



Faculty of Economics, University of Niš, 16 October 2015

International Scientific Conference

**CHALLENGES IN BUSINESS AND ECONOMICS:
GROWTH, COMPETITIVENESS AND INNOVATIONS**

**FORECASTING INNOVATIVE PROSPECTS OF COMPLICATED
TECHNICAL SYSTEMS AS A MEANS TO INCREASE THE
EFFICIENCY OF R&D AND PUBLIC PROCUREMENT
MANAGEMENT**

Vitalii Vorotnikov*

***Abstract:** The article discusses the use of indicators to assess the prospects of innovation appropriateness of the high-tech R&D to create complicated technical systems. Based on the methodology of factor analysis formulated the basic provisions of the use of patent-innovative parameters to predict the prospects of a unique high-tech innovative product. The system of partial indicators of innovation development of the R&D facility and proposed formulas for combining them in order to obtain an integral indicator of innovation prospects of complicated technical systems. The possibility of universal application of the proposed methodology for determining the patent and innovation indicators, both in corporate management and in the management of public procurement to create complicated technical systems.*

***Keywords:** forecasting innovative prospects, complicated technical systems, novelty patent parameters, unique high-tech innovative product*

1. Introduction

The experience of countries and industry leaders shows that during the major high-tech R&D projects implementation the investment under the scheme of public procurement is very important. To make a decision about the beginning of the development is required to develop a rationale for performing research and development on the basis of certain criteria prospects.

Many analysts often associate the prospect of high-tech R&D with high levels of innovation development of the object as innovative technical innovations are protected by patents can be viewed as an important factor in justifying the decisions on public funding. For example, focus on innovativeness of the European Union supported projects in the framework programs (WIPO 2011) that their direct or indirect purpose is to finance the

* State Design Office Yuzhnoye, Sector Legal Protection and Commercialization Intellectual Property (Department of patent-innovative research), Dnepropetrovsk, Ukraine;
✉ vit.an.v@mail.ru
UDC 005.511:330.341.1

process of creating a specific intellectual property rights (IPR) and its exploitation serving the common interest of society.

Innovativeness is most frequently used as a measure of the degree of newness of an innovation (Kumar, Phrommathed 2005). At the same time, in our opinion, it should not be limited only to the assessment of novelty, if it is intended to be used in forecasting the prospects of an innovative product (IP), which is formed by the results of R&D.

Innovative quality technical novelties are protected by patents, can significantly affect the prospects of an IP, which is formed by the results of R&D. However, methodological and practical problems of the patents valuation do not make efficient use of IPR to determine the feasibility of investment in IP. This deficiency is particularly evident for the complicated technical systems (CTS) as small-scale production – unique high-tech innovative product (UHIP), which can be a significant proportion of the IPR cost by the concepts of innovation management.

2. Materials Research and Scientific Results

As WIPO analysts (WIPO 2010) in the countries with economies in transition, especially aggravated the main problems of innovation management that is the difficulty of identifying the best ideas for the correct market with the right resources, a lack of coordination, and challenges measuring innovation.

In countries with economies in transition disadvantages analytical apparatus prediction promising results of R&D impact on the quality of regulatory and methodological support of the public competitive high-tech R&D projects financing. According to the author of this article, the expansion of the analytical database management decision-making at the expense of data with high reliability and objectivity at the stage of preliminary study is one of the efficient ways of the high-tech research and development methodology improving.

Currently, the developed economies are widely used competitive procedures for the selection of projects of R&D for public funding. These expert-analytical instruments reflects the innovative quality of the R&D development object including specific to IPR. Nevertheless, the question remains an objective assessment of the IPR prospects and its impact on the investment attractiveness of the R&D project. According to the World Bank analysts (Goldberg et al. 2011), meanwhile, knows that the inventor and that can evaluate an external mediator, there will always be a considerable gap, in this regard, talk about the information asymmetry that exists between the inventor and main financial intermediaries, such as banks and institutional investors who are skeptical to the likely return on investment in new technologies under development. World Bank analysts consider the problem of information asymmetry one of the main market failures R&D sources.

Many researchers have noted the complexity of the task produce an objective assessment of the IPR in order to allow its effective use. In particular, the work financed by Deutsche Bank, Jan Hoffman wrote (Hofmann 2005), which is currently difficult to measure intangible assets, and it is virtually impossible to compare. Firstly, there is the reluctance of developers to disclose competitive advantages and lack of information resources for patent valuation. Secondly, the intangible assets are often particularly risky

Forecasting Innovative Prospects of Complicated Technical Systems as a Means to Increase the Efficiency of R&D and Public Procurement Management

because of deficiencies assessment methods and distrust the mainstream market of high technologies.

