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A Framework for supporting the alignment of IT Project Portfolios with Long-Term Strategies based on BSC's and Risk Management

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Abstract

Current approaches to Project Portfolio Management analysis (PPM) focus on optimizing economic short-term goals of companies – unfortunately the IT sector is not an exception. This is driven by expectations of shareholders who aim at fast gains for their financial investments. In their analysis they look for promising figures represented in key performance indicators (KPIs) such as the Net Present Value (NPV) or the Internal Rate of Return (IRR).

In the long run companies do however need to focus on the implementation of their long-term goals which are often referred to as their strategy. Yet these are frequently in contradiction to the short-term goals because investments are needed to strategically build up new products and markets. The strategy of a company can be represented in the implementation of various different methodologies, whereby the method of Balanced Scorecards (BSCs) by Robert S. Kaplan and David P. Norton has been proven to be among the most effective.

BSCs optimize the processing of the company to achieve its strategic goals and thereby implicitly focus on the company's operations. Especially concerning the measures of the process perspective this becomes transparent. Changes in such an environment naturally cannot be achieved by summing up small alterations but require projects. This brings up questions as to how these projects can be aligned with a BSC in a way that they fully support it.

This thesis describes a novel framework for selecting, planning and controlling project portfolios by using the BSC methodology, perceptions and methods from the Earned Value Method (EVM) and quantification rules from Risk Management. The criteria for the selection of projects is their long-term contribution to the company's success, not only the attainment of short term financial goals.

The contribution of projects to the α-factors of a BSC are estimated in addition to the assessment of the schedule and cost that are retained from the traditional PPM framework. Costs are considered to be constraining factors – the leading factors being relevant for the selection and the development of the portfolio are the beneficial factors in terms of their contribution to the achievement of long-term goals.

During the planning phase of such a project portfolio the rough estimates from the initial phase onward are broken down into details in order to map out not only the final achievements but also to plan the development of the benefits over time. This enables the project portfolio management to recognize deviations very early on and enables the correction of inaccurate decisions.

The monitoring and controlling of the project portfolio does not end by finishing the projects within the portfolio but ends with the observation period in which the projects in the portfolio have to realize their benefits. This thesis develops KPIs to show the deviations between the expected and the realized benefits. It also describes the interpretation of the KPIs presented.

The thesis closes with a proof of concept (POC) prototype applying the methodologies and tools developed with data taken from a real-life IT environment of an international bank. The algorithms presented have been implemented in a web-application to support the processing of large scale data and to test the usability of the approach developed. The POC demonstration describes the initial situation of the portfolio as well as the development over time. The snapshots chosen focus on the difference between the actions taken in real-life and the ones that should have been taken following the methodologies presented in this thesis.

Given the background of the author and the research focus of the Faculty of Computer Science, the thesis was developed around IT project portfolios and the achieved results were also tested and discussed in this context. An extension to Project Portfolio Management in general is obviously interesting, but is not covered in this thesis.

Ehrenwörtliche Erklärung

Hiermit versichere ich, die vorliegende Dissertation ohne Hilfe Dritter und nur mit den angegebenen Quellen und Hilfsmitteln angefertigt zu haben. Alle Stellen, die den Quellen entnommen wurden, sind als solche kenntlich gemacht worden. Diese Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.

I hereby confirm and ensure that I have written this thesis on my own. I have only used the declared sources and assistances, and did not use any additional or prohibited help. Further, I have not submitted this thesis before, neither in Austria, nor in any other country as an exam paper or for any academic degree award.

Wien, den 6. Mai 2009

Markus Brandstätter

Motivation

The highest achievable goal for project managers is implementing all projects adhering to the constraints delimited by the magical triangle: finishing in time, on budget and on quality. At this point in time the project managers do not care about the relevance of a project for achieving strategic goals – this is the business of higher management.

For about ten years I have been able to collect relevant experience in project management by working for companies such as Honda, IBM and Raiffeisen International. I have learned several very beneficial methodologies and have been trained in using various useful techniques. All of these had one thing in common: improving the methodology of my work. Many questions have been raised during my working experience as well, which can be summarized as follows: is it more important to do things right or to do the right things?

For me it is now obvious that the ultimate goal must bei to do the right things right. That is why I began thinking about how topics in the business I am working in could be restructured to achieve higher goals. These ideas have led to this thesis.

There have been many people supporting me in this effort – I would like to mention the most important ones in the chronological order in which I met them, and say a few words how they influenced me.

My grandfather Ferdinand Sommer was probably the one placing the fundamentals when he taught me to listen to people carefully and question things that seemed dubious to me.

Wolfgang Königstedt explained to me what IT is about and showed me the basics of application development. It is to his credit that I received the

opportunity to practice and enhance my skills in the environment of Honda.

