Project Portfolio Management

Strategic Management through Projects

Publisher:
Project Management Association Finland, PMA Finland
Helsinki 2001

Project Portfolio Management : Strategic Management through Projects
Karlos A. Artto, Miia Martinsuo and Taru Aalto, editors
First Edition, Helsinki, 2001, 176 pages

ISBN XXXX
ISSN 1456-7660

Cover design: Taru Aalto
Cover photo: © Pekka Turunen
Printed by Tummavuoren kirjapaino Oy, Vantaa, Finland

Project Portfolio Management

Strategic Management through Projects

Karlos A. Artto, Miia Martinsuo and
Taru Aalto, editors

Project Management
Association Finland

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Industrial Engineering and Management

TEKES

GLOBAL PROJECT
BUSINESS

STRATEGIES AND METHODS FOR PROJECT PORTFOLIO MANAGEMENT

Taru Aalto, Nokia Ventures Organization

1 Introduction

1.1 Background

More and more companies are moving towards a project-oriented way of managing their operations.[27] [28] [29] Businesses are divided into projects instead of using the traditional functional organization for operating. In the traditional setting, the construction industry and other project suppliers managed their operations by using projectized or matrix organizations. Today even companies with only a few projects with external clients are abandoning the functional organization and changing to a projectized one. Earlier, a large construction project with an external client represented the most common project type, whereas today, internal product development projects with internal clients have become more common.

The fact that companies have begun to manage their businesses in a project-oriented manner creates certain challenges for them. One of the biggest challenges is to ensure that the numerous projects are implementing the same strategy as the company management. This also applies to resources. Are the scarce resources, especially the human capital, allocated to the right projects, namely those that can move the company to a desired direction and produce shareholder value?

Project portfolio management is discussed in the literature, but there is still a need to investigate the methodological content of project portfolio management from the viewpoint of its application in business context.

1.2 Objective and Research Methodology

This study investigates how project portfolio management methods can be used to improve the performance of a project-oriented company.

The objective of this study is to find answers to the following questions:

1. What is project portfolio management?
2. What methods can be used when planning project portfolios?

[27] Turner, 1999, p.2
[28] Artto, 2000, p.13
[29] Turner and Keegan, 1999, p.58

3. What should be considered when creating the portfolio?
4. What is the process of project portfolio management?
5. How does project portfolio management relate to other activities in a company?

The research methodology employed is based on deductive reasoning. Existing literature is used for conceptual reasoning. The study aims at deriving new constructs: the conclusion section is written in the form of a concluding suggestion for an appropriate project portfolio management process and methodology.

The study places emphasis on managing R&D and product development project portfolios, but the considerations at a general level can be applicable to management of any project portfolios. The reason for focusing on R&D projects is their significant influence on the development of a business as a whole.

The emphasis of this paper is on managerial issues. The issue of different kinds of information technologies that can support project portfolio management is not considered in this study.

The strategy creation process is essential for the success of portfolio management. Strategy can be considered as a series of options explicitly designed to affect one another.[30] It is a process of formulating a mission and intent and implementing the two. This process creates the basis for competitiveness of the company.[31] Describing the strategy process is not part of this study and information on it can be found elsewhere [32].

2 Project Portfolio Management

This section introduces the concept and the aim of project portfolio management.

2.1 What is Project Portfolio Management?

A project portfolio is a collection of projects that are carried out in the same business unit sharing the same strategic objectives and the same resource pool. The number of these financial and physical resources is quite often scarce. The projects compete for those scarce resources under the same management and/or sponsorship.[33]

A portfolio can also be presented as a collection of programs, which further are collections of projects with common objectives.[34] These programs together form the objective of the entire business. The idea is presented in Figure 5. Programs and the

[30] Luehrman, 1998, p.90
[31] Hitt et al., 1999, pp.5-6
[32] e.g. Hitt et al., 1999
[33] Dobson, 1999, p.4
[34] Välimäki, 14.10.1999

projects inside them are analogous to the projects that are then subdivided into subprojects.

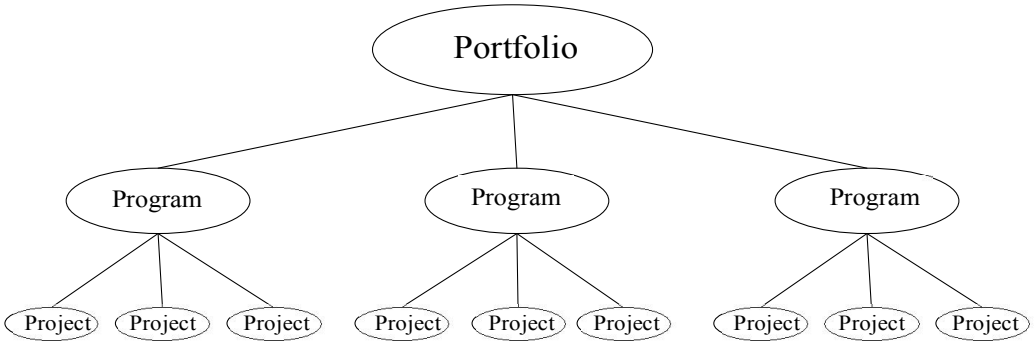


Figure 5. Model for organizing portfolio management.

Portfolio management deals with the idea that companies should not only concentrate on managing independent projects and their specific objectives but also on managing the projects as a tight entity with shared objectives.[35] These objectives common to all projects, and actually to the company as a whole, include numerous issues that are discussed in this study.

Portfolio management is important also due to the fact that most companies have more project ideas than they have physical or financial resources to carry out.[36] The management has to decide which projects to pursue and which to kill. This process of project evaluation, prioritization and selection is one of the essential issues in project portfolio management. Portfolio management also puts an emphasis on the idea that projects should not only be evaluated separately, but in the context of the whole portfolio[37] since projects very seldom are independent of each other.[38]

In short, as Cooper and Edgett[39] describe, portfolio management is a dynamic decision making process whereby a list of active projects in the business is constantly updated and revised. New projects are evaluated, selected and prioritized, existing projects might be accelerated, killed or de-prioritized and resources are allocated and reallocated to the active projects. The decision process is characterized by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependencies among the projects and multiple decision makers and locations.

2.2 Portfolio Management Objective

Portfolio management seeks answers to questions like "What should we take on?" and "What should we leave out?" and it requires balancing strategic and tactical imperatives.

[35] Elton and Roe, 1998, p.6
[36] Archer and Ghasemzadeh, 1999, p.207
[37] Ringuest and Graves, 1999, p.40
[38] Archer and Ghasemzadeh, 1999, p.207
[39] Cooper and Edgett, 1997a, p.16

One should consider what is possible (capabilities) and what is needed (a business wish list). Portfolio management can also be defined as the management of the ultimate level of business that can be achieved with limited resources.[40]

The goal in project portfolio management is to get to the upper right corner of Figure 6. In this corner, project management organization is mature and the projects are seen as a way of managing the business. Project portfolio management is about managing the business through an integrated set of projects.

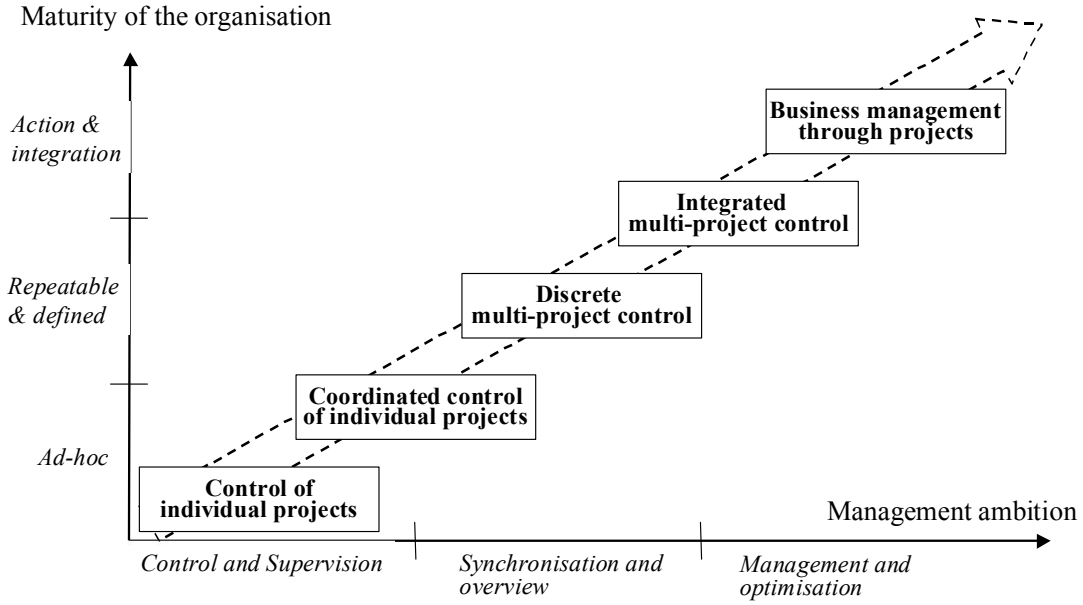


Figure 6. Maturity within project control.[41]

Efficient portfolio management promotes utilization of the company's assets that allow managers to create shareholder value.[42] Portfolio management offers a way to make the right decisions.

The ultimate goal of portfolio management is to implement company strategy. This can be accomplished, according to Cooper[43], by:

1. Linking the portfolio to the strategy of the business,
2. Achieving the right balance and mix of projects,
3. Maximizing the value of the portfolio.

Portfolio management has many benefits compared to project-by-project management of the business[44]. It serves as a link between strategy and projects thereby helping to

[40] Hutchinson, 1998, p.29
[41] Michelsen and Schmidt, 1999, p. 750
[42] Spradlin and Kutoloski, 1999, p. 26
[43] Cooper and Edgett, 1997a, p. 16
[44] Howell III et al., 1998, p.54

implement the company strategy. It also offers a tool for gaining a holistic view of all activities inside the company while also providing help for resource allocation.

Archer and Ghasemzadeh suggest that companies that wish to gain a competitive advantage today and in the future must, thus, exercise portfolio management.[45] There are reasons that make portfolio management one of the most important issues in strategic management. According to some companies[46], there are at least three major reasons why project portfolio management in the field of product development is essential for the success of the business. The reasons are:

1. Successful new product development will be essential in the future and project portfolio management is needed to ensure that the effort is put to the right projects thus enabling the successful launch of new products.
2. Projects, especially the new product development projects, are the most important way of operationalizing company strategy.
3. Resource allocation is becoming increasingly important. The allocation of often scarce resources is one of the essential issues in portfolio management and thus it provides a tool to help solve this problem.

3 Portfolio Management Frameworks and Tools

Project portfolio management has various names and meanings in the literature. Some authors call it portfolio management, others call it portfolio decision making, portfolio selection or portfolio prioritization. I have chosen to use the term portfolio management to emphasize that I do not only mean the decision making process or the actual selection process but the whole process of determining the criteria for the portfolios, selecting the right projects and managing the projects during and between the portfolio decisions. From this viewpoint, portfolio management is a continuous process of managing the company and its objectives.