Considering the problem of public investment allocation justification noted (Stryszowski 2005) that the main question discussed in the literature is whether a policymaker can significantly and permanently influence the rate of economic growth by the appropriate R&D subsidy policy.

As the initial conditions to ensure the objectivity and independence of expertise, you can use the comments of the OECD analysts (OECD 2012) that is necessary to guard against the use of consultants by the industry to carry out the process of the proposals as they may have established a working relationship with the individual applicants. Instead, it is advisable to use the expertise of a consultant for a clear description of the criteria/specification for evaluating and awarding the tender and carry out an internal tender process.

A group of researchers from the World Academy of Science, Engineering and Technology (Cheung et al. 2012) describing the problem with the evaluation methodology intellectual capital, which is understood by economic category, the most comprehensive manner taking into account all the intellectual resources, says that at present, there the lack of common and standardized methodologies for the assessment of the enterprise knowledge capability. They believe that because of the lack of correlation between intellectual capital and identified innovations, especially for enterprises developing innovative technology is very necessary tool in order to audit and evaluate the possibility of knowledge and intellectual capital.

Thus, in the organizational aspect, it may be noted two major methodological problems to ensure the accuracy and objectivity of R&D forecast evaluation - is the problem of selection of expert treatments experts and selection. However, both of these problems essentially result from weakness of the analytical device. Disadvantages of the last largely due to the uncertainty of the IP valuation methods choice rights. What analysts WIPO (WIPO 2011) referred to the problem is "how to choose the most applicable method" to determine the value of the particular IPR assets occurs because, according to experts in the field, today was developed and used more than 50 methods of valuation.

Most authors recognize that all empirical studies have objective difficulties in precise values for IPR obtaining. This is largely due to the fact that the assets of IPR is usually implemented within the CTS as a multi-component product, and evaluating the separate contribution made by IPR is difficult.

In other words (Frietsch et al. 2010), firstly, the economic value of patents is not determined solely by the characteristics of a single patent, but by various factors of a technology, firms, competitors, and markets, so that the economic or commercial value of individual patents can hardly be derived from the information contained in a single patent document and, secondly, the economic benefits of a technological product can hardly be assigned to one single patent, because this product is usually the result of several technologies - also often protected by several patents - implemented in one device, machine etc.

We have to also recognize that it is impossible to objectively determine the value of IPR in the absence of an active market of innovative products and IPR, which is especially characteristic when creating disruptive innovations. How to sum up Parr and Smith (Parr, Smith 2011), the development of views on the economic life of the IPR is often depend on subjective methods as rarely found documentary material, which can be found quite a number of statistics for the study.

Considering the problem of formation of innovation indicators, Greenhalgh and Rogers (Greenhalgh, Rogers 2010) noted that a large number of potential measures of innovation, as well as their complex and overlapping nature, has led to the development of methods for combining these into an innovation index seeks to combine a number of other measures into a single figure.

The analysis of international research and analytical documents, which reflect the latest trends to ensure the development of innovative high-tech industries, suggests the need to improve the expert-analytical tools justify the establishment of CTS due to public funding.

The shortcomings of the methodology currently do not provide a unified approach to the formation of the R&D management analytical tools and of public procurement, given the complexity and diversity issues. It is necessary to overcome a number of paradoxical contradictions present in the innovation theory and practice.

In assessing the use of IPR in analytical instruments, confronted by one of these paradoxes. No one disputes the significance of IPR as part of the IP. Thus, on the one hand, it recognizes the complexity of determining its share in the total income from the IPR - most authoritative experts have concluded small realistic financial assessment of IPR in the early stages of innovation, particularly when it comes to CTS. On the other hand, almost no attempt to use non-financial methods of the IPR role evaluation in the creation of innovations, including high-tech. In saying this, we do not take into account the methods based on the use of patent statistics. Typically, using data on the number of patents and references to them are measured innovative activity of firms or define a steady trend of technological development in a certain direction. They are meaningless at the dawn of the technology and, as will be shown below, are not always effective at the stage of finalizing the real analogues that previously existed only on paper.