More or less at the same time I met Mag. Günter Suda, who is one of the most respected and, at the same time, challenging discussion partners. He contributed to this thesis far more than he might be aware of by just showing me that m thoughts were sometimes more complex than necessary.

Dkfm. Erwin Risch is a former colleague and, meanwhile, close friend who helped me quite a bit with his experience. He was the one who helped me to get a job at IBM. As my mentor there, he introduced me to the discipline of IT Project Management.

At the University of Vienna I met Univ.-Prof. Dipl.-Ing. Dr. Dr. Gerald Quirchmayr who supported me in extending my basic skills on a stable scientific basis. Over the years – and especially during the time of preparing my thesis – he challenged me in very valuable discussions and showed me that the difficulties are often hidden in details. Solving problems is the basis for solid scientific work. Here I would also like to thank Univ.-Prof. Dr. Dimitris Karagiannis who, despite being very busy, agreed to accept the role of the second reviewer of my thesis and gave me very valuable input regarding the core chapters of this thesis.

In the recent years I also met Dipl.-Ing. Markus Kratochvil and Matthias Zacharnik who contributed in very valuable discussions on the topic of Project Portfolio Management, Process- and Quality Management.

Mrs. Petra Jacobsen deserves special thanks. She checked my English script for readability and supported me by providing many suggestions on how to reformulate sections of my thesis. Through her I gained a better understanding of English.

It is, of course, important to mention my mother and my grandmother, who always believed in me and supported the idea of me writing this thesis. Together with my father, my step-mother and many other friends they all helped me simply by accepting that my time for them was, for the duration of my thesis-writing, quite limited.

For all this help provided and the support given I would like to dedicate this thesis to all the persons mentioned above and would like to thank all of them for helping me through this challenging time.

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1

Introduction

1.1 Focus, goals and research approach

This section defines the starting point of the thesis, explaining the present situation and the limitations present in the currently available methodologies. Further it describes the aspired artifacts that should be delivered by the thesis as well as the research approach that is used to develop them.

1.1.1 Focus

Companies are operating in an environment that is getting more and more complex. The number of competitors increases, production techniques evolve faster than in the past and stakeholders have higher expectations regarding the return on investment. In contrast to this development, the improvement of methodologies to manage a company in times of fast and short life cycles seems to happen rather slowly. Managers still think in terms of historic key performance indices like the Net Present Value (NPV) or the Return On Investment (ROI). To put it in a nutshell: the style of management is dominated by financial indicators only.

Robert S. Kaplan and David P. Norton already identified this weakness in the early 1990ies and developed the methodology of Balanced Scorecards (BSC) [KN96] to address all contributors in the company's value chain. However, their work focuses on the determination of objectives and measures for evaluating the factors that drive a company but do not pay too much attention to how the actions needed in the company transformation should be prioritized.

Traditionally the projects and programs driving the change process rely per definition on the same KPIs as current management methodologies do. The existing approach for this type of management – the Project Portfolio

Management outlined in chapter 2 – contains limitations in a way that some major aspects for efficient PPM in today's environment are not fulfilled:

1. The existing project portfolio optimization models are based on the methodology of Markowitz [MAR52] but do not take one important fact into consideration: Markowitz based his theory on financial portfolios. The difference between financial and project portfolios in this context is that financial portfolios are continuously distributed whereas project portfolios are discretely distributed. This is because in financial portfolios shares or derivatives can be sold or bought in arbitrary pieces whereas projects can be executed or not – the execution of 50% of a project to gain 50% of the benefit is unrealistic. In projects the earned value cumulates over all deliverables of the project and the benefit cannot be split or partially fulfilled by a certain number of deliverables. Explanations of the difference between continuous and discrete distribution can be found in [KRE98].

2. Furthermore the projects are evaluated by themselves but not by the value contribution they have with their dependencies to other projects. This means that projects with a low value that act as an enabler for high-value projects might not be implemented. A special case in this context are projects in a portfolio that do not provide a business need itself but are mandatory (e.g. required to fulfill regulations set by the government).

3. The quantifying measures to prioritize the projects are related to financial figures only. They do not affect other key performance indices (KPIs) relevant for the company. Therefore this approach is far from ideal and cannot optimally support a company's strategy.

4. The assumption of the majority of existing optimization algorithms is that the limitation of human resources can be resolved by investing additional money in buying additional "Know-How". In reality, this is not the case –as sensitive and important projects require highly skilled people.

Considering these shortcomings, the current approach to Project Portfolio Management apparently does not anymore meet the requirements of today's business.