This section introduces frameworks and tools for portfolio management. The frameworks describe the process of portfolio decision making. The typical tools are matrices or models which help rank or select projects.

3.1 Project Selection Frameworks

Project selection frameworks or models describe the process of selecting projects. They offer a step by step guide how to proceed. In the following, I will present three different

[45] Archer and Ghasemzadeh, 1999, p. 207
[46] Cooper et al., 1997b, p. 47

frameworks/models. The first one was developed by Archer and Ghasemzadeh[47] [48], the second by Spradlin and Kutoloski[49] and the third by Cooper, Edgett and Kleinschmidt[50].

3.1.1 Framework by Archer and Ghasemzadeh[51] [52]

The Archer and Ghasemzadeh framework is divided into three major phases. The phases are: the strategy development phase, individual analysis of projects, and optimal portfolio selection (Figure 7). The contents of the phases are discussed in the following.

1. Strategy development

It is important to determine the strategic direction of both the company and the strategic business units before starting to evaluate independent projects. The strategic decisions concerning the portfolio focus and the overall budget should be made in a broader context that takes into account both the internal and external business factors. Both the framework for project selection and the techniques and methodologies used in selection should be flexible enough to fit the company, its culture and its management.

For the sake of simplicity, the portfolio selection process should be divided into smaller stages, which allows the decision-makers to move towards an integrated consideration of which projects are most likely to be selected. The users should not be overloaded with data and be offered a chance to access the relevant data.

2. Individual analysis of projects

Common measures which can be calculated separately for each project should be agreed upon. This allows an equitable comparison of projects under consideration. Both the projects underway that have reached certain milestones and new projects should be evaluated. This allows the creation of a combined portfolio within available resource constraints, which takes into account old projects, new project proposals, changes in strategic focus, revision to available resources and changes in the environment.

If the number of projects to be evaluated seems to be extremely high, Archer and Ghasemzadeh recommend having a screening process. The screening should be based on carefully selected criteria to eliminate the projects with no chance to be selected before the actual selection process is started.

3. Optimal portfolio selection

[47] Archer and Ghasemzadeh, 1998, pp. 104-113
[48] Archer and Ghasemzadeh, 1999, pp. 207-216
[49] Spradlin and Kutoloski, 1999, pp. 26-31
[50] Cooper et al., 1997b, pp. 46-52
[51] Archer and Ghasemzadeh, 1998, pp. 104-113
[52] Archer and Ghasemzadeh, 1999, pp. 207-216

Portfolio selection involves simultaneous comparison of different projects in certain dimensions, which should result in a project ranking. The ones succeeding best are then selected according to the number of resources available. Interdependency of projects is likely to cause problems when carrying out this phase. The time-dependent resource consumption of projects should be taken into account when selecting projects.

It is recommended that the decision-makers are provided with an interactive mechanism for project control and selection. The fact that decisions on portfolios are often made in committees requires that the model used is adaptable to groups.

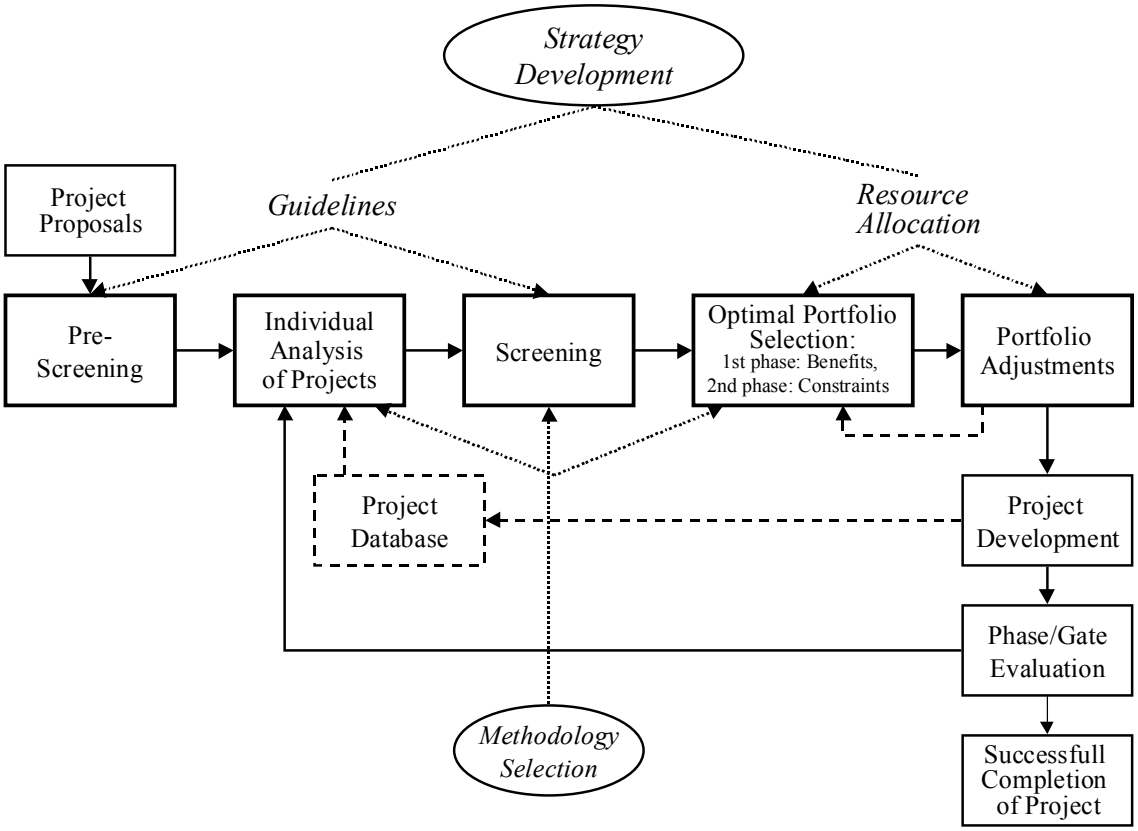


Figure 7. Framework for Project Portfolio Selection by Archer and Ghasemzadeh.[53]

The three phases of the Archer and Ghasemzadeh project selection framework are included in Figure 7. The content of the framework and its phases are discussed in the following. The model is based on the idea that everything is influenced directly or indirectly by the business strategy. Without well-planned and clear strategic objectives, portfolio selection cannot be accomplished. When developing the strategy, also the methods used in portfolio selection should be defined. Strategy gives the guidelines for both pre-screening and screening of projects and influences the allocation of resources on different projects.

[53] Archer and Ghasemzadeh, 1999, p.211

Especially if the number of projects to be analyzed is extremely large, it is recommendable to use pre-screening to eliminate the projects not fitting the strategic guidelines of the company, and thus simplify the actual portfolio selection. Pre-screening is followed by the analysis and the screening phases in which the individual projects are first analyzed and then screened to find the most promising ones. During the analysis, such parameters as risk, NPV and ROI can be calculated. The uncertainty of these parameters must be taken into account. After the analyses, the non-lucrative projects or project initiatives are abandoned.

After screening, the optimal portfolio is selected. The selection is done according to the criteria defined by the business. The selection can be done, for example, with the help of different kinds of scoring models, matrices or other selection tools. Examples of such tools are presented in section 3.2. The first step in the selection, according to Archer and Ghasemzadeh[54], is to determine the relative benefits of each project. In the second step, the project interdependencies, resource limitations and other constraints must be taken into consideration. For example, certain projects might not be strategically very important, but they support a project that is critical to the company. Thus, before terminating a less important supportive project, the influence of the termination on the more critical projects must be considered. One needs to remember that the projects' total benefits are not necessarily the sum of the benefits since the benefits brought by a project depend quite often on the successfulness of many other projects.

In the end, the necessary adjustments for the portfolio are made. These adjustments can be supported by the use of different kind of matrices and interactive displays. Examples of such matrices are presented in section 3.2. If significant adjustments are needed, it might be useful to return to the previous phase of the framework to recalculate new portfolio parameters.

The Archer and Ghasemzadeh framework can be considered to be both quite extensive and quite flexible. It offers a good framework for the process of portfolio selection. In my opinion, the application of rather many phases may require a lot of resources in empirical application, which makes the framework heavy to use and disliked by busy managers. Also, the framework does not consider the time aspect of the process.

3.1.2 The Strategy Table Model[55]

The Spradlin and Kutolowski framework for making portfolio decisions consists of five phases: Framing the problem, building an alternatives table, creating a strategy table, evaluating individual opportunities and evaluating the portfolios (Figure 8). In the framework, each project is considered to be an opportunity for the company.

[54] Archer and Ghasemzadeh, 1999, p.212
[55] Spradlin and Kutoloski, 1999, pp. 26-31

This framework is about allocating resources for opportunities, bearing in mind the relationships among the opportunities. The framework implements the idea of strategy table. The framework is described in the following.

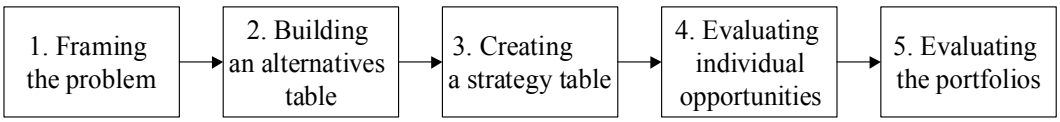


Figure 8. Strategy table model by Spradlin and Kutoloski.[56]

1. Framing the problem

In the first phase, the evaluated opportunities are agreed on. Experts from various functions are used for finding the opportunities. For each opportunity, the current activity and resource usage is mapped. Also, the activities needed for getting the opportunity to market in the future are determined.

Projects are classified by the decision owner. A project can be classified either doomed, equivocal or favorite. Doomed projects are the ones that the decision owner does not want to consume valuable resources on. The equivocal projects are the ones the owner cannot decide about. The owner of these ideas should be open for ideas to improve the original idea. These projects are the ones to be analyzed more in-depth. The favorite projects are the ones the decision owner wants to keep going on no matter what is said or analyzed.

2. Building an alternatives table

In this phase, analysts organize a meeting and brainstorming of alternative courses of action for each opportunity. Also, new alternatives may be presented. The generated alternatives are collected into an alternatives table (Table 1).

Table 1. Example of an alternatives table.[57]

PROJECT A	PROJECT B	PROJECT C	PROJECT D
Momentum	Momentum	Momentum	Momentum
Stop (null)	Stop (null)	Stop (null)	Stop (null)
Delay 6 months	Delay 3 months	License out	
25% more money	Double resources		

3. Creating a strategy table

After generating the alternatives, a subsequent meeting of a smaller group is held to create strategies or alternative portfolios from the alternatives table. The momentum strategy of all alternatives is defined to ensure everyone's understanding. This helps participants understand how portfolio can be generated from the alternatives table. The rehearsal is done using some strategic theme, such as domination of a niche market or

[56] Spradlin and Kutoloski, 1999, p.27
[57] Spradlin and Kutoloski, 1999, p.28

maintaining a balanced portfolio. After the creation of the alternative portfolios, each portfolio is subjected to a simple test of acceptability.