Among specialists in the field of business innovation is no unity in understanding the priorities and objectives of obtaining IPR. Prevailing concepts, built on two principles. The first recommends a situational approach in determining the appropriateness of the legal protection, and the second excludes the existence of a universal best strategy for the use of the IPR.

You can say that this approach is a consequence of the above-mentioned uncertainty methodology IPR evaluating. At the same time, when it comes to ensuring the unimpeded use of output on the market IPR, the cost of IPR is not in itself a decisive factor, and on the basis of the information available to patents for inventions, it is possible to generate indicators to describe the innovative features innovations. When forecasting the prospects for factors UHIP unimpeded use, the use of innovative performance innovations derived on the basis of patents, can be an effective means to inform management decisions.

Forecasting Innovative Prospects of Complicated Technical Systems as a Means to Increase the Efficiency of R&D and Public Procurement Management

It should be noted that in the period of the planned economy had accumulated considerable experience in assessing new technology innovation through the use of options, issued as an invention. Multi-level hierarchical grading as a novelty in the parameters of novelty, object-level technology and inventive step was conditional, as any scale to give numerical values quality indicators. However, the convention has been accepted (approved state method) and therefore allows to determine the relative effect of the invention using with an accuracy which is independent of the specific construction of expert procedure.

Currently, the countries with economies in transition, undertaken some attempts to use these achievements by incorporating them in the methodology for assessing IPR. However, in the management of the CTS creation not used the possibility of using innovative patent indicators.

We also note that the nature and the patentability of conceptual solutions, determining the appearance of CTS, usually set at the stage of pre-study. And this is especially true for breakthrough innovations that are created in the research organizations with considerable experience in this or related fields. When forecasting the prospects of innovative UHIP the parameters that reflection in the parent patent, it can be regarded as the most objective factor, complementing the key technical and economic indicators CTS.

We emphasize that the definition of financial indicators UHIP in the early stages of the life cycle is inadvisable because of their extremely low reliability. Of much greater significance is the estimation of financial risks based on the probability of achieving the objectives of the project, i.e. the creation of CTS with the set of technical and economic characteristics and with the preservation of favorable market conditions.

We believe that in the early stages of creating UHIP method for determining the prospects of innovative R&D results based on the parameters of innovation patent can be an effective means of improving the validity of decisions on investing R&D. This is especially significant when creating UHIP-CTS manufactured in small quantities, thus to predict their prospects effectively apply existing instruments of financial and investment analysis which focused on the mass production of goods.

Thus, the above conditions provide a basis to formulate the following hypothesis of our study.

Hypothesis 1. The validity and usefulness of the CTS forecast prospects as a tool of management can be significantly improved through the use of innovative parameters derived from patents and characterize the degree of the object novelty in relation to the development of its technical level and feasibility.

Hypothesis 2. In addition to the innovative options, formed on the basis of patents describing CTS concept (constructive scheme and operating principles), when assessing the prospects of CTS should be considered potentially significant local engineering solutions that may have a dual use or considered as spillover.

We formulate the following assumptions forming the expert-analytical unit assessing the prospects of innovation.

Firstly, despite the changes in the range and reliability of indicators describing the state of the object at different stages of the R&D development, in order to manage the

development of CTS is necessary to observe the continuity of key monitorable indicators whose values are used to implement the process control.

Secondly, the formation of the indicators set of management prospects CTS competitiveness criterion, including key indicators monitored, it is appropriate to provide the basis of the implementation conditions of all management functions, ranging from forecasting and planning, to evaluation of the CTS development effectiveness.

Thirdly, it is necessary to determine the field of management, for the most rational use of innovative CTS competitiveness indicators, based on patent and innovation parameters. In particular, it is required to assess whether the expert-analytical apparatus evaluation will take into account the prospects of innovation and align the interests of developers and investors R&D to establish a CTS.

The proposed methodology of constructing a universal expert-analytical apparatus assess the prospects of innovation comes from the possibility of using non-financial data about the prospects UHIP to assess the investment attractiveness of R&D to establish a CTS in public procurement. The methodology incorporated a comprehensive approach to the unification of technical-operational, economic and innovative options in the integration index prospects CTS.

