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HOW TO SELECT THE PORTFOLIO OF NEW PRODUCT DEVELOPMENT PROJECTS

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Abstract

In the paper we focus on the approaches and models that can be used in the selection of the portfolio new product development projects, taking into account the compliance with the company strategy, proper balance of projects in the portfolio, maximization of portfolio value and limitation of resources. We briefly characterize three basic tools: financial models, bubble-chart diagrams and strategic approach.

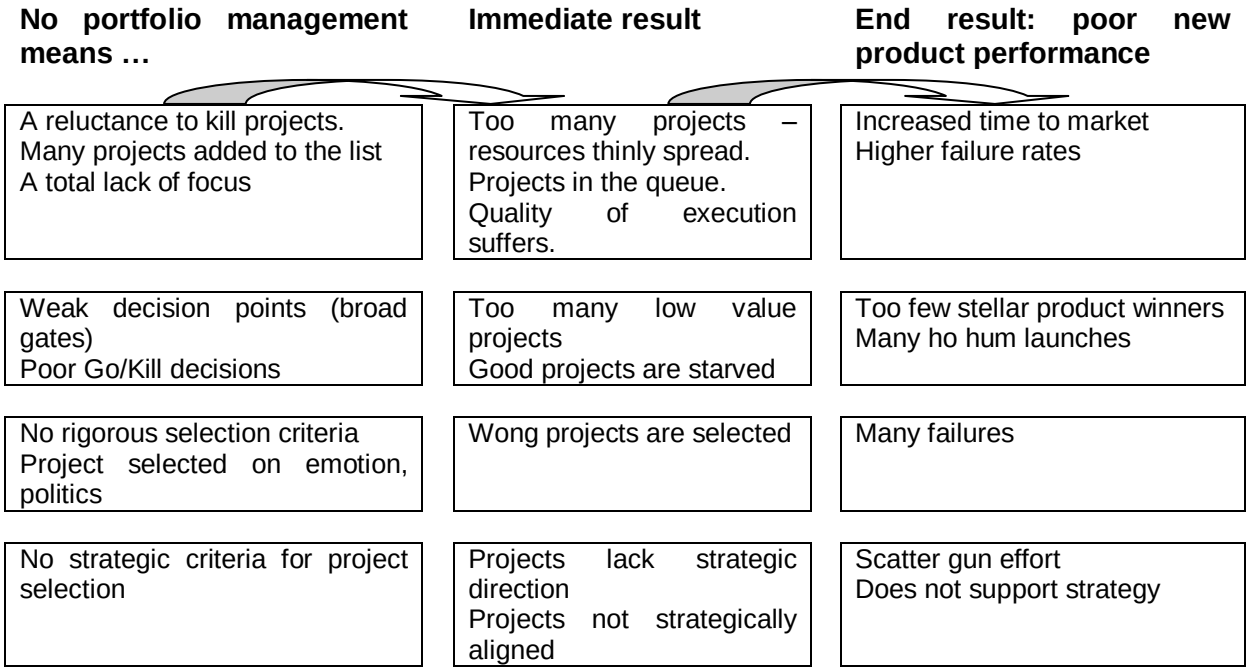
1 Portfolio management, consequences of its lack

This is the fourth in the series of papers presented at AEDS conferences [Vacek 2004, 2006, 2007] and builds on their conclusions.

It is generally agreed that the company cannot be successful and competitive without continuous innovation. The recent years showed that cost savings and leaning brings only short-term effect and that only by savings nobody (neither company nor individual) cannot become rich. Each innovation project brings hope in higher profits, however it also needs resources and is accompanied by risk. Usually, the higher potential profit is linked with higher probability of failure.

The company resources are always limited and it is neither possible nor effective to invest in every idea (although excellent at first sight) without due consideration. It is important to select from many possibilities those with the highest potential, taking into account that today's innovation projects decide about the future profile of the company, its customers and market share. Therefore, our goal is to create such portfolio of products that is rooted in the company strategy and optimizes the company performance. Portfolio management is the dynamic decision-making process of evaluation, selection and prioritization of new projects. In this process, active project can be fostered, put on hold or even killed; priorities and allocation of resources can change. This process is characterised by uncertainty, changing information, dynamics of opportunities and threats, links between projects. The whole process must be based on the long-term company strategy and must support it.

If the company lacks the effective portfolio management, it usually results in deterioration of the company performance and competitiveness. Cooper, Edget and Kleinschmidt [Cooper 2001] summarize possible consequences of missing portfolio management method in the following Figure 1.



