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EVALUATION OF THE NEW PRODUCT DEVELOPMENT AND R&D PROJECTS

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1. Introduction

At the AEDS 2006 workshop we focused on the structure of the new product development process, including its initial phases [Vacek 2006]. In this contribution we would like to show how this concept can be used in the assessment of the feasibility of the new product development project. We will describe the use of probability trees in the determination of the project net present value and briefly introduce the further extension of the valuation models – the real option method.

We hope that deeper insight into these concepts can help designers to better understand that the technical excellence of the product is necessary, but not sufficient condition of the new product success. The final goal of the new product development is to deliver value not only to the customer, but also to the investor and this survey aims to introduce to designers some tools used by the company management to estimate the new product profitability.

2. Stage-gate model and the project feasibility

Let us remind here the basic structure of the new product development process - the stage-gate process, originally designed by R. Cooper (see Fig. 1).

This model divides the innovation process into five stages with gates, in which evaluators decide if to continue or kill the project. Each stage has its cost, duration and probability of success. Usually only the last stage – after successful commercialization - generates profits.

To justify the project development cost, we should prove at the very beginning its feasibility. Usually it means that we have to show that the project net present value is greater than zero, i.e. that the whole project, taking into account the time value of the money, will generate net profit.

Today, the generally accepted method of evaluation of investment, that is applied also to new product development (NPD) and R&D projects, is based on discounted cash flows (DCF). The DCF method works with such indicators of project feasibility as its net present value (NPV), internal rate of return (IRR), etc. The method is successfully used for investment projects with low level of uncertainty and duration from several months up to few years. However, in many cases this method is not suited to long-term NPD and R&D projects, as it penalizes projects with high risk (and most of the R&D projects are risky) and potentially valuable projects can be rejected or terminated.

The weakness of DCF methods lies in the fact that they do not take into account the typical nature of the NPD and R&D projects that can be divided into stages separated by gates, deciding about project continuation or termination. Financial models assume that the decision about the project realization is done at its very beginning and is irreversible. However, investments into NPD or R&D projects are incremental and the evaluators at the gates decide about the project fate on the basis of changing situation.