We believe that a reasonable prospect of the R&D results estimation accuracy, combining technical, economic and innovative parameters obtained by applying the multiple linear regression model of the form:

$$y_t = a_0 + a_1x_{1t} + \dots + a_nx_{nt} + e_t \quad (t = 1, \dots, T), \quad (1)$$

where: $x_t = (x_{1t}, x_{2t}, \dots, x_{nt})$ – vector of the independent variables (factors) values at the time t ;

$a = (a_0, a_1, \dots, a_n)$ – vector of the model parameters, reflecting the degree of influence factor x_i variable y for all the considered range $(1, T)$;

a_0 – constant model;

e_t – random error model.

This structure summary measure prospects allow its use, starting with the stage of feasibility study of the project on the deployment of CTS creation. At this stage, a group of technical and economic performance is largely declarative in nature, has a low accuracy (reliability) and is often reduced to the evaluation of the quality and cost performance target. Features an innovative facility design excellence, complementing data on the effectiveness of the target, greatly enhance the analytical basis justify the adoption of administrative decisions on the creation of CTS. Innovative options can be obtained on the basis of the information contained in patents for invention that protect conceptual image of CTS. It's enough to give a performance of novelty, the technical level and the feasibility of numerical values, for example, by the gradation of ranks in importance.

In accordance with the methodology of factor analysis, combining the technical and economic indicators in the same group of general indicators I_{te} and consider it as one of the factors, and formed by analogy with it a general indicator of the innovative qualities

Forecasting Innovative Prospects of Complicated Technical Systems as a Means to Increase the Efficiency of R&D and Public Procurement Management

of CTS I_i , as the second factor. Then, to determine the prospects of generalizing index equation (1) can be written in the form of two-factor linear regression equation:

$$P_i = a_0 + a_{TE}I_{TE} + a_I I_i + e_i, \quad (2)$$

Here the parameters I_{TE} and I_i will ensure the comparability of the impact of technical and economic factors on innovation and a general indicator of the prospects, the constant model a_0 will display industry-specific, and the error model e_i reflects the value of the confidence interval.

In the formation of innovation prospects indicators should involve not only the parameters based on the essential characteristics of the patent formula, but those are outside the scope of the formula. First of all, it refers to the description of the fragments relating to justify the possibility of practical implementation of innovations. The most important methodological challenge is to develop analytical expressions that correctly identify and agree with each other all the partial indicators in the framework of summary measure of innovation prospects. At the same time, a basic methodological assumptions are the creation of analytical tools that are suitable for universal use in the corporate management of innovation and management of public procurement.

Considering the above opinion of analysts WIPO management problems in countries with economies in transition, addressing evaluation of innovative promising innovations is today one of the most urgent tasks for the development companies and investors to create a UHIP. We will also take into account their conclusion (WIPO 2010) on the need for a special IPR strategy for the Research Institute on the basis of the fact that a considerable amount of research and development carried out scientific research institutes, which are experiencing serious difficulties with the use of the IPR system to protect the results of its research activities and their commercialization.

In our opinion, one of the most important elements of such strategy is an objective assessment of the prospects of innovative innovations, which is beneficial not only to developers CTS, but also to public investors in justifying decisions on the implementation of competitive financing of R&D. This assessment may be based on innovative features innovations reflected in the materials patents. This primarily refers to the essential features of the claims and the description section, characterizing the quality of the object design innovative R&D as the subject matter.

The analysis of sources relating to the issues of R&D investment has allowed us to conclude that, from the standpoint of decision-makers on the allocation of public funding, it is desirable that such an assessment satisfy two conditions. The first - was relatively simple, i.e. easily and quickly determined on the basis of available and intuitive input data. The second – was the minimum discussion, in particular, had a miserable prospect of challenging in court.

In just a few decades, countries and economic leaders formed the complex institutional arrangements to fulfill these conditions. Often even expressed their criticism of excessive bureaucracy. Most of the countries with economies in transition are the alternative to choose the same path, or try to find a solution, based on a different approach. We believe that in terms of the search for alternative methodologies, the problem of public R&D investor, in fact, is to ensure acceptable accuracy and objectivity of the definition of

innovative component of the competitiveness of the CTS. Therefore, the proposed methodology can be demanded to improve the analytical device at the intersection of innovation and investment management to improve the efficiency of decision-making on the allocation of investment in the implementation of the major social, scientific and significant R&D. These should be regarded as projects that benefit not only developers or manufacturers created by IP, and other innovators who can use spillover effect or dual-use technology.