4. Evaluating individual opportunities

The created candidate portfolios are then compared with respect to the expected NPV and other measures agreed on by the group. All alternatives for each project are assessed. The group is asked to give low, base and high estimates for sales and costs. Sales are thought in terms of price, market share and market size. An estimation of influences on other projects is also calculated.

5. Evaluating the portfolios

In the last phase, the cash flows that might result under each selected alternative in any of the portfolios are estimated. When combining the portfolios, cash flows are aggregated. The impact of failure of each project on the value of the portfolio is also estimated. This scenario analysis is done with the help of the low, base and high estimates. Finally, the portfolio selection is made. If one is not able to make the decision, additional information on each alternative is collected.

The final goal is to present and create the decision-makers a summary of risks and rewards associated with each candidate portfolio. Also, other measures like risk and reward can be used.

Even though this framework includes strategy considerations, it does not consider the continuous nature of the portfolio decisions. Furthermore, the framework is partly based on the decision makers' capability and judgement to either abandon or continue with a project.

3.1.3 Strategic Buckets Model[58]

The third model, the strategic buckets model, is based on the idea that implementing strategy equates to spending money on certain projects. Thus, the portfolio requirement setting is about setting spending targets. The model is presented in Figure 9 and described more in detail in the following.

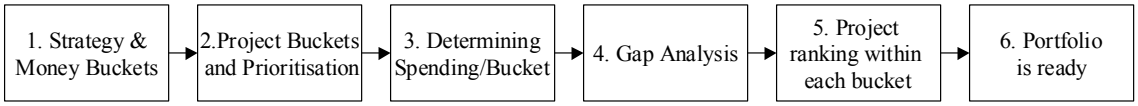


Figure 9. Strategic buckets model.

1. Strategy and money buckets

In the beginning, the management makes the decisions on where they want their money to be spent. Everything begins from the vision, strategy, goals and plans to achieve the

[58] Cooper et al., 1997b, pp. 46-52

goals. This phase requires the management to make forced choices across the key strategic dimensions since the resources must be split on each dimension. These dimensions might include, for example,

- Strategic goals defined by the management
- Product lines
- Project types, for example new product development, process improvement, maintenance, basic research
- Familiarity matrix, for example different markets and/or technologies in terms of familiarity
- Geography, for example local/global resources

2. Project buckets and prioritization

In the second phase, the existing projects are categorized into buckets within which they are prioritized according to the strategy. The various dimensions described above are subdivided into a convenient number of buckets. Examples of buckets include product development projects for certain product lines, cost reduction projects for all products and product renewal projects for certain product lines.

3. Determining the spending by each bucket

After creating and prioritizing the buckets, the desired spending by each bucket is determined. This involves a consolidation of desired spending splits from the strategic allocation determined earlier.

4. Gap analysis

Next, a gap analysis is done. The gap analysis includes categorization of projects by bucket. This is done through determining spending by each bucket. After this, the spending gap between what is and what should be can be identified.

5. Project ranking within each bucket

Projects are ranked within each bucket using, for example, scoring models or some financial criteria.

6. Portfolio is ready

The major advantage of this model is its ability to link strategy and spending. The other advantage is that it takes into account the limited nature of resources within the organization and the trade-offs between projects consuming these resources. In this model, it is also possible to have different criteria for different project types, such as new product development and product renewal projects, due to the different buckets of projects. Application of the model, however, is both time-consuming and it requires a

lot from the management. Furthermore, the model cannot be applied if no specific projects exist as the point of departure.[59]

There is also another similar model called The StratPlan strategic check model. The main difference between the StratPlan and the strategic buckets is that the StratPlan moves bottom up, not top-down as the strategic buckets model. The StratPlan model is described in the following.

In the StratPlan model the projects are first ranked, for example, with the help of a scoring model. The StratPlan is a macro-level, strategic planning exercise used to analyze the different product groups of a company or division. The model results in missions and macro strategies for each product group and classifies them according to a McKinsey-style grid (Figure 10).

The projects are scored and ranked independently of each other. Next, all the projects are listed according to their ranking and a cut-off line is drawn in the point where the spending of projects equals the total budget. Projects above this line, called first cut Go projects, are divided into groups by product group and the total expenditure per project is calculated. These numbers are then compared with each other, seeking the alignment with company strategy. If the proportional spending does not correspond to the original strategy, some balancing is done by removing some projects. The StratPlan is then repeated in several rounds and simultaneously additional projects are removed from the list in each round. Compared to the strategic buckets model, the one advantage of this model is that it is not as time-consuming as the bucket model.[60]

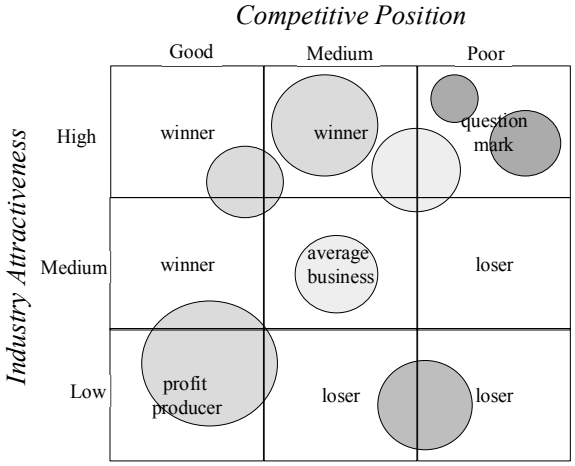


Figure 10. GE/McKinsey matrix.[61]

[59] Cooper et al., 1997b, pp. 45-46

[60] Cooper et al., 1997b, p. 46

[61] Johnson and Scholes, 1989, p.178

3.2 Portfolio Decision Tools

For choosing the projects for the portfolio, clear methods and tools are needed. The old methods, such as interviewing project leaders, a scoring system based on project's strengths and valuation techniques are subject to the bias of project leaders.[62] This section discusses tools that can help in making the portfolio decision.

According to Carl Neun, the CFO of Wilsonville,[63] "The reality is, when allocating your investment dollars, the technique makes a big difference". In other words, the decision makers need dynamic and robust criteria to evaluate the opportunities and select a mix of businesses and R&D projects that reflect the company strategy. Portfolio management can be that link. The business planner must balance efforts in terms of short-term versus long-term payoffs, cash generation versus growth, and business life cycles and technology and market capabilities - all within an acceptable risk framework.

When choosing the criteria for evaluation, one should remember that certain monetary criteria like ROI may limit the scope of the comparison since there is nothing inherent in ROI that links projects to the company strategy. If using ROI, the decision maker probably always ends up in choosing the projects that are based on the current business and not on experimental solutions in new market areas or choosing projects that are important in guaranteeing the long term success of the company. This occurs because of the high volumes of the "old" product markets. Also, ROI estimates for breakthrough projects are very difficult to make. It should also be remembered that the worth of the portfolio can be measured only against the specific business objectives established at the company's executive level.[64]

Factors that can be considered when selecting projects include, for example, marketing and technical risks of projects.[65] The general rule is that the higher the risk and the lower the expected return, the more likely the project should be dropped.

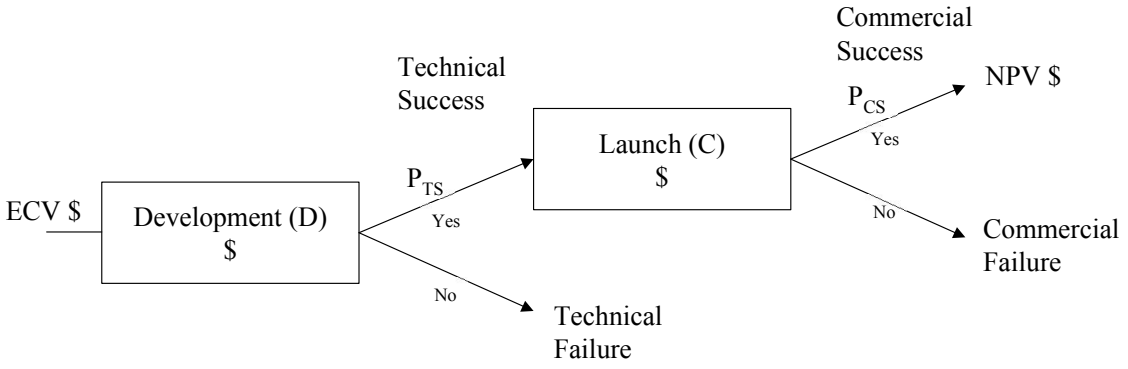
In every case, regardless of the criteria in use, it is important to have right and good data, and understand the dynamics of customers, the dynamics of the market place, and the resource requirements.[66]

The following sections introduce different numerical methods for selecting projects.

[62] Van Arnum, 1998, p.14
[63] Stevens, 1997, p.40
[64] Stevens, 1997, p. 40
[65] Stevens, 1997, p.41
[66] Stevens, 1997, p.44

3.2.1 Expected Commercial Value (ECV) [67]

The Expected Commercial Value (ECV) method is based on a decision tree analysis (Figure 11). In order to be able to prioritize projects, the scarce resources are considered. The constraining resources might be capital resources, people, work months or money. ECV is divided by the constraining resources when prioritizing projects. The major weakness of the model is that the model requires financial and quantitative data and their approximation is difficult and the results are unreliable. Another weakness is that it does not take into account the balance of the portfolio. Furthermore, only one criterion (ECV) is considered for maximization.



$$\mathbf{ECV = [(NPV^{*}\ P_{CS}{}^{*}SI - C)\ ^{*}\ P_{TS} - D]}$$

ECV = Expected Commercial Value of the project
SI = Strategic Importance of the project
P_{CS} = Probability of Commercial Success
P_{TS} = Probability of Technical Success
D = Development costs
C = Commercialisation (launch & capital) costs
NPV = Net Present Value of project's future earnings (discounted to today)

Figure 11. Expected commercial value decision tree.[68]

3.2.2 Productivity Index (PI) [69]

The Productivity Index (PI) is a method where each project is given a score according to the formula presented in Figure 12 and the projects with the highest scores are selected for the project portfolio. This method has the same weaknesses as the ECV model described above.

[67] Cooper and Edgett, 1997a, pp. 19-20
[68] Cooper and Edgett, 1997a, p.20
[69] Cooper and Edgett, 1997a, pp. 20-21

$$PI = [ECV*P_{st} - R\&D]/R\&D$$

ECV = probability weighted stream of cash flows from the project, discounted to the present and assuming technical success
P_{st} = Probability of technical success
R&D = R&D expenditure remaining in the project

Figure 12. Equation for calculating the productivity index (PI).

3.2.3 Dynamic Rank Ordered List[70]

The Dynamic Rank Ordered List represents a more advanced numerical method for project prioritization. The model overcomes the limitation of relying on a single criterion to rank projects. Table 2 shows an example of a ranking system with four criteria used in one company.