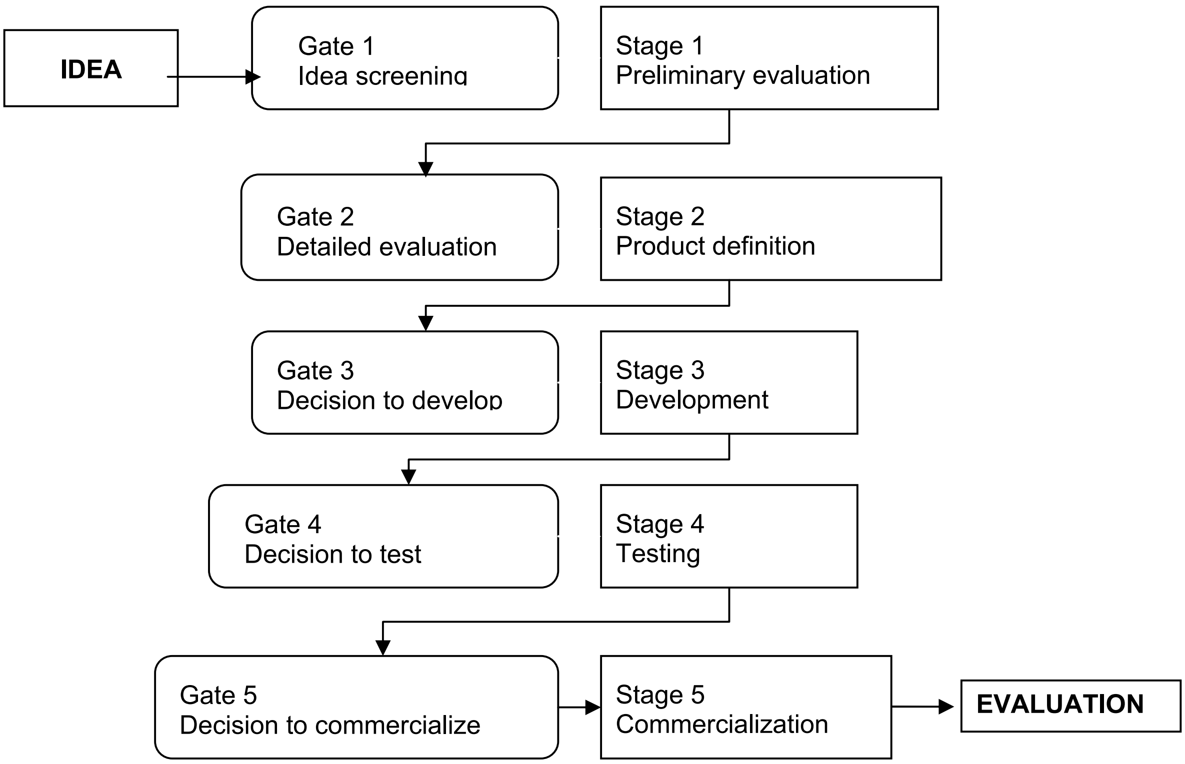


Figure 1: General structure of the stage-gate process

3. Project Expected Commercial Value (ECV)

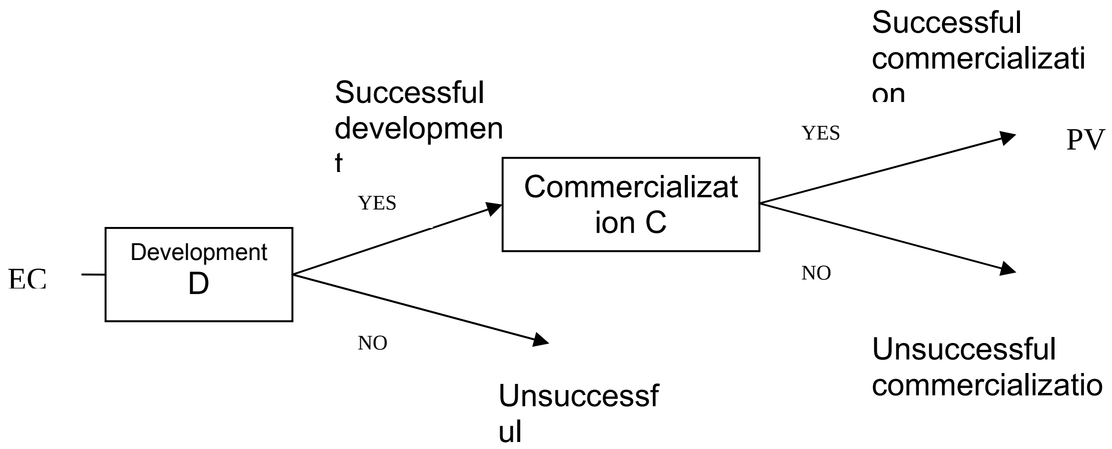
The model of the project expected commercial value takes into consideration all three important characteristics of each phase – its cost, duration and probability of success. This model can be illustrated by the project with only two stages – development and commercialization [Cooper 2001] (see Fig. 2). The project is modeled by the probability tree, which can be easily extended on more stages and gates. The stage duration, together with the discount rate, is reflected in the net present value calculation.

The use of this model is illustrated using example adapted from [Boer 2003] – see Fig. 3.

The first stage (duration 1 year) of the project consist of laboratory tests; the probability of their success is estimated to 50%. The second stage (2 years) is field tests with estimated success probability of 75%. If these tests are successful, the necessary investment into the technology is $5M, expected earnings are $8M and the project net present value is therefore $3M. Financial data are discounted, assuming the weighted capital costs WACC = 12%, risk-free discount rate is 5%.

As the development costs and the specific project risk are high, the resulting expected commercial value is negative (-$109 000) and, according to this criterion, project should be rejected.

It is worthwhile to compare this result with the net present value without the possibility to terminate the project after unsuccessful stages. In such a case the expected earnings would be 37,5% * 1,907M = 715 000 and, after subtracting the costs of 1,201 M the expected loss would be much higher (-$486 000). This example shows the importance of division of the whole project into stages and of the responsible evaluation at each gate.



