible to establish the final parameters for the direct evaluation and comparison of the economic and technical effectiveness of the practical use of a particular product or technology in the civil and military sectors, as well as to calculate the generalized (final) efficiency, taking into account the importance of the IDUP in all possible areas of its use. Among these indicators, the most important is the limit price of the product, technology, or the work performed, including R&D, which is calculated according to the criteria of DIP military effectiveness when used in combat conditions, and for the civilian sphere according to the criteria for calculating economic efficiency.

In modern conditions, the following are of particular importance: scientific justification and development of a general process for performing a pre-investment assessment of the forecast prospects for IDUP market sales including the stages of collecting and systematizing initial data, preliminary examination of the innovative product planned for sale, comprehensive marketing analysis of forecasts for IDUP expected purchases by specific buyers, economic research of IDUP sales processes to be conducted by IDUP customers, as well as determining the nature and sequence of the work for each stage.

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