The analysis of existing problems with ensuring the objectivity of evaluation of R&D allows us to conclude that a reasonable forecast of the prospects UHIP using innovative patent-parameters can be used in the formulation of management decisions in the following cases:

- when assessing the feasibility of the R&D deployment by developer (domestic investment R&D);
- in justifying the receipt of an order to perform R&D for public funds or grant funds of international organizations (the external public R&D investment from non-commercial sources);
- in addition to the investment analysis on the R&D implementation in the implementation of the public-private partnerships scheme (mixed R&D investment from public and commercial sources).

This conclusion is based on the paradox of innovation, which is manifested in the desire of private investors to increase the reliability of investments by reducing the risks posed by the development of novel object. The result is their desire to not only eliminate the stage of research, but also to avoid the innovation itself. Therefore, for private investors novelty of CTS it is not an attractive factor and patent innovative options have great prospects in the analytical apparatus justify private investment.

At the same time, the forecast of innovative prospects UHIP can be applied in the development of 30 to 70% of the decisions when it comes to the use of competitive procedures of public procurement. In support of this conclusion it says not only that the greatest value of contests have it when you create the CTS. According to the recommendations of the OECD (OECD 2012), in modern competitive technologies involved hundreds of experts, which the project is directed by the results of the verification and distribution groups (scientific and technical areas). The selection of projects is on the evaluation criteria, such as novelty, the mass distribution of innovations, etc., and to facilitate the review using special profiles, the conclusion in the form of standard forms (OECD 2012). Thus, the development and adoption of innovative excellence criteria on the basis of patent innovations parameters in accordance with the proposed approach will allow to include them in the group UHIP profiles without substantial change of the methodological and organizational support of expert procedures.

For a comprehensive forecast of the prospects UHIP on the results of R&D is not sufficient to confine patent indicators CTS as an object of design. It is necessary to take into account the totality of indicators that may be of interest to justify the investment in the implementation of high-tech R&D.

One of the rational choices such records may serve as input into the analytical apparatus, justifying the decision to establish a CTS spillover assessments of the innovations prospects and innovations of lower technical level, with the potential dual-use.

Forecasting Innovative Prospects of Complicated Technical Systems as a Means to Increase the Efficiency of R&D and Public Procurement Management

Thus, a general indicator of the CTS creating innovative prospects will be determined based on an assessment of three components - the level of innovation in general, the prospects of the CTS as an object of art, the total volume and the level of local innovations which have immediate prospect of dual-use as well as spillover innovations indirectly promote innovation progress in the development of the technology:

$$I_I = P_{CTS} + P_{SLI} + P_{Sp}, \quad (3)$$

P_{CTS} – CTS innovation prospects indicators;
 P_{SLI} – innovation indicators of dual-use local innovation;
 P_{Sp} – innovation indicators impact on the development of other technologies.

By the formation of CTS innovation prospects indicators there are two possible approaches. The first is focused on the analytical apparatus of decision-making on public R&D funding on a competitive basis, which is convenient to use at competitive rates. The second approach focuses on the formation of indicators that can be used equally effectively in both corporate management and in the management of public procurement.

In cases where the application of innovative competitiveness indicators for determining indicators of innovation prospects CTS proposes the following formula:

$$P_{CTS} = C_I R_I I, \quad (4)$$

C_I – integral indicator (or index) of CTC innovative competitiveness;
 R_I – risk score to ensure the competitiveness of the CTS;
 I – indicators of innovation level CTS.

We believe that for the calculation and the integral index, and the index of CTS innovative competitiveness can use patent and innovative options, the formation of which will be discussed below. A more detailed analysis of the structure and to select the method of CTS innovative competitiveness indicators application should be the subject of a separate study.

To determine the performance of innovative local or spillover promising innovations write the following formula in general form:

$$P_s = \sum_{i=1}^n K_i F_i R_{ii} I_i, \quad (5)$$

K_i – factor the possibility of double application innovations or spillover innovations;
 F_i – rate the technical level of innovation;
 R_{ii} – rate risk to innovate;
 I_i – index of the innovative level of innovation.

The problem of dual-use innovations identification and innovations followed spillover ranking their constituent indicators of innovation is quite complex and requires a separate study. In this article we confine the analysis of approaches to the formation of the index of innovative prospects CTS as an object of art.