Table 2. Dynamic Rank Ordered List as used by one telecommunications company.[71]

Project	IRR*PTS	NPV*PTS	SI	Ranking Score
Alpha	16.0 (2)	8.0 (2)	5 (1)	1.67 (1)
Epsilon	10.8 (4)	18.0 (1)	4 (2)	2.33 (2)
Delta	11.1 (3)	7.8 (3)	2 (4)	3.33 (3)
Omega	18.7 (1)	5.1 (4)	1 (6)	3.67 (4)
Gamma	9.0 (6)	4.5 (5)	3 (3)	4.67 (5)
Beta	10.5 (5)	1.4 (6)	2 (4)	5.00 (6)

NPV = Net Present Value
IRR = Internal Rate of Return
PTS = Probability of Technical Success as a percentage
SI = Strategic Importance of the project, scale 1-5, 5 = critically important
Ranking Score = The mean of the three rankings (IRR*PTS, NPV*PTS and SI)

In this model the projects are prioritized on all criteria simultaneously. The strengths of the model include simplicity and capability to handle several criteria concurrently. The weaknesses are that it does not consider constrained resources, it is based on unreliable financial data and it fails to consider the balance of the projects. Also, evaluating the probability of technical success is difficult and thus its value is somewhat unreliable.

3.2.4 Scoring Models

Scoring models are well-known numerical methods that allow considering multiple criteria when comparing projects. In a typical scoring approach, each criterion is evaluated on a scale, for example 1-5 or 0-10. After the evaluation, the scores are multiplied by pre-determined weightings and summed to get a project score for each

[70] Cooper and Edgett, 1997a, pp. 21-22
[71] Cooper and Edgett, 1997a, p. 21

project. When using a scoring model, the selection of criteria must be made carefully and the refinement of them normally takes several years. In the scoring model developed at Hoechst[72], the criteria have been carefully selected and worded, operationally defined and tested for validity and reliability over some years. The major classification factors at Hoechst are presented in Table 3.

Table 3. Project classification criteria used by Hoechst.

Reward (to the company). • Absolute contribution to profitability (five year cash flow) • Technological payback (the time it takes before cash flow = costs) • Time to commercial sart-up
Business strategy fit (fit with the business unit's strategy). • Congruence (how well it fits the strategy of the product line/business/company) • Impact (financial and strategic on the product line/business/company)
Strategic leverage (ability of the project to leverage company resources and skills). • Proprietary position • Platform for growth • Durability • Synergy
Probability of commercial success. • Existence of market need • Market maturity • Competitive intensity • Existence of commercial application development • Commercial assumptions • Regulatory/social/political impact
Probability of technical success. • Technical gap • Program complexity • Existence of technological skill base • Availability of people and facilities

The five major factors; reward, strategic fit, strategic leverage, probability of commercial success and probability of technical success, are divided into altogether 19 criteria. Each criterion is scored by the management in a scale of 1-10. The score for each factor is derived by calculating the average of the criteria within each factor. The final score for the whole project is calculated by adding together all the factors. The final score is used to make prioritization and go/kill decisions.

The greatest weakness of all numerical models presented above is that they fail to ensure the strategic alignment and the balance of the portfolio. However, they often provide an appropriate working method for finding the good projects.

3.3 Balancing the Portfolio

Just calculating the rankings for individual projects is not enough to make the selection. Projects are often related to each other and they represent various project types of different nature. The portfolio should be a balanced mix of different kind of projects within different timeframes and of different sizes. Visual charts are important tools for

[72] Cooper and Edgett, 1997a, p. 22

balancing the portfolio of projects. The BCG matrix (Figure 13), the GE/McKinsey matrix (Figure 10) or similar matrices (Figure 14) are examples of such visual charts.

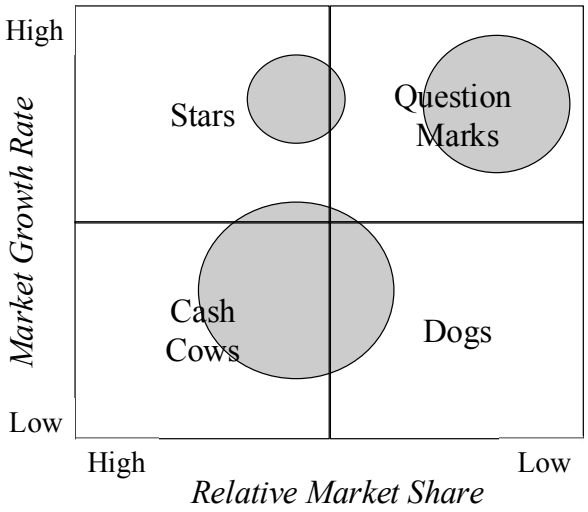


Figure 13. BCG matrix.[73]

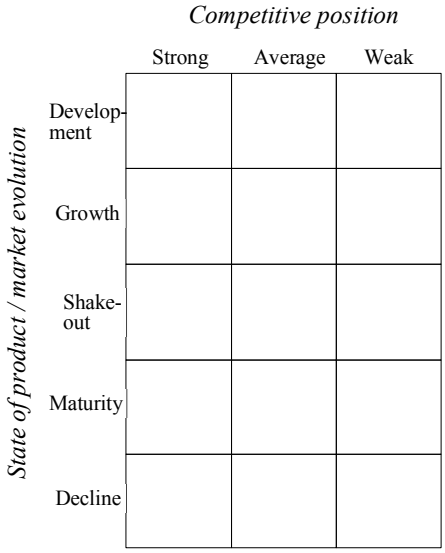


Figure 14. Product / market evolution matrix.[74]

Matrices help in finding the right balance since they offer a visual way for mapping projects into certain categories that depend on each other. The parameters on the two axes of the matrix can vary. Some examples of parameters/criteria that could be used to find the right balance are: [75] [76]

- Fit with business or company strategy.
- Inventive merit and strategic importance to the business.
- Durability of the competitive advantage.
- Reward, based on financial expectations.
- Competitive impact of technologies (base, key, pacing, and embryonic technologies).
- Probabilities of success (technical and commercial success).
- Costs to completion.
- Time to completion.
- Capital and marketing investment required to exploit.

[73] Johnson and Scholes, 1989, p.178
[74] Johnson and Scholes, 1989, p.178
[75] Stevens, 1997, p.40
[76] Cooper and Edgett, 1997a, p. 23

- Business maturity
- Technical familiarity
- Market potential and size
- Market attractiveness

In the next section, examples of matrices used in industry are presented.

3.3.1 Matrices Used in Industry

To link product development projects to company strategy, Christensen[77] suggests establishing a matrix that plots the nature of technology change against the commercial impact on the market place (Figure 15).

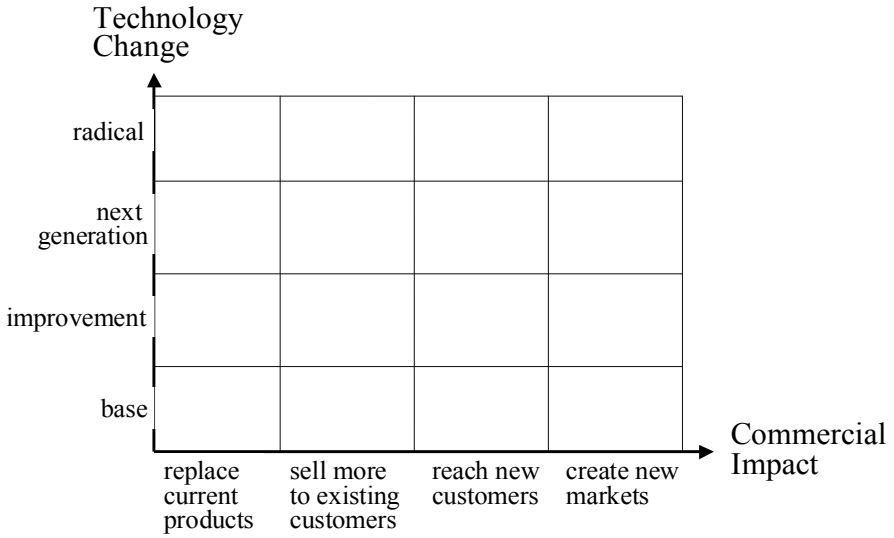


Figure 15. Linking product development project to company strategy.

The application of a matrix should start with strategy by drawing blank bubbles on the matrix that define the projects with a need to execute. The size of the bubble should represent the resource allocation needs to complete the project. Information estimates can be based on previous projects. Then, defining what the matrix will look like in the future helps in reserving the required resources and capacity in the organization.[78]

At Tektronix and Noranda, a technology/market matrix has been in use (Figure 16).[79] In the matrix, the most interesting projects can be found from the lower right corner. These projects have huge possibilities since they are known to the company but new to the whole market. The projects are mapped to the matrix as bubbles of different sizes. The

[77] Stevens, 1997, p.42
[78] Stevens, 1997, p.42
[79] Stevens, 1997, p.42

size of the bubble indicates the cost to project completion and split bubbles indicate projects that are combinations of, for example, current and new technologies.

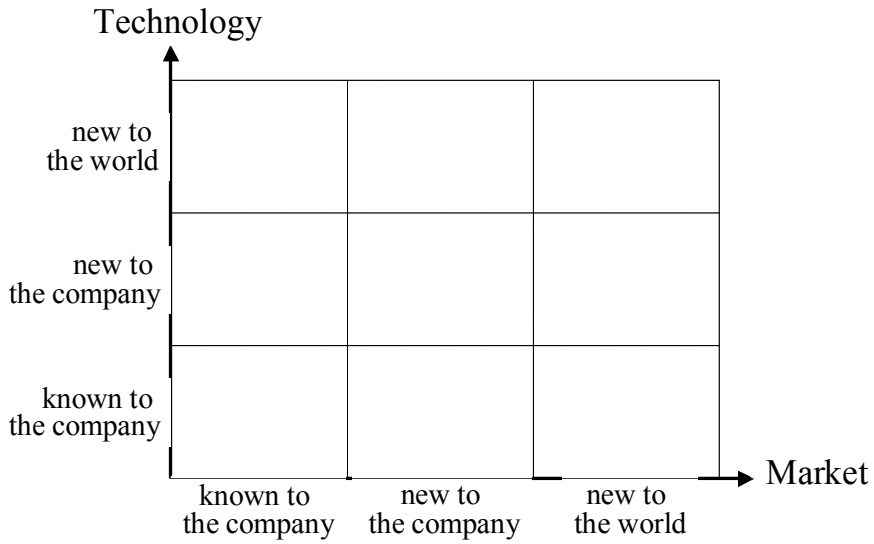


Figure 16. Tektronix and Noranda model for project mapping.