Source: [Cooper 2001, p. 5]

Figure 1. What happens when you have no portfolio management method?

2 Portfolio management goals

On the basis of the analysis of numerous case studies, [Cooper 2001] stresses out the three main goals of the portfolio management:

1. **Maximization of value**

   The majority of companies seek such a distribution of resources that maximizes the portfolio value (long-term profitability, return on investment, probability of success). It is problematic to value projects that are still underway and some of them can fail. Failures cannot be completely avoided; often it is important to discover blind alleys. What is important – to identify failure in time and to learn from it.

2. **Balance**

   Portfolio should be balanced in terms of selected parameters, e.g.:
   - Long-term projects vs. short, fast ones;
   - High risk projects with high potential vs. lower-risk sure bets (e.g. radical vs. incremental innovation);
   - Focus on different market segments (don't pull all eggs into one basket);
   - Different technologies;
   - Different project types: new products, improvements, cost reductions, frontier research.

3. **Strategic alignment**

   The main goal here is to ensure that the portfolio is strategically aligned and reflects the business's strategy.

Clearly, those requirements can be in conflict: focus on the value maximization can result in the portfolio with high share of short-term, low-risk projects, emphasis on strategy can be in conflict with other goals, such as probability of success. Different companies can give different priorities to the above mentioned goals and, according to that, they will use different portfolio management tools.

3 Goal 1: Maximizing the portfolio value

If our goal is to maximize the portfolio value, we must use reliable method of project valuation and suitable criteria for project prioritization. The majority of valuation methods is based on the concept of the discounted cash flow (DCF). In more detail we described methods of project valuation in [Vacek 2007], here we would like to present some approaches to project prioritization.

3.1 Net present value, bang for buck

To rank the projects it is necessary to take into account both the total and immediate resource requirements. In go/kill decisions, sunken expenses are not relevant. The ratio of total resource requirements to NPV (bang-for-buck index) can be used for project ranking. Resources then are allocated on the basis of immediate resource requirements (e.g. in the next quarter) and the spending constraint for the corresponding period. We will illustrate this approach on the simple example, in which we should determine the portfolio by selection from 12 projects and the spending constraint for the period is 15 mil. The parameters of all projects are given in Table 1; by ranking the projects according to bang-for-buck index we get Table 2. This table is then split into two parts: above the division line remain projects with cumulative value of immediate resource requirements lower than the spending constraint; these projects will be included into the portfolio and the resources will be allocated to them. The projects under the line will be either put on hold and can be activated in case of freeing some resources, or are completely discarded from future considerations.

Table 1. Projects net present values and resource requirements

Project	NPV	Remaining resource requirements	Bang-for-buck index	Immediate resource requirements
A	52,0	9,5	5,5	3,2
B	30,0	3,1	9,7	0,3
C	8,6	2,1	4,1	1,4
D	42,0	3,8	11,1	2,5
E	48,5	7,0	6,9	1,3
F	43,8	5,0	8,8	1,5
G	37,5	8,3	4,5	3,8
H	3,0	1,0	3,0	0,7
I	9,5	2,5	3,8	0,5
J	6,2	0,8	7,8	0,8
K	4,5	1,4	3,2	1,2
L	55,0	5,0	11,0	5,0

According to [Cooper 2001, p. 31]

Table 2. Rank-ordered list of projects (spending constraint 15 mil.)

Project	NPV	Remaining resource requirements	Bang-for-buck index	Immediate resource requirements	Cumulative immediate resource requirements
D	42,0	3,8	11,1	2,5	2,5
L	55,0	5,0	11,0	5,0	7,5
B	30,0	3,1	9,7	0,3	7,8
F	43,8	5,0	8,8	1,5	9,3
J	6,2	0,8	7,8	0,8	10,1
E	48,5	7,0	6,9	1,3	11,4
A	52,0	9,5	5,5	3,2	14,6
G	37,5	8,3	4,5	3,8	18,4
C	8,6	2,1	4,1	1,4	19,8
I	9,5	2,5	3,8	0,5	20,3
K	4,5	1,4	3,2	1,2	21,5
H	3,0	1,0	3,0	0,7	22,2

According to [Cooper 2001, p. 32]

3.2 Expected commercial value

The model of expected commercial value (ECV), based on probability trees, is described e.g. in [Vacek 2007]. It eliminates one of the weaknesses of the NPV method, i.e. the omission of risk from considerations. If we want to include into our decision-making process another goal of the portfolio management – strategic alignment – we can adjust the project value by multiplying it by the strategic importance index SI with 3 levels: 3 – high importance, 2 – medium, 1 – low. As the criterion for project ranking we can use the ratio of ECV to the development costs and, as in the preceding example, we will apply the resource constraint value of 15 mil. Resource constraint could be also man-months or other value. If there are more constraints to be considered simultaneously, the calculation would be more complicated.

