

World Applied Sciences Journal 25 (1): 97-105, 2013

ISSN 1818-4952

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DOI: 10.5829/idosi.wasj.2013.25.01.7029

## The Principles and Methods of the Appraisal of Commercialization Projects of the Universities Innovations

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**Submitted:** Aug 16, 2013; **Accepted:** Sep 20, 2013; **Published:** Sep 24, 2013

**Abstract:** The article deals with the summing up of the foreign experience and modern Russian tools of the appraisal of commercialization new technologies, worked up at Universities. The necessity of the appraisal of commercial potential of the results of scientific-technological activity, its analysis and correcting on the 1<sup>st</sup> stages with the aim of raising the chances of the project in the attraction of investment is also explained in the article. Being longstanding in the realization, having a high uncertainty in results and outlays, innovative technologies are not easy to be appraised by means of traditional methods (cost method, market-conscious method, DCF method, real options method). It is proved that the use of officially recommended in Russia methods of the presentation of expert evidence of the commercialization of new technologies leads to different results. To solve this problem we present the results of the research on the worked out program concerning the methodology of the analysis of the hierarchic structure (MAI), which lets consider a number of quality factors, affecting the commercial significance of the University’s innovative technologies.

**Key words:** Knowledge management • The commercialization potential • Result of the scientific - technical activity • Transfer of knowledge and technologies • Diffusion of innovations • Initiatory stage of the technological development

### INTRODUCTION

Nowadays there is no alternative to the economy, based on knowledge, that presupposes the creation of conditions for transformation the science - technical potential of the country into one of the main resources of the economical advance.

During last 15 years in the west innovation theory the model of the innovative development, based on the research of the complex interaction of three main components: university - business - government became very popular [1].

Today this model was admitted in Russia as a model of “triple helix”, where the key components are Universities - which are not only the centers of science and higher education, but also as one of the most important constituent of the innovative activity,

oriented on the commercialization of the results of the scientific-technical activity (RSTA) and as a result, on the high technologies market launch of the commercially viable product. The real market launch of the Universities is difficult because of the commodity-money appraisal of the commercial potential of the products of the intellectual activity of Universities and also because of the uncertainty of the legal regulation of novations in current legislation of Russia. The level of the commercialization RSTA of country Universities still remains insufficient and improper to the innovative potential of the universities.

Considering everything this the model instrumentality must play the important role, letting consider the diversity of quality factors, which affect the commercial significance of the innovative technologies, worked out at Universities.

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European countries use a rather big toolkit of means and instruments to develop innovations. Nowadays in Russia they use elements of modern foreign methods in the domain of presentation of expert evidence of projects of commercialization of technologies: technological marketing, GAP - analysis, SWOT - analysis, the LIFT method, the system TAME™ [2]. The most actual nowadays for Russia examples of programs were studied and those which concern the logic of the strategy of Russian innovative politics. The choice of the examples of programs and projects based on the appraisal of the performance, including the data of the European program - TrendChart Innovation Policy in Europe. So, the six examples of the most successful European programs and projects were chosen. In the number of the considered examples are included:

- The experience of the creation of new technological companies. The office of transfer of technologies of the Max Plank Society (Germany);
- Innovating-oriented science research programs (Holand);
- The program of the innovative competence for small and medium-sized business PRO INNO II (Germany);
- The system of the tax reducing on R&D (Great Britain);
- The program of stimulating of the innovative activity in Universities - EXIST (Germany);
- Science park Sophia Antipolis.

The European experience definitely shows the necessity to involve the industry on the primary stages of the development of new technological domains, which helps to execute a seamless transition to the practical use of the results of basic studies in the industry and to make the science-research activity of the Universities more affective [3]. At the same time the implement of the positive world experience in Russia is impossible because of the deference of the institutional components: the legislative base is not developed for the activation of the innovative activity, although the stock market, the market of intellectual property (IP), the toolkit, maintaining the innovative activity don't have sufficient power of maintenance and also the stimulating tax base for maintaining of innovations does not exist.

On the base of studied material we discovered that the fundamental researches in Russia are executed still in isolation and they are intended mostly for science publications, than for practical use.