1.1.2 Goals

This thesis will provide a solution for the shortcomings described above. In a greater level of detail, the goals can be described as follows:

1. **Definition of a meta-model for IT Project Portfolio Management:** This meta-model describes the requirements of companies towards IT Project Portfolio Management. It covers traditional financial perspectives as well as others that contribute to non-financial targets.

2. **Development of a model implementing the meta-model:** The implementation of the meta-model is based on existing and proven models and extended by the additional requirements defined in section 1.1.4. The model is not completely created from scratch because the combination and extension of models that already stand the proof of concept over time promise to generate a more robust model.

3. **Introduction of a new method for IT Project Portfolio Management based on Balanced Scorecards and relevant aspects of Risk Management and Project Management:** The aim of the method is to provide a set of processes that support the strategic selection, planning and executing of IT projects and programs within a project portfolio to achieve the strategic goals of a company. The focus of this method is not only with the projects and programs during their life cycle but furthermore with the realization of the expected benefits after the actual execution is already finished.

4. **Implementation of a tool-support:** Based on the model and the method, a tool-support is implemented that allows the processing of the data. Further the tool supports the making of decisions by calculating the key performance indices (KPIs) defined in the model.

1.1.3 Research approach

In research two different paradigms are to be distinguished – the action research approach and the design research approach.

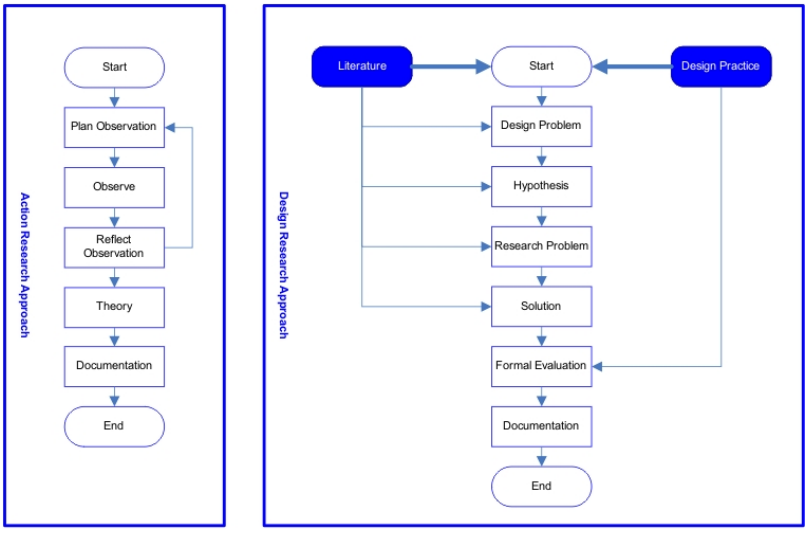

Fig. 1.1. Overview on the action- and the design research approach

The **action research approach** observes existing behavior and deduces a model from it. The observations are repeated as long as the theory does not fully reflect reality. As soon as the model is finished it is formally documented. In this thesis this approach cannot be used for two reasons:

- As strategy oriented IT Project Portfolio Management is a new field, no best-practice implementations can be observed
- If there would be a best-practice implementation available, the observed results would be biased by the fact, that I would observe everything with a predetermined background in terms "how it should be"

The **design research approach** has at its beginning a design problem, where a hypothesis is built on to resolve the issue. This is done by the study of relevant literature which leads to the formulation of the research problem and the development of a solution. The solution is formally evaluated with real data where the solution and the hypothesis are either verified or determined to be incorrect. In case of a working solution, it is documented.

This approach is used in this thesis – so the first step is the identification of the design problem. In the case described in this thesis, the selection and execution of project portfolios does not return the results expected.

In reality it is often not clearly defined why projects in a portfolio are prioritized the way the are. Often the personal strength or the organizational position of stakeholders count more than the benefit of a project for the company. This is also the reason why expectations towards project portfolios remain unclear – the execution requires lots of resources but what might the company expect out of it?

During the execution of the project portfolio the projects need to be monitored. What are the indicators that show stakeholders if projects in the portfolio should be re-prioritized? How can be seen if the project portfolio is in time and on budget? Is there a possibility to identify projects which will not return the expected benefits before they are finished?

As soon as some of the projects in the portfolio are finished, the question raises how the realization of benefits can be monitored. How can lessons learned be transfered for future projects and portfolios? Is there a possibility to identify and track side-effects among various projects?

All those questions lead to the hypothesis that there needs to be a kind of Project Portfolio Management methodology which prioritizes projects based on their relevance and benefit for the company, enables tracking and monitoring over the whole life cycle of benefit generation and builds a clear relation between the realized benefits and the projects in the portfolio which achieved them.