Let's again illustrate the procedure by example. In Table 3 you can find project expected values. Notice the considerable difference between PV and ECV indicating that rating projects merely according to PV can be misleading. Here, PV is the net present value of project's future earnings. If we eliminate project F, which violates the resource constraint, there remains space for inclusion into the portfolio of the smaller project D:

Table 3. Calculation of the project expected value (ECV)

Project	PV	Probability of technical success	Probability of commercial success	Development cost*	Commercialization cost*	ECV
A	30,00	0,80	0,50	3,00	5,00	5,00
B	63,75	0,50	0,80	5,00	2,00	19,50
C	9,62	0,75	0,75	2,00	1,00	2,10
D	3,00	1,00	1,00	1,00	0,50	1,50
E	50,00	0,60	0,75	5,00	3,00	15,70
F	66,25	0,50	0,80	10,00	2,00	15,50

* cost remaining in project

According to [Cooper 2001, p. 36]

Table 4. Rank-ordered list according to ECV/D, resource constraint 15 mil.

Project	ECV	ECV/D	Cumulative development costs	Adjusted cumulative development costs
B	19,50	3,90	5,00	5,00
E	15,70	3,14	10,00	10,00
A	5,00	1,67	13,00	13,00
F	15,50	1,55	(23,00)	
D	1,50	1,50	24,00	14,00
C	2,10	1,05	26,00	16,00

According to [Cooper 2001, p. 38]

If we used as the ranking criterion ECV instead of ECV/D, the order of projects would be different and the total portfolio value with the given constraint would be lower - see Table 5.

Table 5. Rank-ordered list according to ECV

Project	ECV	Cumulative development costs
B	19,50	5,00
E	15,70	10,00
F	15,50	20,00
A	5,00	23,00
C	2,10	25,00
D	1,50	26,00

A careful review of the described procedure reveals that the ECV model prioritizes more highly the projects with the following properties:

- closer to launch (increase of PV and consequently of ECV),
- higher income streams after launch (increase of PV and consequently of ECV),
- less resources to be spent (decrease of D),
- higher probabilities of success (increase of ECV),
- utilize less of the constraining resource (it's easier for them to be above the line).

Similar approach can be used if we utilize real options model for project valuation (see [Vacek 2007]).

3.3 Multi-criteria project valuation

If we want to take into account more criteria, we can use the modification of the following model using four criteria:

NPV – net present value adjusted to probability of commercial success,
IRR – internal return rate
SI – project strategic importance (1 – 5, 1 the lowest, 5 critically important),
PTS – probability of technical success.

Input data of the model are presented in Table 6 below:

Table 6. Multi-criteria project valuation, input data

Project	IRR	NPV	SI	PTS
A	20%	10	5	80%
B	15%	2	2	70%
C	10%	5	3	90%
D	17%	12	2	65%
E	12%	20	4	90%
F	22%	6	1	85%

According to [Cooper 2001, p. 36]

Final project ranking procedure is the following (see Table 7):

1. Calculate adjusted values of IRR and NPV – multiply them by PTS.
2. Rank projects according to adjusted values of IRR and NPV and according to SI.
3. Calculate the average value of those three rankings and use it for final ranking.

Table 7. Multi-criteria project valuation, final project ranking

Project	IRR * PTS	Ranking according to IPR*PTS	NPV * PTS	Ranking according to NPV*PTS	SI	Ranking according to SI	Average of rankings	Final project ranking
A	16,0%	2	8	2	5	1	1,67	1
B	10,5%	5	1,4	6	2	4	5,00	6
C	9,0%	6	4,5	5	3	3	4,67	5
D	11,1%	3	7,8	3	2	4	3,33	3
E	10,8%	4	18	1	4	2	2,33	2
F	18,7%	1	5,1	4	1	6	3,67	4

3.4 Applicability of financial models of project valuation

The main weakness of financial models is the unreliability of input data, especially in the initial project stages; therefore they should be used only in later stages. Small errors in probabilities of success rapidly propagate and can result in significant differences. Generally speaking – the complexity and sophistication of financial models fairly exceeds the quality of input data. It does not mean that we should not pay proper attention to financial data in the initial project stages. However, we should not make decisions solely on their basis; they should be combined with non-financial models described in the following parts of this paper.