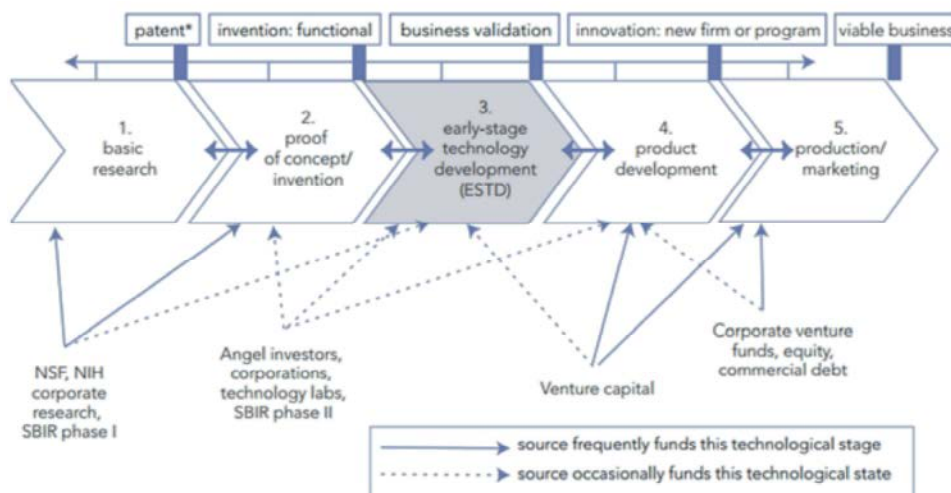
The strategic goal of Russian Universities centers is the regulation of the efforts of getting new knowledge, technologies and IP between higher education institutions, government, big industrial and small innovative enterprises (SME), loss making organizations for the creation and development of mechanisms of the implementation in the producing of the perspective innovations, which appear in a process of execution of governmental and small business financed researches and for stimulating of the apparition in the sector of science and technique of new small innovative enterprises (SME) and of the development of current SME, which could be attractive for venture investors.

To define the degree of attractiveness of the project for potential investors it is necessary to get an expert analysis of the project of commercialization of technologies, appraising the commercial potential of the R&D results on the initial stage, to make an analysis and correcting following the goal to raise the chances of the project in the attraction of investments and, finally to realize the complex of the correcting actions to improve the potential of the commercialization of the R&D results.

In the result of studying of traditional methods of the appraisal of commercialization projects of innovative technologies the range of bugs was found in every method (cost method, market-conscious method, DCF method, real options method). Also the expert method and the method based on the methodology of fuzzy sets. As a result we propose to use the model toolkit, satisfying the most important demands of the R&D expertise, called - the methodology of the analysis of the hierarchy structures, based on the definite mathematical eigen-vector method for the processing of the antysymmetric matrix, which helps operating with quality and quantity criteria.

**Essential part:** Under commercialization (capitalization) of knowledge in the frame of present research we estimate any activity, connected with the practical use of the results of scientific and (or) scientific - technological activity with the purpose to product launch of new advanced products, processes and services, oriented on getting the positive economical effect, benefit from the use of the results of the scientific researches, scientific competences.

It's known that the diffusion of innovations has five stages: knowledge, persuasion, decision, realization and confirmation. This process is one of the kinds of taking decisions [4].



**Note:**

The region corresponding to early-stage technology development is shaded in gray.  
 The boxes at top indicate milestones in the development of a science-based innovation.  
 The arrows across the top of, and in between, the five stages represented in this sequential model are intended to suggest the many complex ways in which the stages interrelate.  
 Multiple exit options are available to technology entrepreneurs at different stages in this branching sequence of events.

\*A more complete model would address the fact that patents occur throughout the process.

Fig. 1: The consistent model of the development and funding

Small and medium enterprises play a key role in creation of new ideas, which help on the attraction to the market of new goods and services. That's why the creation by Russian universities the economic entities in a form of small innovative enterprises (SIE) practically realizes the mechanisms of the development of national innovative system, realizes the innovative potential of High school in Russia, increases the marketability of national economics and promotes the hi - tech products on the international markets.

In the competitive and business area knowledge is estimated as one of the most important strategic assets [5] for modern organizations.

The necessity of the permanent appraisal of the commercial potential of R&D on different stages of the innovative cycle is dictated also by that fact that during the passage from fundamental research to the design and experimental lay-outs and further to the opening up of the production the strong augmentation of expenses occurs, according to statistics, expenses increase approximately tenfold.

Considering this facts, the cease of the commercially futureless researches and developments allow to economize significant financial, intellectual and other kinds of hard executed resources. The primary sponsorship as a rule corresponds to the initial stage of the technological development (ESTD), which presupposes the prove of the commercial potential of the offered idea during its implementation.