So the research problem is:
How does a Project Portfolio Management system needs to be structured, so that it fully supports the strategy and targets of a company – not only in terms of prioritization but also in verifying the planned benefits over the life cycle.

The methodologies and concepts provided in chapter 2 and 3 will provide a baseline to support and understand the design problem mentioned above. The framework developed in chapter 4 will provide a solution to the questions raised and will be formally evaluated in chapter 5 with a set of two use cases.

1.1.4 Research focus

The development of this thesis starts with the identification of shortcomings in the current approach to Project Portfolio Management: the selected portfolios seem to support the short-term growth of a company but are often in contradiction to the goals that have been set for the long run. This becomes obvious when the KPIs measured are compared to the vision and strategy of the company and it turns out that they have close to nothing in common.

This finding is the starting point for a search of literature on the topic of strategy implementation which leads to the studies of the Balanced Scorecard concept. Understanding how the selection of objectives and measures is done raises the question of a IT Project Portfolio Management mapping. As current approaches do not meet the expectations at all, they are used as a baseline to construct a new framework. This new framework attempts to combine the beneficial parts of all methodologies, supplemented with the best practices derived from experience.

In order to develop the final framework a series of steps are necessary. At the beginning the measures of the BSC concept and actual Project Management methodologies are compared. Whereas BSCs rely on measures that are completely tailored to the requirements of the company, indicators for project management are usually standardized to time, cost and quality. Time and cost can be determined quite exactly but the appraisal of quality is usually a highly subjective figure. However, none of the three measures allow a direct linkage to the BSC of the company.

Therefore the next step is to find an association or a link between BSC and the influence a project has on the measures defined there. The solution chosen in this framework is to use the not further dividable indicators of the BSC (so called α-figures) to define the influence of every single project on the existing BSC. This minimizes the loss of information due to a difficult transformation of figures and increases transparency. Another advantage is that these indicators are already well known, their application is logical and the acceptance with employees is ensured.

Still, there are four major issues to be addressed:

1. How are the projects for a project portfolio chosen, if the contribution of the project candidates is determined by several indicators?

2. How are the indicators estimated?
3. How can the progress of projects be tracked, if they are not longer measured against time, schedule and quality only?
4. How can be ensured that strategic goals are reached and that it is clear which of the executed projects was beneficial and which not?

The first issue is addressed by taking the relative value of the contribution of an indicator in a project compared to the highest value of this measure of all project candidates. Finally the area of a radar chart checked by the relative values is calculated to compare the projects against each other. The advantage of this method is that the information can be used for graphical representation of the results and for calculation purposes without additional effort.

The solution for topic number two needs to address uncertainty and therefore makes use of a method coming from Risk Management. It is close to impossible to precisely estimate the influence of an indicator achieved by a project. Giving the lowest, highest and probable value gives a range that can be weighted and thereby describes the contribution better than providing a single figure.

The tracking of indicators described in issue number three shows affinities with the tracking of time and cost in Project Management methodologies. Therefore it seems logical to adapt the concept of Earned Value to also track figures of the BSC. Actually, the core concept of a planned and an earned value for a specific point in time is transferred directly for every indicator coming from the BSC.

The answer to issue number four relies on the clarification of the question – "When do the effects of a project start influencing the BSC of the company?". Certainly the effects of a project are not gone by its close down – some might become measurable only long after the project is finished. Therefore the observation period of the influenced indicators needs to be chosen carefully and the planning of the effects will exceed the duration of the actual execution of the project by far. Whatever period is chosen, it needs to be the same for all projects in the project portfolio. Otherwise the comparison of several projects might be deformed. Based on the deviation of the planned compared to the earned values the achievement of the goals set for every project can be tracked. The processes behind are taken from the traditional Project Portfolio methodology.

Finally all these observations have been put together in a set of artifacts – a meta-model, the model, the method and a tool support. Together they form a new IT Project Portfolio Management framework. As already mentioned, it has been developed based on the following standards:

- **Balanced Scorecards (BSCs)** to identify the measures for the implementation of the strategy
- **Earned Value Management (EVM)** to define the relation between the measures of the strategy and the results that are measured during the life-time of an IT project portfolio
- **Risk Management** for the estimation of planned figures in an IT project portfolio
- **Traditional IT Project Portfolio Management** in terms of the life cycle. All other parts are redefined or extended

The tool support is provided by a software solution implementing these artifacts. To ensure the practicability of this approach, a proof of concept prototype was developed utilizing data gathered from an internationally active bank. Therefore the applicability of the model could be verified for the field of IT project portfolios executed in financial industries. Possible adaptations necessary for other industries and application domains are beyond the scope of this thesis.