In combination with this matrix, Tektronix uses a risk/reward plot and another matrix presented in Figure 17.[80] The matrix can be easily used in quantification of key attributes: An aging and mature technology should be abandoned if the company has a week position in the market. [81]

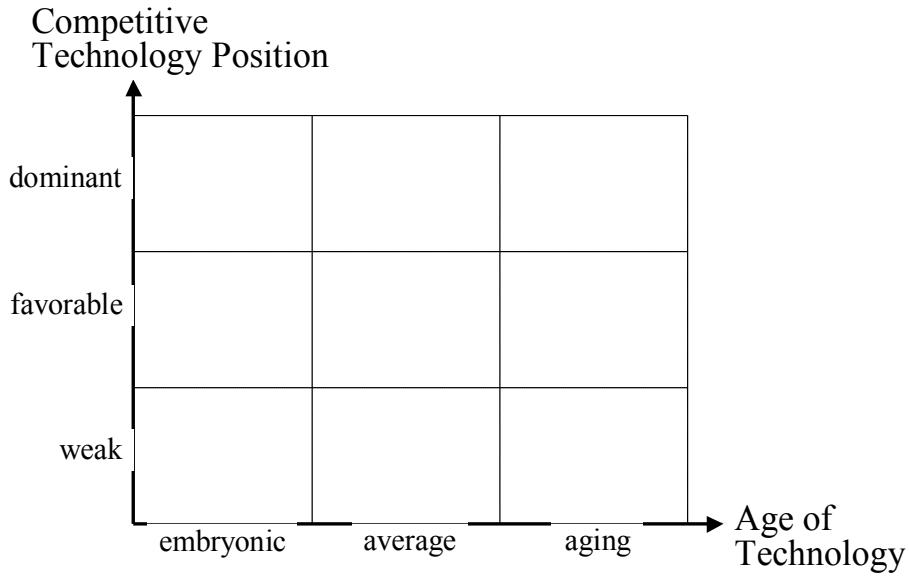


Figure 17. Tektronix's matrix.

[80] Stevens, 1997, p.42
[81] Stevens, 1997, p.42

In general, each company must define its own goals regarding different aspects, for example, technology age or market situation, and then with the help of a matrix find the projects that best meet those goals.

One of the most popular bubble models is a variant of the risk/reward diagram. In this diagram, the one axis presents the reward to the company and the other the probability of success. [82]

Companies calculate the probability of success in different ways. In some companies, the probability of success is calculated by multiplying the probability of commercial success by the probability of technical success and the reward is ranging from modest to excellent. In some other companies, the risk-adjusted NPV presents the reward and the success is the expected technical success. [83]

Figure 18 presents an example of a risk/reward type matrix. In the matrix, pearls are the potential star products/projects, oysters are long-shot projects, bread and butter projects are the small "no-brainer" projects and white elephants are the projects with lowest probability of success and reward.[84]

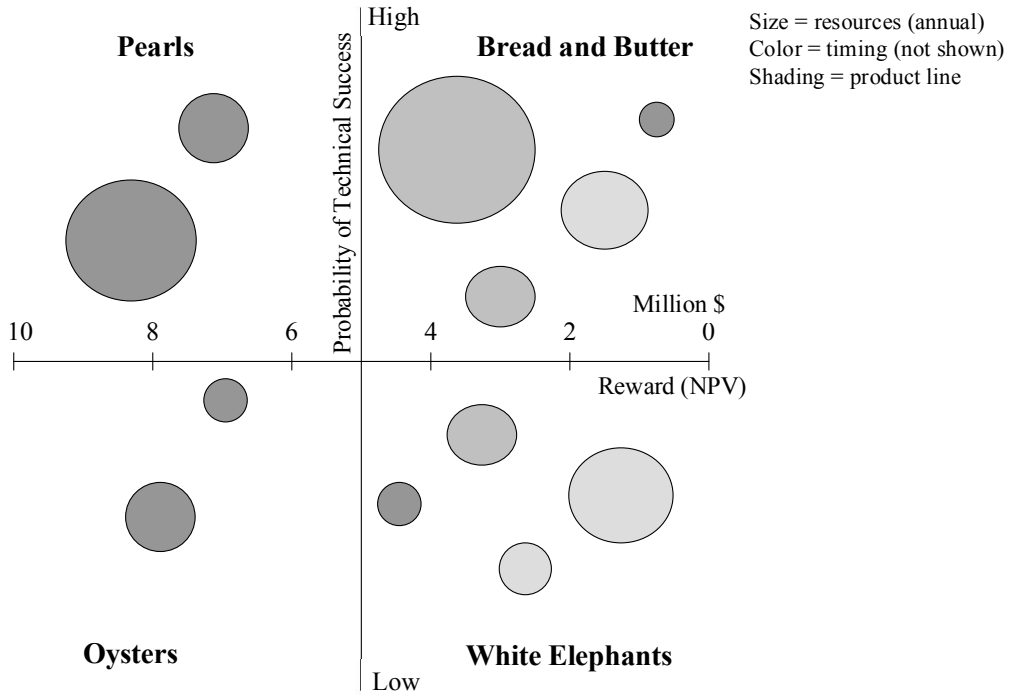


Figure 18. Bubble diagram for balancing the project portfolio by a chemical company.[85]

[82] Cooper and Edgett, 1997a, p. 23
[83] Cooper and Edgett, 1997a, p. 24
[84] Cooper and Edgett, 1997a, p. 24
[85] Cooper and Edgett, 1997a, p. 24

The advantage of the diagram (Figure 18) is that it forces the management to think about the limited number of resources; the sum of the bubble areas is constant and if one project is added, then the company should give up some other project. [86]

The other advantage of the model presented in Figure 18 is that it deals with the issue of how projects are related to each other or associated with certain pre-determined criteria by e.g. presenting the projects of the same product line with the same darkness or shading. Additionally, the model addresses the timing issue; the color of the bubble presents the timing of the project. Red indicates "imminent launch" and blue indicates "an early-stage project".[87] This model requires exact estimates of reward and probability of success, which are often difficult to get.

At 3M, the problem of not having exact estimates has been solved in the model by defining the uncertainties of NPV and technical success by applying a range determined by pessimistic and optimistic values. The model is shown in Figure 19. The bigger the bubble, the more uncertain the estimates are.

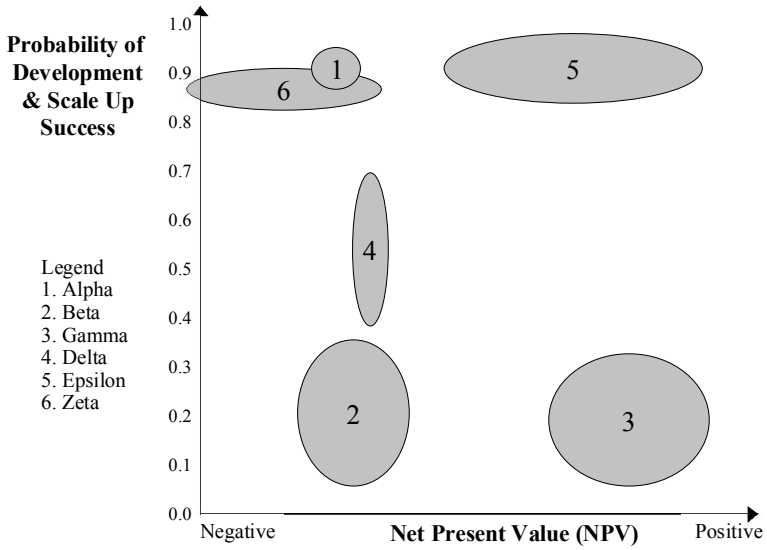


Figure 19. Bubble diagram used at 3M.[88]

At Procter and Gamble, a three-dimensional model is used. The axes of the model are NPV, time to launch and probability of commercial success. The uncertainty of the estimates used in Figure 19 can be added to this model, too. [89]

Reckitt & Colman uses a simple model based on the risk/reward idea. The model is presented in Figure 20. The axes in the model are the ease of implementation and market/concept attractiveness. The place of the small bubbles is determined with the help of a scoring model. Both axes can be created from numerous smaller criteria,

[86] Cooper and Edgett, 1997a, p. 25
[87] Cooper and Edgett, 1997a, p.25
[88] Cooper and Edgett, 1997a, p.25
[89] Cooper and Edgett, 1997a, p.25

which could include product advantage, sustainability of advantage, business-unit interest, customer interest, technical feasibility, creditability, technical capabilities, financial attractiveness, possible problems etc.[90]

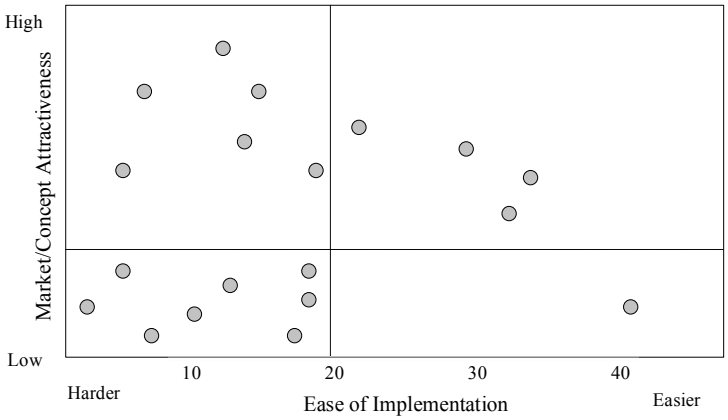


Figure 20. A simple risk-reward model used at Reckit & Colman. [91]

The projects can be evaluated against several objectives such as return, competitive position, balance, impact, timeframe and technology maturity, and thus many different diagrams can be simultaneously in use. The idea of Roussel, Saad and Erickson's Third Generation R&D is based on that idea (Figure 21)[92].

[90] Cooper and Edgett, 1997a, pp. 25-27
[91] Cooper and Edgett, 1997a, p.26
[92] Foster, 1996, p.33

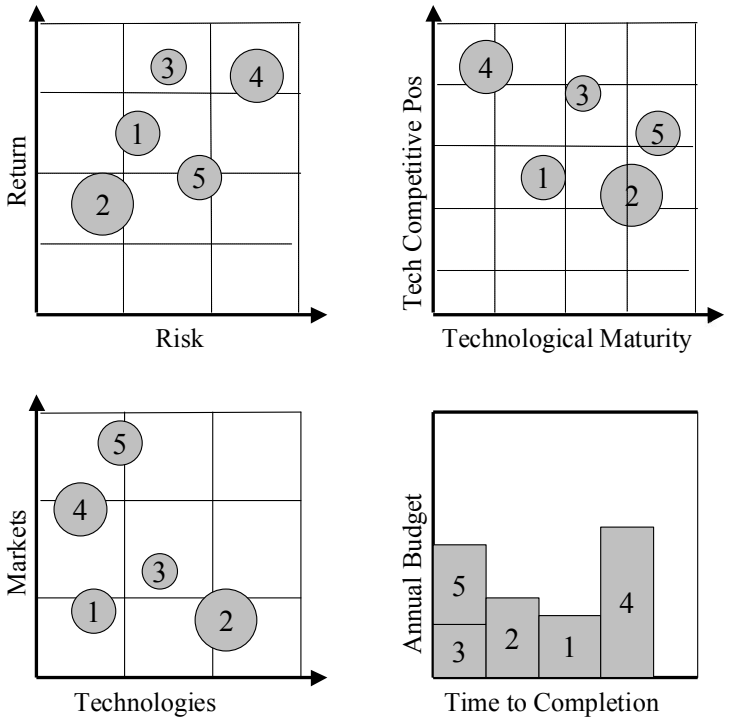


Figure 21. The Third Generation approach. [93]

3.3.2 Conclusion on the Tools for Portfolio Balancing

The different tools for balancing project portfolios presented above give good support to portfolio decision making. They offer the decision-maker a visual presentation of all the projects, their interdependencies, resource consumption and timing while also presenting, for example, their potential for technical success.