The existing model of the innovative process, presented on the pic. 1 allows to understand when (on what stage) the passage from knowledge (invention) to innovation is done. This stage is called an initial stage.

The process of the development and funding of R&D is divided into 5 stages. First two are included into the stages of basic researches and the creation of archetypes, starting with scientific research, then follows the stage of the demonstration of R&D to prove that the commercial appeal is unique. It's a stage called in brief "invention". Not always it is proprietary, but anyway is shows the technical information, who's intellectual core may be protected by some means.

At the beginning of the 3<sup>rd</sup> stage the R&D result is an invention, whose passage to the new status is initiated after finishing this stage. On the 3<sup>rd</sup> stage the specification of the R&D result is connected with the operating process and comes down to the appraisal of its cost. This stage where the business case may be checked and may begin to attract the fund, sufficient for the initial production and marketing activity, presupposing the passage to the beginning of the 4<sup>th</sup> stage. Then, being at the end of the 4<sup>th</sup> stage R&D result launches on the market, so becomes an innovation. On the last 5<sup>th</sup> stage the investors can wait the profit from their investments.

The system of the commercialization of technologies on the initial stages should be considered at least from 4 points of view. Firstly, from the positions of the process, activity, based on the chain of the creation of new technological cost and its attachments. Secondary, it must be considered in the aspect of the business-system and profit, because the opportunity to get then a high profit is a condition of the investment appeal of the new technology. Third, it must be considered from the position of the market offer in a struggle for the potential investor. Last, it must be considered from the side of the concurrence of offers, as in the competitive process the real price of the competitive advantages of the technology becomes evident.

The target of the expertise of projects of commercialization of technologies is not only appraisal of the commercial potential or the R&D results, but also the determination of the degree of appeal of the project for potential investors on the definite stage, the execution of analysis and correction to raise the project's chances on the attraction of investment and, finally to realize the correcting actions to augment the potential of the commercialization of technologies. In general the process of the appraisal of the technology is executed in two stages. During the 1<sup>st</sup> stage the developer of the innovative project formulates his own point of view on the perspectives of the commercialization of his technology in the frame of the project (usually in the form of responses on the questioner, which helps to concretize the innovative product or service, its usability, eventual spheres of use, the potential consumers, other aspects, affecting the opportunity of the commercial use of the results of the execution of the project). Such responses are analyzed by the experts and they make a report, showing the perspectives of the commercialization of the R&D results, based on the use of those results. On the 2<sup>nd</sup> stage the external expertise is done, which the results are

presented in a report about the potential of the commercialization of the results in a frame of the innovative project. On this stage the experts can propose some concrete event listings for a successful commercialization of the proposed technologies.

Nowadays there is a powerful toolkit for the appraisal of the potential of commercialization of technologies on the initial stages. The first method is a technological marketing, different from traditional marketing. The stages of the technological marketing are: preliminary primary marketing, principal technological marketing. The technological marketing analyses all the events, oriented on the achievement of the commercialization of technologies. These events are oriented from one side on the development of the company in a significant technological sphere and from another - on a solution of the problem of present and future consumers of the technology. The targets of the technological marketing are concluded in the choice and goal-seeking positioning of the activity of the science-research establishment in a domain of the development and promotion of technologies.

The next method of the appraisal of the commercialization of the innovative projects is GAP - analysis, which is concluded in the finding the difference, which exists between the current trend of the development of the scientific research organization or innovative company and in posse way of its development in case of realization of the project of the commercialization of technologies.

On the base of GAP-analysis variants of strategy are built and then the appropriate direction of the commercialization of proposed technologies is chosen. GAP- analysis presupposes the trend plotting (Fig. 2) using two most important economical variable - time and money.

The core of such a graphic is in reflection of the current trend of the development of the scientific-research organization or innovative company in future and in finding means of optimization of this trend.