The framework abstains from developing its own modeling language because the use of existing standard modeling languages has the advantage of tappinng into available knowledge and proven applicability.

1.2 Context and addressees of this thesis

This section addresses the context the thesis was written in and gives an indication for whom this thesis could be of interest.

1.2.1 Context

The basis for this thesis and essential parts of the research have originated during my work in the field of IT Project Management of middle- and large-scale projects in an international environment. Large segments of this thesis are not only based on theoretical models but also supported by the real experience of day to day business. The aim was to develop an IT Project Portfolio Management solution that is not only theoretically interesting but can be practically implemented as well.

The inputs provided by my professors made me think of reusing established models in an adapted context and not to reinvent the wheel. This has led me to a completely new understanding of the reuse of existing technologies and methods.

The combination of these two worlds has affected the content of this thesis to a large extent and, hopefully, in a positive manner.

1.2.2 Addressees

For scientists this thesis provides a new perspective to the topic of aligning strategies and project portfolios. Additional approaches can be developed based on this methodology going more into detail on algorithms and extending the framework by supplementary parameters.

From a practical point of view this thesis should be interesting for IT board members and IT managers at any level, managers in charge of coordinating large scale IT projects and/or programs in a company, change managers and scientists who deal with the optimization of limited IT resources by optimizing results. This thesis is not explicitly limited to any industry but has been verified – as previously mentioned – only by data obtained from the financial industry.

From a tool oriented view this thesis might be interesting for software-vendors building a bridge between tools covering Balanced Scorecards and implementing the functionality of IT Project Portfolio Management.

1.3 Structure and style of this thesis

The next sections provide an overview of the structure of this thesis and topics that are going to be discussed. Further the styles of text, references and citations are defined.

1.3.1 Structure

This thesis is structured into seven chapters, starting with the current chapter. This gives an overview of the thesis' focus, the goals that are to be achieved and the research approach that has been applied to develop the thesis. The following chapters will provide the following contents:

- **Chapter 2 – State of the art: Project Portfolio Management (PPM)** provides an overview of how project portfolio management is currently defined in the literature and offers an insight into some practical experiences in the field.

- **Chapter 3 – Definitions and references to already existing methodologies** discusses proven methodologies in the field of strategy development and project execution which will be used later on as baseline methodologies for the development of the new IT Project Portfolio Management approach. It is important to mention that this thesis is based on reliable

methodologies because a basic demand for the workable methodology is that it must be applicable to the real world scenarios.

- **Chapter 4 – The Framework** is further split into the meta-model, the model, the method and the tool-support. The meta-model describes the requirements on an abstract level to ensure that different domain specific implementations are possible by using the same abstract meta-model. The model represents the implementation of the meta-model that is the content of this thesis – however, there may be other implementations based on the same meta-model that are not within the scope of this thesis. The method shows the process part of the model being presented. Finally the tool-support gives an example for the tool-implementation of the model and the method.

- **Chapter 5 – Proof of concept (POC)** is the discussion of the developed thesis based on data obtained from a real-life environment in the financial industry. It provides data for a simple and a more complex portfolio from the setup of the portfolio through the execution and the achieved results. Thereby it compares the decisions taken from the ones that would have been suggested by applying the content of this thesis.

- **Chapter 6 – Achieved Results and limitations** is the review of the results and limitations that have been attained in this study.

- **Chapter 7 – Conclusion and future work** summarizes the thoughts of this thesis and offers some indications of further fields of research that can build on the results of this thesis.

1.3.2 Style

Titles in the paper are numbered through the first three levels – additional levels are not numbered but highlighted only. Abbreviations are defined in the text after their full context has been explained and are set into parenthesis. Items in an enumeration start with a hyphen. Quotations are indicated by italic letters and always described by the sources they were taken from. All references used in this thesis are listed in the references-section at the end of the paper and used in the text by the usage of squared brackets ([]). The reference indicator is built by the first letter of the last names of the first three authors in alphabetical order, plus the last two digits of the year when the reference was published. If there are only two authors, the indicator for the author is only two letters wide; in case of one author the first three letters of his last name are used; if the author is an organization the first three letters or the abbreviation are being used. The meta-model and model have been created by applying the class-diagram notation of UML.

Female as well as male notations are always including both female and male markings, whereas typically the male notation is applied in this thesis.

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2

The state of the art in Project Portfolio Management (PPM)

In the past the role of Chief Executive Officers (CEOs) was mainly driven by optimizing economies of scale. Research and development represented a minor success factor, because the life cycles of products lasted years. Competition was driven by the price, rather than by unique selling points of specific products. Over time markets evolved and products moved closer and closer to the special requirements of various customer groups and the diversification gradually increased.