ECV = Project Expected Commercial Value
p_d = probability of successful development
p_c = probability of successful commercialization
D = development costs
C = commercialization costs
PV = net present value of the project expected profits

ECV = [(PV * p_c – C) * p_d] - D

Figure 2: Project Expected Commercial Value (according to [Cooper 2001])

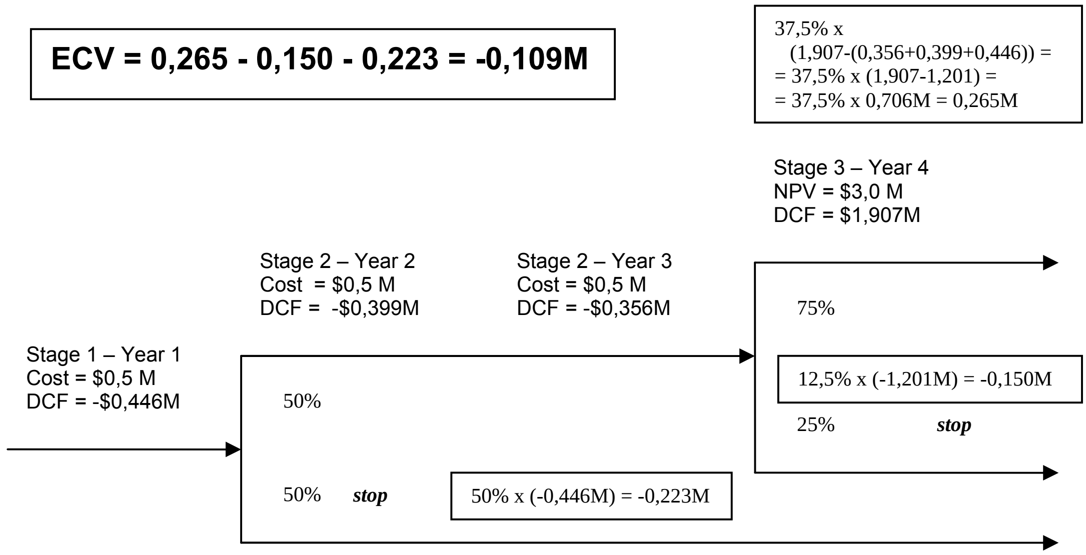


Figure 3: Project valuation using the probability tree (according to [Boer 2003])

4. Real options and two kinds of risks

The concept of real options is closely related to financial options that found their place in financial markets in recent decades. Real options relate to company opportunities and emphasize the basic idea that risk can bring the competitive advantage and as such it should be rewarded.

The application of the real options theory is briefly described in [Boer 2003], the related website contains further information and references to more detailed resources. Here we will give only a brief account of basic concepts and terminology.

The theory distinguishes between two kinds of risks:

- The ***specific risk*** (or individual risk) is specific for the partial situation and is – at lest partly – under your control (e.g. risk of a fire or risk of project failure). Specific risks can be diversified - we can use insurance to share fire risk and maintain the diversified project portfolio to protect against the risk of project failure. Therefore the market does not pay any premium for specific risks. Specific risk can be often characterized by its probability. Better management of specific risk can help us to achieve the competitive advantage.
- The ***market risk*** (or systematic risk) is not under your control and cannot be diversified. The pharmaceutical company, as a part of health care sector, can do little to diversify the market risk. Traditionally, market risk increases the capital expenses and therefore decreases the project value. However, the situation is different with options: here the higher market risk, expressed as volatility, increases the option value, which can be quantified using the Black-Scholes algorithm, well known from financial options.

Volatility quantifies the rate of change of market value of the ***underlying asset,*** i.e. the asset to its ownership we are entitled by buying the option (technology, database of customers …). Volatility is usually specific for the industry and can be estimated on the basis of information available from e.g. stock market, industry statistics, etc. The higher the volatility, the more advantageous is to hold the respective option. The higher volatility means the higher potential of both the increase and decrease of the related asset price. As the option holder we can fully exploit the increase, while in the case of decrease we do not realize the option and the maximum loss is limited by the option cost.

Boer in [Boer 2003] applies the real option model (OPT) with volatility equal to 50% to the example from Fig. 3 and he shows that using this method the project value is $0,171M, i.e. it is positive and the project is feasible. The difference in project value assessed by ECV and OPT models is $0,279M, what is enough to justify the project. The difference is caused by market volatility.

Boer also proves that in case of the zero market risk, i.e. the zero volatility, both methods give the same result.

The method of real options brings the most significant effect to projects with high level of risk having slightly negative net present value determined by ECV or other models based on the discounted cash flow.

5. Conclusion

In this paper we attempted to illustrate the often neglected side of the new product development and R&D projects. The researchers, engineers, designers must work together with investors to determine before the project launch and in the gates how efficiently is used the capital invested into the effort. It is not an easy task; however, we hope that we succeeded to persuade the auditorium that this important task cannot be avoided.

Acknowledgement

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