The main variables of this graphical model are: **T** (period) and **S** (expected economical effect). The index **T<sub>0</sub>** characterizes today's modern period of the development of the scientific - research organization or innovative company and line **A** - shows the trend of the strategic development of one of them, extrapolated on the base of previous results of their activity. Line A tends to the economical effect **S<sub>0</sub>**, strategic period **T<sub>1</sub>** (min 5 years), e.g. to the term, when the realization of the strategic

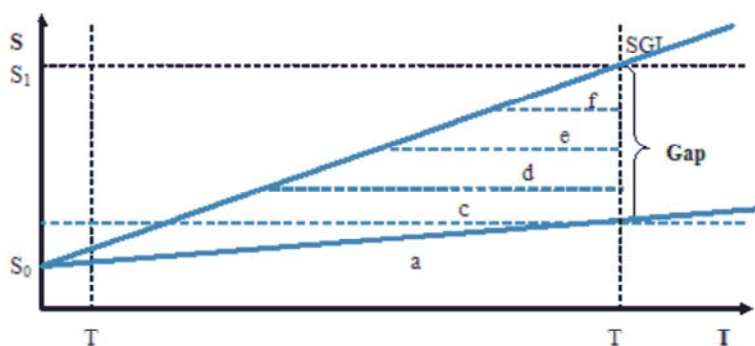


Fig. 2: Graphical model of the GAP-analysis

program of the commercialization of technology or brief-case of technologies must be accomplished. The line B - reflects the trend, which will happen in case of realization of projects of commercialization of technologies and attraction of investments.

At this time there are 4 essential directions of the investment activity, which help to realize this trend. These 4 strategic directions of the activity of the organization or innovative company in a realization of projects of commercialization of technologies (lines C - investment strategy of optimization, line D - investment strategy of innovation, line E - investment strategy of segmentation, line F - investment strategy of the diversification) differ by some parameters [2]:

- The duration of the anticipation of the based economical effect from the sell or exploitation of the innovative technology or the brief-case of technologies.
- The dimension of demanded initial and supposed future investments in the projects of the commercialization of technologies.
- The degree of risks and the probability of the achievement of the Strategic Goal of Investment (SGI).
- The optimal expected economical effect.

So, GAP - analysis shows during the expertise of the project of commercialization of technologies, how the strategic innovative activity of the science-research organizations and innovative companies connected with such functions of the management of science-research organization or innovative company, how marketing, the realization of the project of commercialization of technologies, production etc., what means the maximum wide competence of managers of organizations, responsible for the formulation and realization of the strategy of the innovative development.

One more method of the appraisal of the potential of the commercialization of technology on initial stages is SWOT - analysis, which is concluded in the consistent studying of the inner state of the organization, in a research of positive and negative sides and also the forecasting of presupposed opportunities from the external project environment of the commercialization of technologies. During the SWOT - analysis the lists of strengths and weaknesses of the project of commercialization and of the potential dangers for the realization of this project are composed. Then the initial data for the SWOT - analysis are tabulated.

SWOT-analysis is a method of diagnostics, which helps to create a strategy of activity on commercialization of technologies which takes in consideration strengths and opportunities, compensates weaknesses, minimizing menaces and risks. The results of such an analysis are used for making lists of recommendations in the development of the marketing strategy of projects of commercialization of technologies. Nowadays the elements of new foreign methods of the carrying out expert examination of projects of commercialization of technologies are used in Russia. Among them - the LIFT (Linking Innovation, Finance and Technology) method, which was elaborated in the frame of 5<sup>th</sup> program of the European Commission, including the corporation INBIS (Great Britain) to define the degree of the commercialization of innovative technologies. This method combines the technological auditing and business planning. In point of fact it is a method of the selection of projects of commercialization of technologies for financing. The technological auditing using the LIFT method, usually, is held by the three expert team, who are the specialists in the commercialization of technologies, in the work with the intellectual property and in the economy of innovations. The procedure of the technological auditing includes three stages:

- The fulfilling of the questioner of the project of commercialization of technologies.
- The interview of experts with designers.
- The expert's conclusion.

The method is built on the module type and consists of sections, which allow characterize different sides of the innovative project. The project of the commercialization of technologies is measured in five-point grading scale by indexes, which are divided into two groups: the indexes of appeal of the project and indexes of risks of the project. The highest possible rate of the project can be equal to 50 (ten indexes by 5 points). The expert rate is counted by all the experts, participating in the auditing.

It must be said, that the essential parts of the LIFT method were adapted to Russian conditions in Tomsk, Novosibirsk and Krasnoyarsk regions [7]. This method does not claim to give full answers on the questions, appearing during the technological auditing, but it gives a definite cut-off about the commercialization project's state of the definite innovative technology.