Companies needed to adapt their organizational structures and processes in such a way as to be more efficient and to react to the demands of the market faster. The interplay of legal restrictions such as the Sarbanes-Oxley Act (SOX) and the right of stakeholders to understand and follow up on the decisions made by the board forced companies to increase their level of Corporate Governance. Criteria such as Profitability, Return on Investment (ROI) and Windows of Opportunity were extended to topics designed to optimize the implementation of the company's strategy:

- Which mix of potential projects will provide the best use of human and cash resources to maximize long-range growth and return on investment?
- How do projects support strategic initiatives?
- How will the projects affect the value of corporate shares (stock)?

To answer these questions, projects within the company must be managed following the mission and implementing the strategy of the company. This is what led to the current best-practice in the PPM implementation.

2.1 Historic development of PPM

In 1952 Harry Markowitz described the Modern Portfolio Theory (MPT) for the first time in his seminar paper "Portfolio Selection" in the Journal of Finance [MAR52].

In 1981 F. Warren McFarlan applied MPT to the management of projects. In the Harvard Business Review article entitled "Portfolio Approach to Information Systems" [MCF81] he recommended employing a risk-based approach of selecting and managing projects.

In 1994 the US Government Accountability Office's (GAO) report "Improving Mission Performance Through Strategic Information Management" [GAO94] described the private sector organizations using a portfolio investment process to select, control and evaluate projects.

In 1998 the GOA published the "Executive Guide: Measuring Performance and Demonstrating Results of IT investments" [GAO98]. Portfolio management and analysis were pointed out as one of four strategic enterprise objectives.

Since the introduction of SOX in 2002, companies listed at the stock exchange have to be transparent in the use of their capital and the actions they pursue. Project Portfolio Management proved to be one possibility to comply with the regulatory standards by effectively managing the companies' resources. Figure 2.1 describes the level of implementation as of 2005 [PS05].

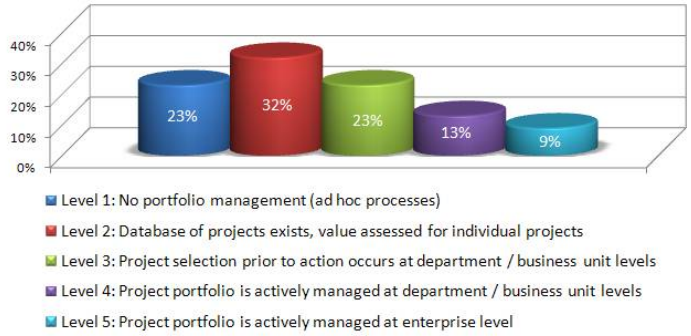


Fig. 2.1. Distribution of organizations regarding the implementation of PPM [PS05], p. 499

2.2 Definition of PPM

As projects became increasingly important over the years, traditional operational companies included in their business the field of project execution. Operations and project execution were controlled independently of one another. Many stakeholders recognized the shortcomings of this approach and considered PPM to be the bridge between the two worlds a shown in figure 2.2.

Fig. 2.2. PPM seen as a bridge [LEV05], p. 91

The reasoning behind this is based on the fact that operations and projects utilize the same resources but view them in different ways. The functional departments focus on business performance, while the project manager focuses on project performance. The satisfaction of the stockholders is of interest to the business, whereas project managers are more interested in the satisfaction of the stakeholders.

In fact PPM is much more than this. Following the definition of [CEK99] and [CEK01] PPM needs

- to maximize return and achieve financial goals
- to maintain the competitive position of the business – to increase sales and market share
- to properly and efficiently allocate scarce resources
- to forge the link between projects selection and business strategy
- the portfolio is the expression of strategy – it must support the strategy
- to achieve focus – not doing too many projects with the limited resources available and providing resources for the great projects
- to achieve balance – the right balance between long- and short-term projects and high-risk and low-risk ones, consistent with the business's goals
- to better communicate priorities within the organization vertically and horizontally
- to provide better objectivity in project selection and weed out bad projects

This alters the original picture towards a new understanding of PPM: PPM acting as a hub servicing various interests and functions:

