introduction of the tactical decisions after operative allows improving the gross profit on 24,21%, the introduction of the strategic decisions after tactical – on 15,65%.

It was offered to determine the elements of strategy in the regulative influence on the tires competitiveness level. These elements are:

- geographic vector of growth – is formed with MD_{q_prod} (for the determining of coordinate «technology»), MD_{q_cons} (for the determining of coordinate «need»), MD_{c_prod} (for the determining of coordinate «recourses»), μ^{gr} and η^{gr} (for the determining of coordinate «market geography»);

- competitive advantages – are formed and estimated with unitary indexes of quality $I_{q\_cons}^{m}$ and $I_{q\_prod}^{m}$, components of index $I_{c\_prod}^{m}$;

- synergism and strategic flexibility of the portfolio of SMZ – are provided with MD_{sale}.

The objective of the strategy is to provide the sustainable development by improving the product competitiveness level and increasing in profit.

Thereby, modelling of management decisions for the enterprise strategy formation is based on estimation of the product competitiveness and set theory.

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VALUATION METHODS OF NEW TECHNOLOGIES

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МЕТОДИ ОЦІНКИ ВАРТОСТІ НОВОЇ ТЕХНОЛОГІЇ

The article deals with the methods of technology assessment. The authors also present analysis of the basic methods in the valuation of new technologies: cost, comparative and income, as well as some complex methods. Grounded advantages and disadvantages of the methods considered have been suggested in the current article.
Keywords: technology, transfer of technology, methods of technology assessment.

У статті розглянуто методи оцінки вартості технології. Дається аналіз базових методів в оцінці вартості нових технологій: витратному, порівняльному і дохідному. а також деяким комплексним методам. Обґрунтовано недоліки і переваги кожного з розглянутих методів.

Ключові слова*: технологія, трансфер технології, методи оцінки технології*

One of the key moments while preparing the transfer of technology is to determine the objective price for this new technology. This is a problem both for the developer and the buyer, especially in the case if the intellectual property rights are to be sold. Even more difficulties arise with the assessment of future technology that is under development. It is obvious that each of the parties at the time of the negotiations will do everything possible to defend their interests on the proposed price as one that most objectively reflects the value of the new technology.

There are three basic approaches to assessing the value of new technologies: cost (cost approach to valuation), comparative (market) (comparative approach to valuation) and income (income approach to valuation) [1]. These methods are not complicated mathematical models, and are based on logical deduction about current information concerning new technologies. Along with the basic valuation approaches, there is a number of complex methods, which are based on a more complex mathematical apparatus.

The cost approach method is based on evaluation of the costs used for creation of the new technology:

- for the supplier - taking into account the full amount of the costs associated with the development of new technology, including the indirect costs of infrastructure, utilities, labor, etc.;

- for the buyer - the analysis of the potential costs to develop their own technology.

The cost approach method may be applied to the transfer of equipment and other physical objects. Although, there are following disadvantages of this method: impossibility to estimate the costs of intellectual property creation, which is the knowledge imported and received in the course of development; groundless costs for negotiators, which were the result of poor management of one of the parties in any field related to the development of new technologies; impossibility to reflect the profitability of the new technology and its position in the market.

Positive aspect: the cost approach method can serve as the start at the initial stages of negotiations and help in understanding the position of the other party in the negotiations, as well as be useful in establishing a joint venture, calculating the investment made by each of the parties.

The market approach method is based on the analysis of the cost of similar and comparable technologies that are already available on the market. This method is a reliable way to get a market price for which the technology can be currently acquired.

However, in practice there is not always an active technology market available in a particular area. In the case of new technologies it is usually difficult to find comparable analogues. It should also be noted that even if the market of similar technologies exists, the prerequisite for application of comparative assessment is the openness of the market, i.e. availability of diverse financial information about the transactions that take place on it. Furthermore, as in the case of calculating the costs, the market evaluation does not provide information about future incomes of a new technology [2, s.305].

In the income approach the buyer relies on the assessment of future income following the introduction of new technology, comparing the costs of acquisition and use of new technology with future revenues from its implementation within the established time.

The main drawback of estimating future earnings is the fact of uncertainty of any long-term forecasts. Therefore, the key point in the evaluation of future income is the concept of risk associated with each factor, potentially affecting both the market associated with future demand, regulation, exchange rate and other factors, and the technology itself, which may become obsolete in the future.

In practice, there are different methods of estimating future income, taking into account different ways to record the risk affecting the future profit from the new technology.

Today, the most widespread method is the <u>Discounted Cash Flow</u> method, which is based on the principle of changing financial value of money over time. This method allows to determine the current value of future cash flows.

$$PV = FV/(1+k)^i ,$$ (1)

where, FV— future value;

PV — current value;

k — discount rate;

 i — the year of the forecast period.