Another example of the up-to date foreign experience of the appraisal of objects of the intellectual property and their commercial potential is a system TAME™, which is elaborated by Lambic Innovation Ltd company to provide the structured approach to the appraisal of the technology and of the market of its commercialization. The problem of the innovative technologies is in the absence of the quantity criteria for their appraisal, that's why experts have judge according to their own opinion. But, in this case it's enough to define the market perspectives of the use of new technology, to appraise the opportunities and to give the forecast of expenses, for potential investors could decide either to work or not with the offered technology.

The system TAME™ has five essential criteria of the appraisal [2]:

- Strengths and the latitude of the market use, provided by the intellectual property objects.
- The essence of the new technology.
- The problems of the commercialization of technology.
- The problems of the contribution to the process of the commercialization of technology.
- The commercial questions.

For the appraisal of each of them there is a great number of questioners with a range of answers. The main aim of the system in whole is a system approach to the

perspectives of the commercialization. It is connected with that fact, that the appraisal of different technologies in different criteria can be multivalued. The highest possible rate of technology in this system - are 200 (for some technologies it is needed to make more than one system appraisals on different levels).

All enumerated methods of the appraisal of the potential of the commercialization of technology on different stages can be united by their target. The question about potential customers, ready to buy the innovation products and services on the price which will provoke the best economical effect, must be essential in the projects of the commercialization of technologies. It's important to mention that the problem of the appraisal of the commercial potential of R&D results is a kind of unstructured problems (using the terms of G. Saymon), which are characterized by quality and quantity criteria.

In the result of the studying of traditional methods of the appraisal of the potential of commercialization of innovations, recommended in Russia we found the following weaknesses:

- The ROR method (cost-method) (by fact expenses): the adduction of diachronous expenses to the current period is subjective in a choice of correspondent coefficient of the reassessment of prices and other criteria, that disfigures the veracity of the appraisal. Also a disadvantage is concluded in the absence of the consideration of future benefits from use of innovative technologies, which can exceed the real expenses on their creation, attainment and the implementation in the economic turnover. That's why the calculated value of the innovative product must be considered as low as practicable in current sails conditions.
- The market-conscious method (on the base of analysis of comparative sells): same as the ROR - method it has the similar disadvantage, connected with the correcting of prices and indexes of correspondence. Although there is a risk of non-achievement of technological, economical and social criteria of the appraised technology in changed market conditions. This method helps to define the would-be market price of the innovation in current conditions and their use on the market.
- The DCF method (by the index of potential benefit): the disadvantages of this method are connected with the uncertainty of conditions of future market environment, of the appraisal of criteria of the activity of small innovative enterprise (SIE) and of the correction of macro economical indexes. This method

allows to appraise the predicted high possible cost of the innovation for the current moment of appraisal, without considering the uncertainty of future strategies of SIE and their market environment.

- The real options method (based on the hypothesis that any investment opportunity is considered as a financial option): using this method they use as input information the nonfinancial indexes [8].
- The expert method (the attraction of qualified and experienced specialists): to achieve more accurate results it is recommended to use the step-by-step appraisal of the project of commercialization of new technologies by 7-10 experts.

Using all these methods of the appraisal of the potential of commercialization of innovative technologies is impossible to find the correspondence between quality and quantity criteria, because there is no necessary objective information. At the present moment we elaborate the program of new method of appraisal of potential of commercialization of technology, considering disadvantages of current methods.

Today is the most difficult to appraise the commercial potential of fundamental researches, their appraisal is possible only on the base of grade-expert method, which is one of the essential method in solving the questions of financing and maintenance of scientific-technical elaborations as on the government level as on the level of concrete company.

It is defined that for a quality attribute “expected effectual demand” it’s enough to have a subjective scale.

Example of use of the method of analysis of hierarchical structures (MAHS). In our example of the commercialization of innovative project it was defined that for the quality attribute “expected effectual demand” it’s enough to have a subjective scale which has quality gradations. They will show the level of the “expected effectual demand”: “low: - L; “medium” - M; “high” - H; intermediate quantity - LM (lower than medium) and HM (higher than medium) [9].

The R&D results according to this scale are presented in Table 1.

Let’s show the subjective scale with quality gradations on the absolute numerical scale. Let’s suppose that the matrix in the result of pair wise comparison of quality gradations has the next look (Table 2).

It is defined that the maximal index of the matrix of the pair wise comparison is equal to 5,22 and coefficients  $IC = 0,055$  and  $OC = 0,049$ . Consequently, the matrix is logical and the experts’ opinions are true.