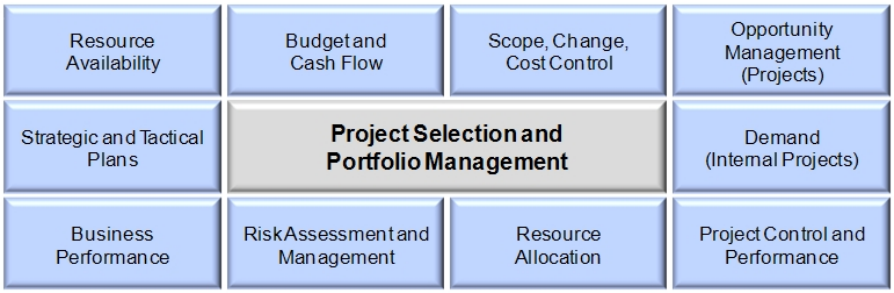


Fig. 2.3. PPM seen as a hub [LEV05], p. 91

- Strategic and tactical plans
  the proper prioritization of projects according to their relevance regarding the strategy and the progress of execution in order to achieve the targets set must be monitored.
- Resource Availability
  resources for upcoming project demands to be scheduled and planned carefully, since there normally is some lead time for all of them: e.g. human resources have to either be trained or hired, financial resources such as loans need to be applied for.
- Budget and Cash Flow
  budgets for projects must be cross-checked and the cash flows determined to plan the required financial resources.
- Scope, Change and Cost Control
  the scope of any of the projects in the portfolio has to be closely monitored since all the factors in other projects of the portfolio depend on it. That is why any change might affect not only a particular project, but the whole portfolio.
- Opportunity Management
  if there are opportunities for optimizing the portfolio, they have to be recognized and managed. This function has a wide range of activity, starting from the recognition of newly raised dependencies between projects in the portfolio to changes in the market, so as to better allocate resources. Further important function is monitoring of the competitors' moves which might change the implementation plans for the company's strategy.
- Demand (Internal Projects)
  besides the company's strategic projects, there is also the need for projects that might not have direct impact on the firm, but are required to improve certain processes.
- Project Control and Performance
  the ongoing projects require to be monitored in terms of classical project management procedures to understand the progress and realize the impact on other projects in the portfolio.
- Resource Allocation
  the resources must be distributed over the projects to optimize the possible output. Since the resources are limited, this needs to be handled with a portfolio optimization approach such as the Modern Portfolio Theory (MPT) of H. Markowitz.
- Risk Assessment and Management
  the risks for the projects and the whole portfolio have to be assessed during the selection of the projects and over the entire life-time, because risks evolve over time. The main responsibility of PPM is to protect the company from unexpected risk.
- Business Performance
  the execution of the projects and the portfolio is very important but the crucial point for the company's success is, whether the projects delivered

return the business value expected. Therefore, the implemented projects call, after their closure, for a review of the return on investment. Conclusions for ongoing and future projects have to be drawn.

2.3 The Process Model of PPM

In contrast to the execution of projects, PPM has neither a defined beginning nor a defined end, because it is an ongoing process. However, the process can be divided into five phases which are often separated by methods such as the Stage Gate® Process. This means that they are only allowed to enter the next phase if and when the preceding phase is finished and certain criteria are fulfilled. The phases for PPM are defined as follows:

- Identification of needs, goals and objectives
  in the first step the requirements for the portfolio are defined. The demands describe the reasons why the company implements PPM. The goals and objectives define the targets to be achieved and the measures to quantify them. Taking these as a baseline the selection criteria are build or updated in order to choose the proper projects for the portfolio. As expectations towards PPM evolve over time and the acceptance and success of PPM depends on clear expectation management, this step is not defined as a one-time preparation step but is an integral part of the PPM life cycle. It is important to note that the objectives should be kept as stable as possible over the duration of the project. A change in the objectives for the PPM means that the traceability of the portfolio is disturbed.
- Selection of the best project combinations (the portfolios),
  the quality of the portfolio depends to a large extent on the quality of the selection-criteria defined in the first step. In addition, the current business strategy and actual targets are taken into consideration so as to pursue the right set of projects. Details will be discussed in the chapter dealing with criteria for selecting projects.
- Planning and execution of the projects
  this step deals with the scheduling and the accomplishment of projects in the portfolio. It must not be confused with the planning and execution of projects in terms of project management, because the focus in this phase is on the state of the portfolio and the contribution of each single project to the portfolio and not on the details of the projects in the portfolio.