Timing considerations are of importance when making the decision on the project portfolio. It is not recommended to invest entirely on short-term or long-term projects. For example, a steady stream of new product launches is very desirable. Another timing issue to be considered is the cash flow. Both the cash-in and cash-out flows should be balanced. [94]

Another important issue to be considered in balancing the project portfolio, is the issue of project types. The portfolio should consist of new products, product renewals, product extensions, product maintenance, cost reduction and process improvements. Also markets, products and technologies should be considered when deciding on the portfolio.[95] Furthermore, projects in the different phases of the business or product life cycle should be included in the portfolio so that projects associated with mature businesses are balanced with the growth potential. [96]

[93] Foster, 1996, p.33
[94] Cooper and Edgett, 1997a, p.26
[95] Cooper and Edgett, 1997a, pp. 26-27
[96] Stevens, 1997, p.40

The advantage of bubble diagrams is their ability to visualize the situation. They often force the management to think about the limited number of resources; if the sum of the bubble areas is constrained by the resources available, then if one project is added something else must be given up.[97] The visual bubble diagram illustrations can also deal with the issue of how projects are related to each other, or associated with the company strategy, for example, in terms of the project type. A bubble diagram can also address the timing issue of projects through the color of the bubble.[98]

For making the decision, a combination of different types of matrices is often needed. This is necessary for being able to present all important issues and to make sure that one can make sense about the matrices. The use of different kinds of matrices, though, has some problems: [99]

1. Some of them require financial data, which is either unavailable or uncertain.
2. The large number of different kinds of maps makes people frustrated.
3. They are for information display, not decision models, which introduces decision-making difficulties, as they do not end up with a ranking list of projects.
4. It is not always clear what the right balance is.
5. People do not know how to use them.

Finally, it is important that the parameters of the two axes of the matrix are based on the business objectives of the company. One methodology to derive appropriate axis dimensions is to put the objectives on the two axes and then deriving the right measures that reflect the pre-determined objectives.

4 Implementing Project Portfolio Management

4.1 Portfolio Decisions

4.1.1 When to Make the Evaluation and the Portfolio Decisions?

Even thought portfolio management needs to be a continuous process, it does not mean that one should perform evaluation after evaluation for each project. The evaluation should not be constant but rather concentrate on certain milestones in the project. These points are in some literature called Go/Kill decision points[100] due to their nature. The frequency of these decision points must be made according to the project type and size. The number should neither be too high to avoid the management frustration nor too low to ensure that the portfolio is updated frequently enough.

[97] Cooper and Edgett, 1997a, p.25
[98] Cooper and Edgett, 1997a, p.26
[99] Cooper and Edgett, 1997a, p.27
[100] Cooper et al., 1997b, p.44

When using numerical tools, projects are usually evaluated independently of each other. This evaluation is only a small part of portfolio management since portfolio management is also about comparing the existing projects between each other and trying to find a need for a new project. To make this comparison between projects, the results from the evaluations can be used. The comparison should be made periodically and it should be integrated and harmonized with the milestone evaluations[101].

If company's strategy changes substantially between the evaluations, all projects should be re-evaluated regardless of their stage.

4.1.2 Can a Certain Project Be Put on Hold?

Luehrman[102] has presented an interesting view to portfolio management. According to him, managing a portfolio of strategic options, in other words projects, is like growing a garden of tomatoes. If the tomatoes are ripe and perfect or totally rotten, it easy to make the decision, but if they are something in between, with varying prospects, the decision is a lot more difficult.

Active gardeners are not only making decisions; they are monitoring the options and looking ways to influence the underlying variables that determine the value of the option and, ultimately, the outcomes. Option pricing can help estimate the value of the entire year's crop before the season actually ends.

If a project is in a state that it neither seems very interesting nor uninteresting, it might be wise to wait, but not for too long, to make the decision. Figure 22 presents a model of how to locate a project and how to determine whether to invest into it now, maybe, or never. In the figure, the value-to-cost ratio is the estimated return of the project divided by the expenditure required to build or buy it and volatility describes how much the situation can change before the decision must be made.

[101] Cooper et al., 1997b, p.47
[102] Luehrman, 1998, p.90

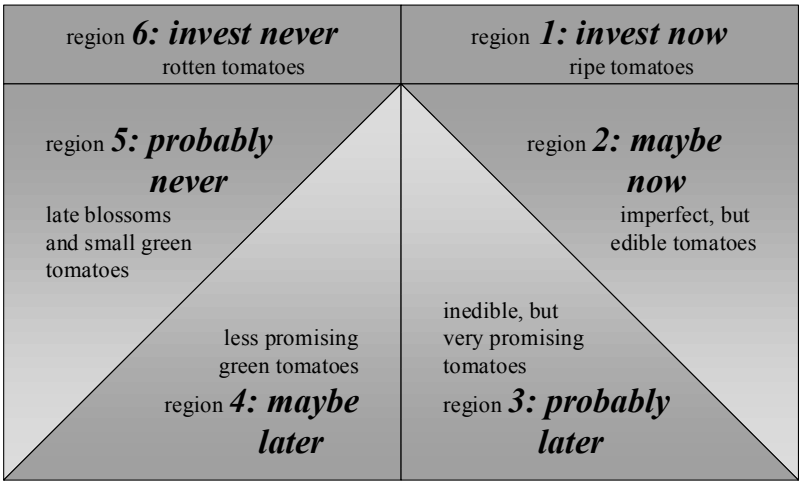


Figure 22. Tomato garden model for mapping options. [103]

When time passes, projects can move in the model. In general, projects tend to move to left and up since the time for the decision deadline and the benefits of the project diminish. With the help of good luck and active management, however, they can move to the opposite direction. Position in the matrix can be also influenced by the threats described in Porter's Five Forces Model[104]: new entrants, suppliers, customers, substitutes or competitors.

4.2 Which Projects to Compare?

It is important to take along all the projects into the portfolio decision process[105]. These projects could include not only the new product development projects but also,for example, the process improvement, cost reduction, basic research, product improvement projects, and external delivery projects or their initiatives. This is justified since all the projects inside a company compete for the same and often scarce monetary and human resources.

To alleviate the comparison between different kinds of projects, some companies use a model where the management can first decide what kind of projects the company should have and assign them certain resources[106]. The resources could then be divided within these project groups. This approach would be analogous to that of the strategic buckets framework discussed earlier. However, this system may have disadvantages: what if all the process improvement projects are performing badly[107]? Should also projects with low performance be given resources in any case due to the general rule that the company givesfor example 25% of its resources to process improvement projects? The message behind this argument is the criticism that each project should be evaluated

[103] Luehrman, 1998, p.93
[104] Luehrman, 1998, p.95
[105] Cooper et al., 1997b, p.48
[106] Cooper et al., 1997b, p.48
[107] Cooper et al., 1997b, p.49

against its merits and not chosen because it is of the right type, even though having a balanced portfolio is important.

4.3 Are the Models Enough?

No matter how well the models used in decision-making are planned a human interference plays a significant role in project portfolio management. There are so many different liaisons between the projects that they simply cannot be modeled to reflect the actual decision making situation in an appropriate manner. These liaisons might include, for example, resource sharing, performance targets, commercial and market interactions and technical risks[108]. The effects of these interactions are both difficult to estimate and impossible to implement in the models. And even if they could be implemented, the models would become so complex that no one would be able to use them. So, in the end, the individuals in the organization must be tightly integrated into the decision-making process between the projects. The appropriate role of models is to facilitate this process. The participation of the management and other individuals in the organization to the decision-making process also ensures that the implementation of the decisions is frictionless and effective.

4.4 Between Portfolio Decisions

When the portfolio and resource allocation have been agreed on, what if a new very promising project appears? Should the new project be put on hold for a while, should it be given some resources from the already accepted projects or should the whole portfolio management process with all relevant considerations be gone through?

The theoretically sound action in this situation is to make again all the comparisons between all the projects. However, if that were done each time a new promising project initiative appears, companies would only be comparing their projects and not managing them and therefore this alternative is not recommendable. The other two alternative actions have both advantages and disadvantages and both of them are actually used in the industry[109]. The alternatives are discussed in the following.

In some companies when a new project appears it is given resources from the other projects. This model has been argued to be good since it gives the management certain flexibility between the portfolio comparisons[110]. This is not, however, always appreciated among the employees since it slows down the work in the already existing teams. Another disadvantage is that if there are numerous changes between the portfolio decisions, the follow up becomes very difficult and nobody really knows what is happening and where, and what are the priorities in order to prioritize the

[108] Howell III et al., 1998, p.54
[109] Cooper et al., 1997b, p. 47
[110] Cooper et al., 1997b, p. 47

accomplishments in important projects. Furthermore, borrowing resources from existing projects without an early notice may lead to an ineffective project culture due to the fact that project leaders build hidden reserves in the budgets to ensure that they can finish they project in time even if they are required to lend their resources to other projects.

Some other companies believe that the resources should be fixed and the decisions respected for the sake of continuity and morale. The main idea is that the project teams should not be broken up constantly even thought allowing certain flexibility to the management would be very recommended. Moving the resources around from one project to another is also waste of time and resources. Moreover, if one always moved resources from the older projects to the new and exiting ones, no project would ever be finished.

In my opinion the latter option is more desirable even thought the flexibility in high level managerial decisions should be fostered. In my experience, if people are continuously moved from one project to another, they lose the sense of belonging to somewhere and their working efficiency decreases. However, some businesses with very short projects are used to change teams quite frequently. The first model could be appropriate for the employees of such businesses. If using the more flexible model, one should, however, make sure that the control of changes is put in place so that the control on business is not lost. Also, if the projects were originally carefully chosen, it should not very often be necessary to kill existing projects. Therefore careful selection and analysis of project initiatives is of great importance.

4.5 Obstacles in Implementing Portfolio Management

When starting to implement project portfolio management, there are many obstacles and problems a company might face. Some of the problems are typical cultural change resistance problems and others may be normal problems faced by all companies business regardless of their management methods. Typical problems include:[111] [112]

- Too proud or stubborn technical community to give up projects.
- Resources applied to the project hidden in the expenditures of another project.
- Projects and/or portfolio do not reflect the company strategy.
- Poor quality portfolios.
- Resources, especially human resources, are too scarce.