Table 1:

R&D	R&D -1	R&D -2	R&D -3	R&D -4	R&D -5
Appraisal	M	LM	HM	M	HM

Table 2:

A <sub>5</sub>	L	LM	M	HM	H
L	1	1/3	1/4	1/8	1/9
LM	3	1	1/2	1/3	1/6
M	4	2	1	1/2	1/3
HM	8	3	2	1	1/2
H	9	6	3	2	1

Table 3:

R&D	-	R&D -2	R&D -1, R&D -4	R&D -3, R&D -5	-
Gradations	L	LM	M	HM	H
w <sub>i</sub>	0,036	0,100	0,156	0,289	0,419

Table 4: The function of the appraisal by the quality criteria A<sub>5</sub>

R&D	R&D -1	R&D -2	R&D -3	R&D -4	R&D -5
W(R&D /A <sub>5</sub> )	0,158	0,100	0,292	0,158	0,292

Let’s find the eigen - vector, corresponding to the maximal latent root of this matrix. So, we have:

$$W = (w_1, w_2, w_3, w_4, w_5) = (0,036, 0,100, 0,156, 0,289, 0,419).$$

The components of the vector W define the numerical indexes for quality gradations. At the same time the R&D results get next rates by the A<sub>5</sub> criteria (Table 3).

Standardizing the obtained results, we get the function of the appraisal of R&D results by the quality criteria A<sub>5</sub> (Table 4).

In such a way all enumerated methods of the appraisal of the potential of the commercialization of technology on different stages can be united by their target. The question about potential customers, ready to buy the innovation products and services on the price which will provoke the best economical effect, must be essential in the projects of the commercialization of technologies in Universities innovations.

## CONCLUSION

The tendency to the integration of the regional economics to the global market processes, the WTO accession of Russia lay out high demands to the marketability of the economic entity, which can be provided by the incessant implementation of innovations from the University environment [10].

It’s important to mention that many national systems of developed countries contain the complex of the organizational- economic innovations, helping the activation of the transmitting of technologies from

governmental sector to private one. Nevertheless, nowadays, Russia does not have enough resources to implement them into the economics, created with governmental funds of the intellectual property, that's why it's necessary to look for other ways of solving this problem and not to admit the monopoly strengthening of license by government.

The Universities must participate actively in the creation and using of the objects of intellectual property on different stages of the innovative cycle, of the effective mechanisms and algorithms of knowledge transferring, of the development of the market, by the agency of the participants of innovative infrastructure of universities and regions.

The strategic goal of the creation of centers of commercialization of universities innovations must include the governmental innovative politics by formatting the innovative potential of RF (Russian Federation) and economic entities on all levels, by developing the mechanisms of transferring of technologies, by protecting the IP and its involvement to the economics and also by management of information and work on activation of licenses on the output by the economical entities of the commercially viable, science-intensive products, based on the technical solutions and products, protected by licenses.

So the big Universities where the intellectual product is generated, accumulated and shared, must become the centers of the formation and protection of the IP, of the transferring of knowledge and new technologies to transmit intellectual products into the objects of intellectual property (IP) and of the delivery in a real turnover for integrating into economy.

The development of the methodology and the toolkit for the effective expertise of the projects of the commercialization of universities innovations and the establishment of the system of transfer of new technologies in leading universities of the country, with attraction of all mechanisms of IP into the economic turnover in a real economic sector needs a deep independent science research.

Many depends on the effectiveness and consistent management of different parts of innovative system, whose structure is defined like: idea - laboratory model - commercial pattern - pilot series - batch production with a modification of the product. But the correction of the commercialization of the project must be provided on every stage [10], in this case innovations on the initial stages can gain the benefit and create the stable

competitive advantage to the enterprise during the process of the realization of the project of the commercialization of the results of the scientific - technical activity in universities.

**Issues:** The questions of the appraisal of the projects of commercialization of innovative technologies are rather difficult and demand further studying to create their reliable methodological and methodical base. The augmentation of demands to the quality and marketability of Russian knowledge-intensive product also need the specification of principles and development of methods and tools of the commercialization of universities innovations and their active integration into the economic turnover.

The source of high profit must be producing of new ideas, technologies and social innovations, possessing a sufficient potential of the commercialization and realized on the small innovative enterprises in universities. The effective methodic of the expertise of the potential of commercialization of R&D results is offered.

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