3.5 Scoring models

Scoring models are based on the list of criteria distinguishing between highly profitable and less successful projects. The projects are then evaluated according to all criteria, mostly on the scale 1-5 or 0-10. We can assign weights to the criteria and calculate the weighted average that can be used for project ranking. As states [Cooper 2001], on the basis of the extensive reviews in many companies it can be proved that these methods give very good results. What is important is the selection of criteria that really separate the winners from the losers. Such criteria must be based on the analyses of your own company and other companies in the same industry. In fact, you must develop the expert base to be used in project valuation.

One of the models described in [Cooper 2001] uses five main factors:

1. business strategy fit (2)
2. strategic leverage (4)
3. probability of technical success (4)
4. probability of commercial success (6)
5. reward to the company (project profitability) (3)

Each of these factors comprises several characteristics (metrics) – see numbers in parentheses – and the management scores projects on the scale 1,4,7,10. Resulting valuation can be then used either for decision about one project in the gate (e.g. if the project does not achieve at least 50% of possible points, it is killed) or for the project ranking in portfolio selection.

Cooper describes more scoring models and illustrates them on case studies. It is important to understand that the published models cannot be applied as such, they should serve as a guideline for developing company specific model. On the other hand, be careful not to built into the model – even unintentionally – hidden personal preferences of its authors and/or sponsors.

4 Goal 2: Balance

In many cases, the project portfolio is not balanced; often it contains too many small projects and not enough of radical, visionary but highly risky projects necessary to maintain the company competitiveness. Suitable tools for creation of the balanced portfolio are bubble diagrams; most frequently used diagram is the risk – reward bubble diagram, which is used according to [Cooper 2001] by 44 % companies in the sample. The example of such diagram is in Figure 2; the bubble size is proportional to resource requirements.

Diagram can be subdivided into several areas, usually four quadrants; in case of the risk-reward diagram in Figure 2, they have the following meaning:

- **Pearls**: potential „star“ projects: high probability of success, high expected reward. We would like many of such projects.
- **Oysters**: highly speculative projects: low probability of success, high expected reward. Here the breakthroughs pave the way for solid payoffs.
- **Bread and butter**: simple projects, high probability of success, low expected reward. Often too many of them in the portfolio, consuming substantial ratio of resources.
- **White elephants**: low probability of success, low expected reward; projects that are difficult to kill, often from personal reasons.

The advantage of this graphical tool is its simplicity. If we use more colours, shading, etc., we can simply distinguish e.g. product lines, project timing, etc. Using computer support (often the MS Excel, used also for preparation of Figure 2, is sufficient) the management team can simulate various combinations and fine-tune the balanced portfolio.