Index of innovative CTS prospects that can be universally applied in corporate management and in the management of public procurement, rational form as an integral

indicator of patent-innovative parameters CTS. In the formula for its calculation must be taken into account the impact of the innovative progress CTS as an object of art, the extent of its patent protection and the likelihood of feasibility:

$$P_I = (C_{IPR} + C_{IL})C_{UR}, \quad (6)$$

where: C_{IPR} – an indicator of the protection level for CTS relevant technical level of the object development and the object of patent protection;

C_{IL} – an indicator of the CTS novelty;

C_{UR} – an indicator of the effect of the feasibility degree.

The exponent security CTS determined by the formula:

$$C_{IPR} = P_{IPR}K_{CR}, \quad (7)$$

where: P_{IPR} – benchmark technical level technology object as an object of development;

K_{CR} – weight of comparable rank of the object of development and most of the R&D conceptual invention.

The proposed values of these quantities for the CTS-UHIP presented in Table 1.

Table 1. The components to form exponent security CTS

Level rank	Characteristic technical level object technology as an object of development or invention	Grading scale value baseline technological level	Ranks correction of the difference of object development and invention	
			The degree of compliance (the difference of ranks)	The weighting factor of rank corresponding
1	The functional unit	1-10	low (5)	0,01
2	A separate unit as a set of nodes	10-100	weak (4)	0,02
3	A simple system as a set of components and assemblies	100-200	medium (3)	0,05
4	A complex system as a set of simple systems and components (part of complex products and independent STS, may affect the basic characteristics)	300-500	moderate (2)	0,1
5	Separate complex product (included in CTC top level affects its basic characteristics)	700-800	high (1)	0,5
6	CTC top level as a set of complex systems and independent product	900-1000	full (0)	1

Source: Authors

To determine the level of novelty on set of essential differences, we write the following equation:

$$C_{IL} = P_{IL}K_{CRA}, \quad (8)$$

where: P_{IL} – the exponent of the object changes novelty character of patents;

K_{CRA} – the novelty factor correction on real counterparts.

Forecasting Innovative Prospects of Complicated Technical Systems as a Means to Increase the Efficiency of R&D and Public Procurement Management

The proposed values of these quantities for the CTS-UHIP presented in Table 2.

Table 2. Components of the index level for the formation of novelty

The exponent of the character object changes novelty in technology patents		Correction factor of novelty on real analogues	
The change character	Value	The analogues presence	Grading Scale
The conditional (formal) novelty	1	In a development of the industrial production	0,1
Minor changes to minor signs	10	The design study	0,2
Changes to the essential features of which do not lead to an improvement in the basic characteristics of CTS	50	The pre-design studies	0,3-0,4
Changes essential features which improve the basic characteristics of CTS	200	The sources of patent information	0,5-0,6
fundamental modernization	500	Fragments of the concept were unveiled earlier	0,7-0,8
Revolutionary changes	1000	A fundamentally new concept - no close analogs	0,9-1,0

Source: Authors

To determine the influence of the feasibility indicator degree write the following equation:

$$C_{UR} = P_{IPR}K_{CDP}, \quad (9)$$

where: P_{IPR} – a general indicator of the feasibility;
 K_{CDP} – correction factor for the development phase.

The value of summary measure feasibility can be calculated as the sum of the partial indicators presented in the equation:

$$P_{IPR} = V_{TC} + V_M + V_{RS} + V_{SD} + V_{IA}, \quad (10)$$

where: V_{TC} – an indicator of the possibility in principle to implement the technical concept of the development of the object;

V_M – an indicator of the technological possibilities of manufacturing facility development with planned costs;

V_{RS} – adequacy of resource support R&D;

V_{SD} – an indicator of the success of the risks development (probability of achieving and deviations from the planned values of time and technical-economic characteristics);

V_{IA} – exponent of investment appeal (the likelihood of attracting outside investment).

The proposed values of these quantities for the CTS-UHIP presented in Table 3.

Table 3. Components of the index for the formation of the feasibility degree impact

Components summary measure feasibility correction factor for the development stage		Correction factor for the development stage	
Feasibility Criteria	The value of the private index	Development Stage	Grading Scale
Evaluation of the possibility in principle to implement the technical concept of the object development	0,1-0,2	Concept	0,1
Estimation of technological opportunities of manufacture of the object to the planned development costs	0,1-0,2	Preliminary design	0,2
The adequacy of resource support for R&D	0.1-0,2	Technical project	0,5
Risks successful development	0,02-0,2	Production of design documentation	0,7
The degree of investment attractiveness	0.02-0.2	Experimental and industrial design	1

Source: Authors

The lower end of the particular values range indices corresponds to an earlier forecast of upper - time positive conclusion with a high certainty degree. In this regard, the correction factor can be figuratively called the coefficient of success confidence.