Most problems that companies face when starting to implement project portfolio management are not relevant as portfolio management matures and the problems are solved as they appear when applying portfolio management.

[111] Cooper and Edgett, 1997a, p.27

In addition to avoiding the typical problems in companies presented above, successful portfolio management requires avoiding falling in love with the company's own technology and expertise or always selecting the "easy and fast" projects or the ones with most charming or persuasive presenter. Instead, a company should emphasize developing good project selection or killing criteria, good communication and making sure changes in strategy are reflected to projects. [113]

5 Project Portfolio Management Support Functions

The previous chapters discussed frameworks and tools for project portfolio management, and project portfolio management implementation. This chapter discusses the important areas of linking strategy to the portfolio and projects, allocating resources to projects, and to some extent organizing the supporting activities of project portfolio management.

5.1 Projects, Portfolio and Strategy

The mission, vision and the strategy of the company are made operational through the decisions on where to spend money. The resources must be allocated to those projects that support the company strategy.[114]

5.1.1 Linking Portfolio to Strategy

Strategy is everything. Without a sound strategy, portfolio management cannot bring value to the company. Creating a strategy, however, is not enough: a link between the strategy and portfolio management is needed.

In the study by Cooper et al.[115], two general approaches were observed in companies to achieve strategic alignment: building strategic criteria into project selection tools and using top-down strategy models. The first is about using numerous strategic criteria in go/kill and prioritization decisions and the second about making a strategic cost breakdown.

Strategy can be built into the models. In industry, scoring models are found to be good in this since they enable both maximizing the value of the portfolio and ensuring the strategic fit. The maximal strategic fit was derived by posing different strategic questions. This is done among others at Hoechst[116] (Table 3) and at Reckitt & Colman [117], where each project even before progressing to the scoring model (Figure 20) must

[112] Stevens, 1997, p.43
[113] Stevens, 1997, p.43
[114] Cooper et al., 1997b, p. 43-46
[115] Cooper et al., 1997b, p. 44
[116] Cooper and Edgett, 1997a, p.22
[117] Cooper and Edgett, 1997a, p.26

pass the list of "must meet" criteria which test the strategic fit of the project. If the fit is not found, the project is rejected without further evaluation. The strategic fit is also evaluated in the scoring model.

The top-down strategic approaches differ from scoring models in the respect that they are only designed for ensuring the strategic fit of the portfolio. They examine if the money spent in projects mirrors the business's strategy. There are at least two variations of this model: Strategic Buckets Model and StratPlan. Both were presented in section 3.1.3.

5.1.2 Getting Strategy to Projects

Getting the business's strategy to the projects is difficult. Project managers often tend to focus on successfully completing their projects without thinking whether the project is aligned with strategy or not. In fact, they do not even always know the strategy or the objectives. This makes estimating projects difficult. Another problem is raised due to the multiple possible interpretations of the characteristics of a successful project. The ambiguity also enables deliberately created biases: managers might want to make their projects seem better than they really are to ensure their appreciation or bonuses. To promote a positive climate for aligning strategy and projects, the following basic principles should be followed[118]:

- Common vocabulary for strategy and projects
- Strong links between projects and strategy
- A clear and understandable method for project selection / prioritization
- Effective management and sourcing

In addition to the principles presented above, good communication is important. [119]

5.2 Project Management in the Portfolio

One might easily conclude that, inside the portfolio, the procedures in each project should be similar. Advantages of common procedures are said to include things like comparable progress reports, consistent calculations of resources enabling resource sharing and free movement of people between projects due to easily adaptable management methods.[120] This, however, is based on the assumption that the projects in the portfolio are homogenous.

[118] Foster, 1996, p.34
[119] Verish, 1998, p.43
[120] Payne and Turner, 1999, p.55

Payne and Turner[121] discovered that having common procedures has also disadvantages. According to them, projects may even succeed better if project managers are allowed to create their own procedures for each project by adopting the procedures to project type, size and skills.

The findings show that in projects of different sizes the main management emphasis must be on different issues. The smaller the project, the more emphasis must be laid on the resource prioritization and the larger the project, the more emphasis is on coordinating different activities.

Turner[122] discusses the differences of how well methods and goals are defined in different types of projects in a company, and based on the different nature of the project types, the suggestion is that different project management methodologies should be applied for their management.

Since exactly common methods cannot be used in all projects, it is recommendable to allow certain freedom on the ways projects are managed, especially on the day-to-day management level. The freedom should not, however, be too large, to enable certain comparison of results. The same type of projects should be managed quite similarly.

5.3 Resource Allocation Management

Resource allocation must be interconnected with strategy. The strategy is not effective if resource allocation is not implemented according to the strategic directions. [123]

According to Hendriks, Voeten and Kroep,[124] the process of resource allocation can be divided into five elements: long term resource allocation, medium term resource allocation, short term resource allocation, links, and feedback.

Long term resource allocation is based on the strategic objectives of the company, as presented in Figure 7. The five year plan is made yearly and its output is a budget per capability.

Medium term rough cut resource allocation is done quarterly and its main tasks are to check the overall status and situation of the project and to decide on the decision rules followed by the group leaders when deciding on short term resource allocation. If the project portfolio and/or company strategy have changed during the previous three months, some adjustments might be made on the original resource allocation plan, and thus, the project portfolio might change. The planning horizon of the medium term plan is one year.

[121] Payne and Turner, 1999, pp.55-57
[122] Turner, 1999, pp. 25-27
[123] Cooper et al., 1997b, p.47
[124] Hendriks et al., 1999, pp. 182-184

Short-term resource allocation is linked to the day-to-day planning of individual resources for the following weeks. It is done every two weeks and its planning horizon is about six weeks.

The long, medium and short-term resource allocation processes each have their own tasks but they are also interconnected. The connections are called links and they give information that is needed in decision making. Both the links and the long, medium and short-term allocation processes are presented in Figure 23.

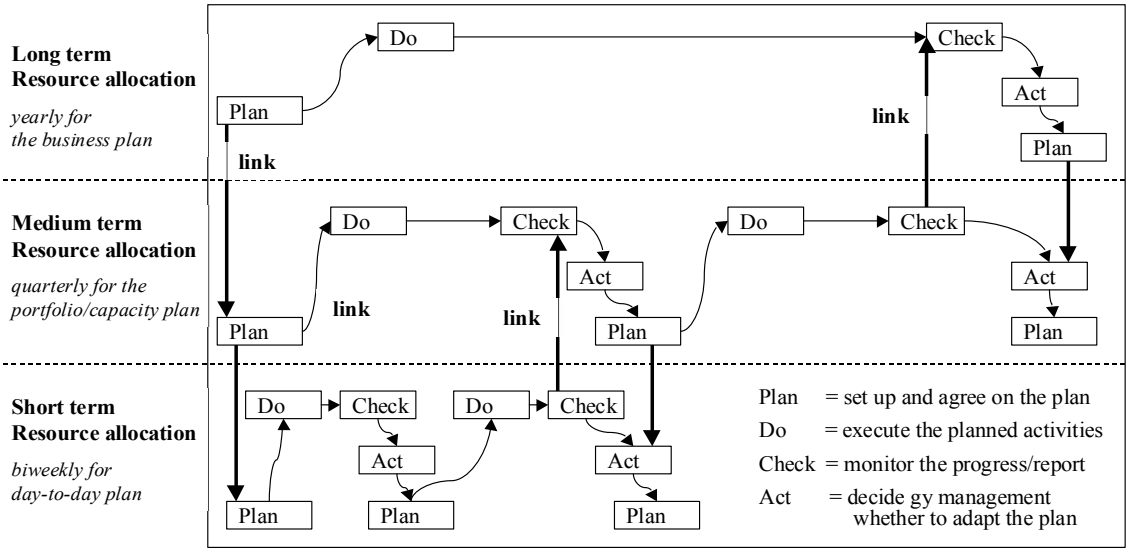


Figure 23. Links between various resource allocation processes.[125]

Resource allocation is a means to limit the number of projects in the portfolio. This is why the creditability of resource estimates is important. The interested reader is advised to consult Van Arnum[126] for criteria for ensuring creditability of the resource estimates.

5.4 Project Office

Project offices are organisms established for managing a collection of projects. The project office concept is partly related to portfolio management. However, the tasks of a typical project office do not often include considerations for common objectives, strategy and portfolio balance.[127] In some very recent literature, however, strategy has been partly combined to project office thinking.[128]

Even if project office thinking does not correspond to portfolio management, it cannot be disregarded, as its tasks typically include serving as a link between the company management and the project management, gathering and organizing information from

[125] Hendriks et al., 1999, p.184
[126] Van Arnum, 1998, p.15
[127] Artto et al, 1999
[128] Jansson, 1999, p.245

projects, and organizing company-wide resource allocation and other support for projects [129].

6 Conclusions – Suggestions for Process and Methods

This section will conclude the article by summarizing the project portfolio management process and methods that can be recommended as appropriate for project portfolio management.

6.1 Project Portfolio Decision Process

The frameworks presented in the beginning of this study and the analysis above can be combined to the model of the project portfolio management process presented in Figure 24. The model is mainly based on the framework developed by Archer and Ghasemzadeh[130] (Figure 7).

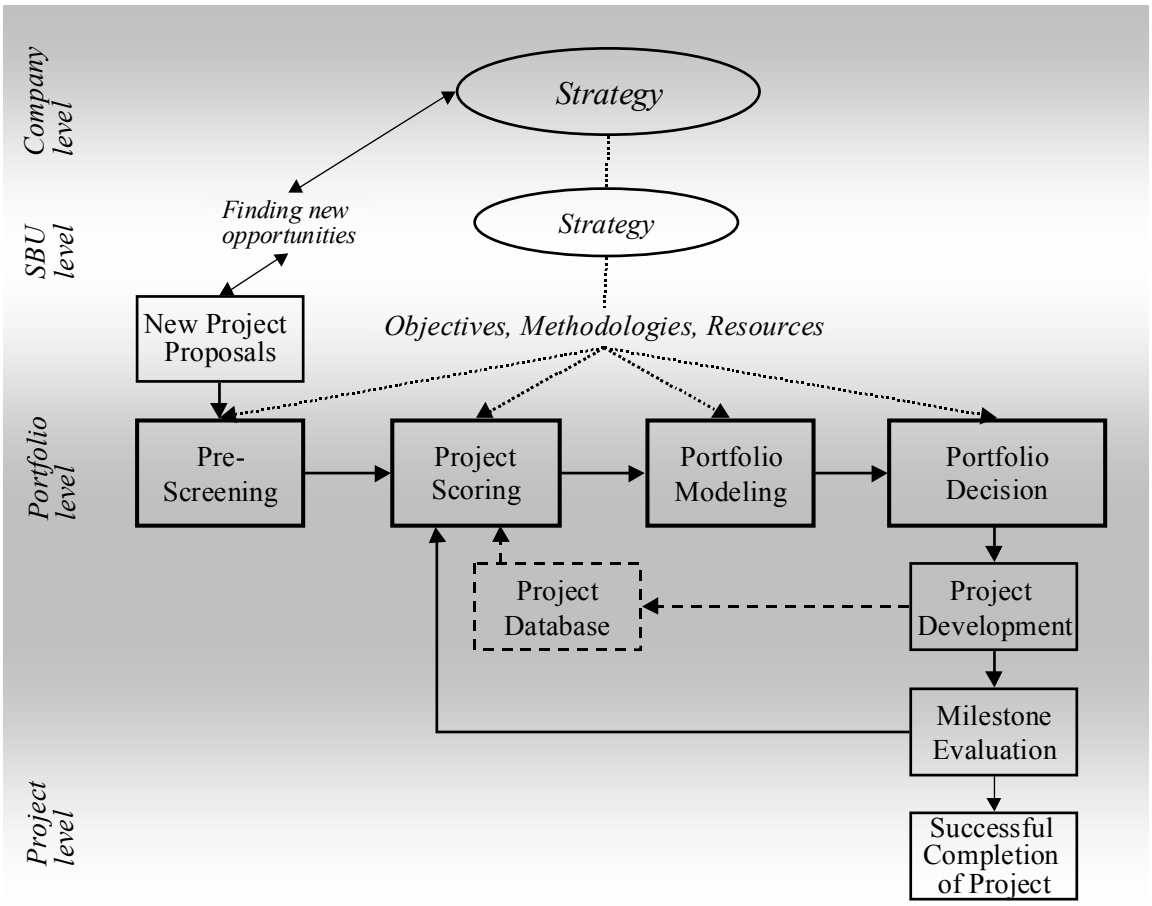


Figure 24. Project portfolio management process.