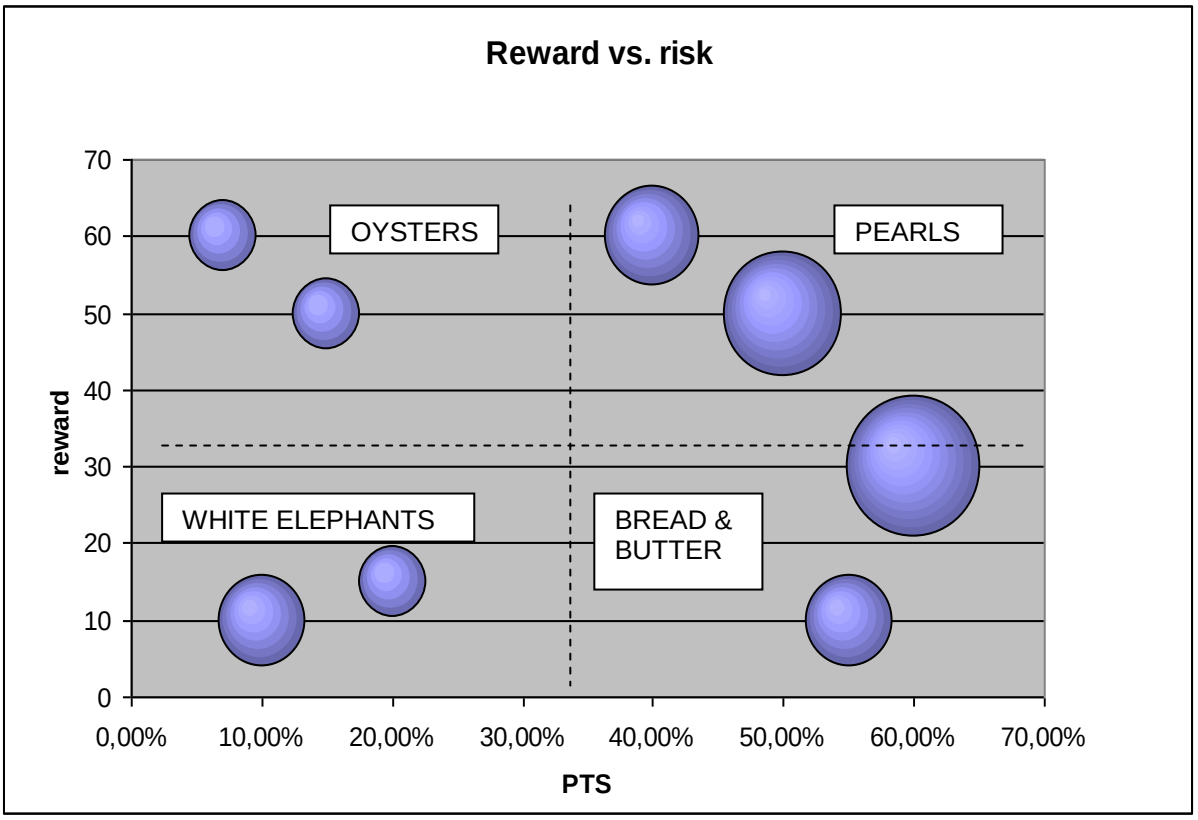


Figure 2. Risk-Reward bubble diagram

Other types of bubble diagrams with examples of their use are described in [Cooper 2001]. These visual models are not decision-making tools resulting in the ranked list of projects. They should be used as an analytical tool facilitating comparison of various solutions. It is important to try work with various diagrams and focus on their reasonable number. They can be easily combined with methods focused on the portfolio value maximization and strategic alignment.

5 Goal 3: Strategic alignment

When speaking about the portfolio value maximization and balance, we must not forget business strategy. Strategy and allocation of resources are closely linked: until we start allocating resources to specific activities, strategy is only paperwork. In portfolio creation we will follow the following objectives:

- Projects are aligned with business strategy;
- All projects contribute to achievement of strategic goals and objectives;
- Allocation of resources reflects specified strategic goals and objectives.

In portfolio management we use three basic approaches: top-down, bottom-up and combined.

5.1 Top-down approach

In this approach we proceed from the strategy formulation (using principles, methods and procedures of strategic management, see e.g. [Grant 2008]). Objectives for new products are often stated in terms of ratio or growth of turnover, profit, market share, etc., during several (usually 3-5) years.

Companies introducing technologically advanced innovations can use with advantage technology strategic roadmaps, results of technology foresight and other studies performed often on the macro-economic level. In the Czech Republic such studies are prepared e.g. by

Technology centre (http://www.strast.cz/) and CESES – Centre for social and economic strategies (http://www.ceses.cuni.cz/), at the EU level by the Institute for Prospective Technology Studies in Seville (http://ipts.jrc.ec.europa.eu/). Technology roadmaps are developed also within the framework of technology platforms of the 7-th EU Framework Programme for Research, Development and Demonstrations (http://cordis.europa.eu/fp7, http://cordis.europa.eu/technology-platforms).

Useful method of resource allocation is the method of strategic buckets based on the understanding that the strategy implementation begins with allocation of resources to projects. The company management, on the basis of strategy, decides what resources will be allocated to basic categories of development projects (e.g. X % to platforms, Y % to new products, Z % to incremental innovations) and projects are then prioritized within those buckets. It can happen that resources originally allocated to one bucket are not sufficient, while there are still free resources in the other bucket. In such a case the resources can be redistributed. However, after the final allocation of resources to strategic buckets it should not be possible to reshuffle the resources between buckets. Especially it should be avoided to take resources originally allocated for strategic, long-term goals and use them for short-term, more "urgent" projects, often backed from "political" reasons (as if you used money originally allocated for housing to pay for expensive holiday). Such redistribution undermines long-term strategic goals and all the strategic planning.

5.2 Bottom-up and combined approaches

Bottom-up approach builds strategic criteria into the model of project selection, usually to the scoring model (see 3.5). This approach guarantees that all projects are strategy aligned, however it cannot guarantee allocation of resources in compliance with strategic priorities.

This weakness can be eliminated by the use of combined approach, in which we first use the top-down approach to establish strategic buckets, and then we evaluate all active projects and projects on hold and prepare their ranked list. Finally we assign projects to corresponding categories (buckets) and include them in the portfolio until the exhaustion of resources. Usually this first iteration is not completely satisfactory and it is necessary to use more iterations to reach satisfactory results.

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