The discount rate reflects the various types of risk associated with inflation, taxation, changes in raw material and energy costs, prospect of growth in both the enterprise and the country in general and other risks that affect future income.

The cost of technology is made up of future income for each year of the forecast period, adjusted for the discount rate.

Thus, the discounted cash flow method allows us to estimate revenues from new technology, taking into account the effect of various parameters on future business processes.

The main and most difficult task of this method is to determine the discount rate to calculate which a variety of methods is used, often involving complex mathematical calculation, for example, using the CAMP formula [3].

The advantage of the discounted cash flow method is highly precise definition of the technology value.

The disadvantages of this calculation, to a large extent, are the assumptions made in determining the future revenues and risks. Consequently, the objectiveness of the technology cost will depend on the objectiveness of the assumptions. Neglectful or wrong prediction of one of the parameters that affect the future value can drastically distort the final result. Besides, the more complex the calculation the higher its sensitivity to changes in input parameters. Even small errors in the predicted values can exponentially change the outcome of the evaluation. Thus, the two estimates of the same technology, made by two different analysts may have completely different results.

<u>Real options method</u> allows you to make adjustments to the valuation of technology cost in accordance with changes in the future.
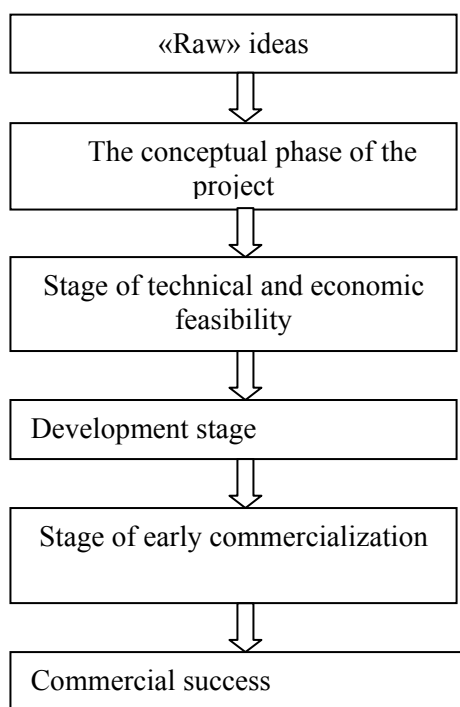

Fig.1. R & D stages [5]

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This method is based on the theory of financial options. Option is a contract that gives its owner the right (but not the obligation) at some stipulated time to buy or sell a specific financial asset at a pre-fixed price. While concluding the option contract, the buyer pays the seller a sum which is in fact a fee for the right to conclude the deal in the future. To calculate the value of options various methods are used, among which the most widespread one is Black-Scholes model [4, p. 95-112]. In the case of technology assessment, an option gives the investor the exclusive right to decide on the further investment of the project at a certain time in the future.

The concept of options is used in the evaluation of research projects, as well as other projects, consisting of several parts with a high degree of uncertainty in their success [5, p. 326-331]. The research project goes through several different stages that have different names (Figure 1).

"Critical analysis at the end of each stage serves as a "screening" process, which removes the unpromising and strategically inappropriate projects. A lot of ideas for products or technologies disappear, while they successively go through "checkpoints between stages", and many just do not persist to the end of the process. Some called it a "funnel of R & D" [5, p. 350-375].

Buying basic options for the continuation or termination of the project and the expansion or contraction of financing, the investor gets the flexibility to decide, depending on the results of each stage of the project.

Expansion of funding for each area is possible if in the course of research discoveries, suggesting its application in various industries, have been made. However, if scientific research has not led to any results, then the investor can stop funding the entire project. Similarly, this methodology is applied to all subsequent stages of the project. The success or failure of a prototype on the base of the study results, will determine the amount of investment in production. The demand for a new product after its release on the market will enable the investor to make a decision on further investment into its commercialization.

The disadvantages of this method are:

- bulkiness of the option calculations, which limits the application of the method in real life;
- difficulty in determining the phases of the project for the introduction of options.

The above example is a very simplified model of the research project. In practice, the introduction of options in the project involves considerable experience and a thorough understanding of each area related to the research project and its subsequent commercialization.

The technology price is, of course, a subject of bargaining in the negotiation process. It should be clear that there is no exact price that objectively reflects the value of technology. That is why, in the case of technology transfer, the key point is the choice of valuation method, which would be adopted by each party of the negotiations. This will determine a kind of game rules that will allow to affirmatively discuss the arguments of the parties to reduce or increase the cost of technology.

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