[129] Melymuka, 1999, pp.44-45

[130] Archer and Ghasemzadeh, 1999, p.211

The model consists of four different layers, between which there are no exact borders. I have chosen to present the levels since I consider as very important to understand that portfolio management is a process that occurs in every level of the organization. If one of the levels is not taking care of its tasks, portfolio management is not complete. The levels from bottom up are project level, portfolio level, strategic business unit (SBU) level and company level. Especially the limit between SBU and portfolio levels is very vacillating, if it even exists. In many cases, depending on the organization, the business unit level and the portfolio level can be the same.

The input for the whole process is company strategy. Each business unit concentrates on certain competence areas and has its own strategy that is based on the company strategy. Company strategy kind of flows through the business units to the projects and acts as the input for selecting projects for the portfolio.

The process is gone through a couple of times a year depending on the size and the number of projects in the company. Each time, new proposals and old projects are evaluated and ranked. This ranking should not only be done with existing projects but also with potential project initiatives that might be starting within some months. Furthermore, it is important for the organization to concentrate on finding new opportunities that could be formulated in the form of new project initiatives. There is a need for a vision of the future.

Each project that has some potential for being approved is given scores on different areas of importance, which are then weighted. The criteria used depend on the company as well as on the type of projects in the company. The criteria should take into account at least competition, customers, own competencies and suppliers' competencies, risks and potential for success, reward and resources of different types. Developing a good model takes years and it should be continually improved as the company and its business changes.

After giving each project a score, the projects are modeled using different matrices. The axes on matrices can include, for example, the issues mentioned above. Colors, different bubble sizes and color brightness should be used to make the matrices as rich in content as possible. When selecting the matrices, it should be remembered not to choose too many matrices so the selection process does not come too difficult. A trade-off between the amount of information and the simplicity of the decision process must be made.

Based on the models, the management together or with the help of project managers makes the decision on the portfolio. In the decision, interdependencies of projects should be carefully considered, for example, by mapping the projects into groups that are interconnected. The projects should also be classified as primary projects and supportive projects. If a primary project is abandoned, the supportive projects may become unnecessary if they are not linked to other projects.

After the decision, projects in the portfolio are further developed and the key issues in each project are made clear to everyone who belongs to the project or serves as its stakeholder. It is important that the project personnel understands the strategy and the fundamental reasons for having the project and agrees to follow the strategy.

Each project is evaluated carefully on each milestone. The number and place of milestones depend on the project size and type. The information gathered for the milestone evaluations is used in making portfolio decisions. Projects can also be abandoned between the project portfolio selection processes if the situation with the project has radically changed. If the situation in the whole market changes, the entire portfolio selection process should be carried through.

The information in the model does not only go from top to bottom (top-down) but it also goes to the opposite direction (bottom-up). The first major decision about the strategy should be done in co-ordination with all other levels, since the upper level needs to understand the capabilities of the company.

My suggestion for the project portfolio management process (Figure 24) has three major differences when compared to the framework of Archer and Ghasemzadeh (Figure 7). First, the active search for new project ideas has been added to the model to emphasize the importance of identifying new opportunities. Their feasibility must then be considered by simultaneously comparing them to the current ongoing projects. If the opportunity that the new initiative carries is viable, a decision could be made to start a new project with the expense of another project that is strategically less important. Second, another modification is a slight modification in the major steps on portfolio level. The names of the steps of the process have also been changed to better describe the actual task of the step. The figure presents the process of Archer and Ghasemzadeh in a simplified form.

Third, in the model, the importance of strategy during the whole process is emphasized. This is done by describing the strategy as an issue that influences all steps on the portfolio level through chosen methodologies and their characteristics and resource allocation in the form of clearly defined objectives.

6.2 Implementing Project Portfolio Management

The methods for project portfolio management presented in this study all have their strengths and weaknesses and company specific features and thus cannot be directly used by other companies. A company using portfolio management should always create its own models to ensure the right balance of projects. One of the most important things in portfolio management is that the management understands its value and that there is someone responsible for it. The one responsible should have a good understanding of strategy and understand what kind of projects the company needs to have to be able to reach the strategic objectives of the company. A portfolio management framework

should always be used as a flexible guideline that should not be followed in too detail: It should neither be let hinder managerial work nor destroy innovation.

Portfolio management is a continuous process. The methods used should be actively improved as the understanding of the strategy and portfolio management improves.

When starting portfolio management, it might be useful to start with a quite simple model and then proceed to a more detailed one,for example, by combining different models taking into account the issues of value maximization, portfolio balance and strategic alignment. When further developing the model, one should, however, carry in mind that one simply cannot include everything into the model. Otherwise no one understands the model and it becomes impossible to use. The right balance between information included and left out must be found.

The portfolio management process is just one of the numerous processes in a company. The ones most tightly connected to portfolio management include the company's and the business unit's planning and strategy creation processes, budgeting, the project management process and the new product process. The processes are interconnected mostly through people and information. The information flows back and forth between processes. Direct and indirect feedback loops and iterative planning loops between the processes are important.

7 References

Archer N., Ghasemzadeh F., 1998. A decision support system for project portfolio selection. International Journal of Technology Management, Vol. 16, No. 1-3, pp. 105-114.

Archer N., Ghasemzadeh F., 1999. An integrated framework for project portfolio selection. International Journal of Project Management, Vol. 17, No. 4, pp. 207-216.

Artto K., 2000. Managing Business by Projects - The Basics of Project Management from a New Perspective, Part I. Espoo, Finland, 125 p.

Artto K., Arenius M., 1999. A Framework for Organizational and Individual Project Management Performance. 15th IPMA World Congress on Project Management, 20-25 May 2000, London, England.

Artto K., Kähkönen K., Koskinen K. (Eds.), 1999. Managing Business by Projects, Volume 1 & 2. Helsinki, Finland, 1298 p.

Cooper R., Edgett S., 1997. Portfolio management in new product development: Lessons from the leaders I. Research Technology Management, Vol. 40, No. 5, pp. 16-28.

Cooper R., Edgett S., Kleinschmidt E., 1997. Portfolio management in new product development: Lessons from the leaders II. Research Technology Management, Vol. 40, No. 6, pp. 43-52.

Dobson M., 1999. The Jugglers Guide to Managing multiple Projects. Project Management Institute, Pennsylvania, USA, 134 p.

Elton J., Roe J., 1998. Bringing Discipline to Project Management. Harvard Business Review, March-April.

Foster T., 1996. Making R&D more effective at Westinghouse. Research Technology Management, Vol. 39, No. 1, pp. 31-37.

Hendriks M., Voeten B., Kroep L., 1999. Human resource allocation in a multi-project environment. International Journal of Project Management, Vol. 17, No. 3, pp. 181-188.

Hitt M., Ireland R., Hoskisson R., 1999. Strategic Management: Competitiveness and Globalization, Third Edition. South-Western College Publishing, USA, Ohio, 502 p.

Howell III J., Andersson R., Boulanger A., Bentz B., 1998. Managing E&P assets from a portfolio perspective. Oil & Gas Journal, Vol. 96, Issue 48, pp. 54-57.

Hutchinson A., 1998. Use portfolio and project mgm't to get off the triage treadmill. Internetweek, No. 729, pp. 29-30.

Jansson T., 1999. Management of projects with PROPS, Ericsson's Model for Project Management. In: Artto K., Kähkönen K., Koskinen K., (Eds.), Managing Business by Projects, Volume 1. Helsinki, Finland, pp. 236-252.

Johnson G., Scholes K., 1989. Exploring corporate strategy: Text and cases. Prentice Hall, Hertfordshire, United Kingdom, 575 p.

Luehrman T., 1998. Strategy as a portfolio of real options. Harvard Business Review, Vol. 76, No. 5, pp. 89-99.

Melymuka K., 1999. Project office: A route to better performance. Computerworld, Vol. 33, No. 31, pp. 44-45.

Michelsen T., Schmidt M., 1999. A Match between the Project Control System and the Organisation. In: Artto K., Kähkönen K., Koskinen K., (Eds.), Managing Business by Projects, Volume 2. Helsinki, Finland, pp. 742-754.

Payne J., Turner J., 1999. Company-wide project management: the planning and control of programmes of projects of different type. International Journal of Project Management, Vol. 17, No. 1, pp. 55-59.

Ringuest J., Graves S., 1999. Formulating R&D portfolios that account for risk. Research Technology Management, Vol. 42, No. 6, pp. 40-43.

Spradlin C., Kutoloski D., 1999. Action-oriented portfolio management. Research Technology Management, Vol. 42, No. 2, pp. 26-32.

Stevens T., 1997. Balancing act. Industry Week, Vol. 246, No. 6, pp. 40-43.

Turner J., 1999. The handbook of project-based management, Second edition. McGraw-Hill Publishing Company, England, 529 p.

Turner J., Keegan A., 1999. The Management of Operations in the Project-Based Organization. In: Artto K., Kähkönen K., Koskinen K., (Eds.), Managing Business by Projects, Volume 1. Helsinki, Finland, pp. 57-85.

Van Arnum P., 1998. Drug makers look to new strategies in portfolio management. Chemical Market Report, Vol. 254, No. 21, pp. 14-15.

Verish J., 1998. Program management tasks and tools. Institute of Transportation Engineers, Vol. 68, No. 12, pp. 40-44.

Välimäki J., 14.10.1999, Workshop: Development Project Management and Managing Project Portfolios in Business Context.