This is consistent with another paradox of innovation, which is caused by the influence of the CTS development stage on its investment attractiveness. With the completion of this indicator level is growing exponentially and with the development of the industrial design that has been tested, its value will be more than an order of magnitude higher than at the stage of the forecast. In this regard, the value of novelty as object development for investors is appropriate to consider in relation to the extent practicable.

An illustration of such adjustment can serve many breakthrough projects in the aerospace industry. For example, when the firm Orbital concluded a high probability of successful completion of the development airspace system (ASS) Pegasus was the obvious need for the development of the object of patent protection to ensure its smooth launch on the market. Despite the existence of a significant number of patents protecting various concepts that are left in the form of project proposals, experts Orbital able to maximize the use particular patent law and bypass counterparts. Lacking absolute novelty of the concept, a single patent protecting the ASS Pegasus as a whole as CTS allowed to reach the maximum level of investment attractiveness of the criteria to ensure the smooth use of the market.

Not so contrasting, but essentially similar characteristics of patents protecting the concept was first put into practice the CTS demonstrate such pioneering projects as the Space Shuttle and Sea Launch.

Thus, in order to really novelty could be the basis of summary measure of innovation prospects STS, this value should be adjusted according to two factors.

On the one hand, it acts downward trend, which takes into account the real novelty of the concept, not the art of casuistry originator applications in juggling terms. It aims to identify and eliminate the introduction of misleading investors in the applicant as a result of manipulation aimed at declaring unreasonably high claims of novelty.

Forecasting Innovative Prospects of Complicated Technical Systems as a Means to Increase the Efficiency of R&D and Public Procurement Management

On the other hand, the increasing trend is a factor of practical implementation. He was more than offset by the loss in the conceptual priority to the technical nature (what can be called the ideological superiority of earlier analogs), if it is possible to obtain legal protection for the STS as an object of design in general. This is because from the perspective of an investor justify any terminological manipulation patents, which ensure the smooth use of the facility development R&D.

The proposed methodology for determining the prospects of innovative R&D object development focuses primarily on the creation of CTS, so to evaluate the use of its performance analysis of possible situations that could be and really was in the process of developing ASS Pegasus as an innovative technical solution.

Associate calculations correspond to the real situation and possible developments in the case, if it decided to carry out R&D Orbital is not their own, and by attracting public investors. At the same time, investment in software producing the patent application would be framed already at the pre-stage. The calculation results are presented in Table 4.

Table 4. Dependence patent innovative parameters CTS from development stages on the example of ASS Pegasus and its analogs

Innovative parameters	The technical level			Level of novelty			The feasibility degree			Integral indicator of patent-innovative parameters CTS (P_I)
	P_{IPR}	K_C R	C_{IPR}	P_{IL}	K_{CRA}	C_{IL}	P_{IPR}	K_{CDP}	C_{UR}	
Analogs in the concept stage	1000	1	1000	1000	1,0	1000	0,34	0,1	0,034	68
Recognized as a high probability of success	1000	1	1000	1000	0,65	650	0,8	0,7	0,56	924
At the stage of industrial design	1000	1	1000	1000	0,65	650	1,0	1,0	1,0	1650

Source: Authors calculations

We emphasize two nodal points of the formation for the proposed method final assessment. The first correction is introduced lowering the level of ASS Pegasus novelty due to the existence of the earlier concept of unique game that Orbital has managed to get around due to the qualification of the applicant in the patenting procedure. More lenient experts agree adopts the information sources with similar ASS concepts ($K=0,7-0,8$), more stringent, experts will refer to the patent sources ($K=0,5-0,6$), so as a result of their generalizations we obtain the views of the average value of about 0,65. On the second point with the introduction of the value of assessing the feasibility of innovation prospects ASS Pegasus not only compensates for the loss, but also far superior analogs which have remained at the conception stage.

Analyzing data from the table, as follows clarify and supplement the basic provisions set forth previously forming technique drawing conclusions about the CTS creation prospects.

Firstly, the importance of innovation prospects at different stages of the CTS creation differ quite significantly, which leads to the need for a differentiated approach to decision-making on the financing of works at various stages of the CTS creation. For example, through the development of various rating scales of decision-making, which will be included in the procedure of the expert opinions issue.

Secondly, for the purposes of corporate management, and for the purposes of investment management performance and the technical level of innovation should be complemented by the assessment of feasibility. Performance of technical and economic groups should be comparable to the largest of them, for example, by introducing the correlation coefficients, and corresponded to assess feasibility.

3. Conclusion

Develop an objective conclusion on the feasibility of CTS establishing is an essential element of management innovation for development companies and investors for public R&D.

In order to increase the objectivity of the CTS establishing feasibility conclusion in low reliability of the technical and economic characteristics of a rational extension of the analytical framework for the assessment of innovation performance through the use of CTS.

In the early stages of CTS most objectively justified characteristics of innovation CTS can be obtained on the basis of patents protecting the conceptual essence of CTS in the form of constructive schemes and operating principles.

The main innovative parameters of CTS according to the patent characteristics is the technical level, the degree of novelty and validity of practical implementation, the determination of which is not limited to patent data.

Evaluation of CTS novelty becomes an effective tool for forecasting the prospects of IP-CTS only when the indissoluble link with the assessment of the feasibility and the smooth launch IP market.

The most complete picture of the CTS creation prospects can be obtained by summarizing the assessment of three components: the level of innovation in general, the prospects of the CTS as an object of art, the total volume and the level of local innovations which have immediate prospect of dual-use as well as spillover innovations, indirectly contributing to progress in the development of innovative art.

Promising areas for further research are to identify the tasks of innovation and spillover dual-use innovations make up the ranking, followed by the index of innovativeness of local innovations and dual-use indicator innovation impact on the development of other technologies.

The tender procedures for making decisions on public R&D funding to create UHIP, which is convenient to use indicators of competitiveness. Patent and innovative options CTS should be used for calculating the integral indicator or index innovation competitiveness, the choice of structure and methods of application which should be the subject of a separate study.

**Forecasting Innovative Prospects of Complicated Technical Systems as a Means
to Increase the Efficiency of R&D and Public Procurement Management**

References

1. Cheung, C., Ma, R., Wong, W., Tse, Y. (2012) Capabilities Assessment (OKCA) Method for Innovative Technology Enterprises. International Conference on Innovation, Management and Technology (ICIMT2012): 54-65. Zurich: World Academy of Science, Engineering and Technology.
2. Frietsch, R., Schmoch, U., Looy, B., Walsh, J., Devroede, R., Du Plessis, M., Jung, T., Meng, Y., Neuhausler, P., Peeters, B., Schubert, T. (2010) The Value and Indicator Function of Patents. Berlin: Expertenkommission Forschung und Innovation (EFI).
3. Goldberg, I., Goddard, J., Kuriakose, S., Racine, J.-L. (2011) Igniting innovation : rethinking the role of government in emerging Europe and Central Asia. Washington: World Bank.
4. Greenhalgh, C., Rogers, M. (2010) Innovation, intellectual property, and economic growth. Princeton NJ: Princeton University Press.
5. Hofmann, J. (2005) Value intangibles! Intangible capital can and must be valued owners and valuers alike will benefit. Frankfurt am Main: Deutsche Bank AG.
6. Kumar, S., Phrommathed, P. (2005) New product development: an empirical study of the effects of innovation strategy, organization learning and market conditions. New York: Springer Science+Business Media, Inc.
7. OECD (2012) Recommendation of the Council on Fighting Bid Rigging in Public Procurement, http://www.oecd.org/daf/competition/RecommendationOnFightingBidRigging_2012.pdf (22.11.2014)
8. Parr, R., Smith, G. (2011) Intellectual property: Valuation, Exploitation and Infringement Damages. Hoboken, NJ: John Wiley & Sons.
9. Stryzowski, P. (2005) Intellectual Property Rights and National R&D Subsidy Policies in a Two-Country Schumpeterian Framework. DEGIT Conference Papers: c010_027: 1-14.: http://degit.sam.sdu.dk/papers/degit_10/C010_027.pdf.
10. WIPO (2010) Project paper on innovation and technology transfer support structure for national institutions (Recommendation 10), http://www.wipo.int/edocs/mdocs/mdocs/en/cdip_3/cdip_3_inf_2_study_vii_inf_1.pdf (10.11.2014)
11. WIPO (2011) Management of academic intellectual property and early stage innovation in countries in transition, http://www.wipo.int/export/sites/www/dcea/en/pdf/tool_1.pdf (15.12.2014)