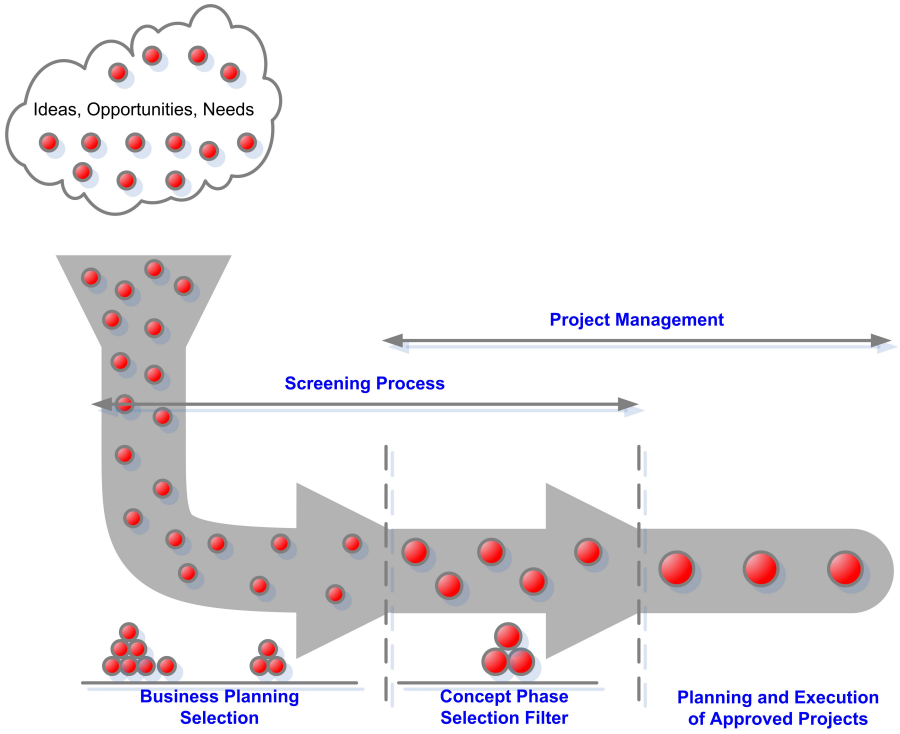


Fig. 2.4. The first three steps of the Project Portfolio Life Span [WID04], p. 109

- Monitoring portfolio performance
  the monitoring focuses on the delivery of the expected project deliverables and their contribution to the development of the portfolio. Variations of the plans are detected and corrective actions undertaken or change requests are registered. The main deliverable for the board of the company at this stage is a dashboard providing them with the information of the current status of the strategy implementation.
- Realization of benefits
  the last phase in the cycle is used to compare the implementation of the project deliverables and their business impact with the expected results. This step not only provides information regarding the achievements of goals, but must also be used to question the reasons in case of failure. They might provide new or additional input for the first cycle and help define the needs, goals and objectives.

There is no general recommendation regarding the duration per iteration of the life cycle, since a reasonable time frame depends on the projects in the portfolio. However, for most of the portfolios a benchmark should be a month.

The portfolio life cycle which has been described up to now leaves open how the Project Management methodology is embedded. The best-practice solution proven by various implementations is shown below:

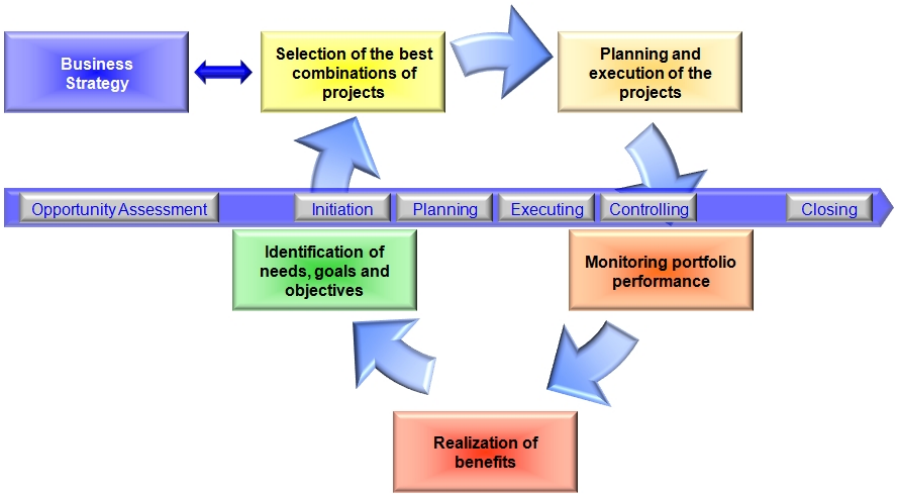


Fig. 2.5. life cycle of PPM in combination with Project Management [PS05], p. 502

Because projects have different start-dates, milestones and end-dates, they cannot be synchronized in a way that would fit in a phased approach where all of them share the same rhythm. Therefore, PPM has to adapt and be flexible enough to handle projects in various stages of their life cycle and still fulfill its function. The approach in figure 2.5 shows that ideas and opportunities are collected at the very beginning but are treated outside the PPM-Cycle itself (but in the PPM-responsibility as displayed in figure 2.3). After an opportunity or an idea has been selected, the initiation phase for the project starts. From there it continues throughout the entire project management life cycle (Initiation – Planning – Executing – Controlling) with the exception of Closing. Throughout this period the PPM oversees the project and monitors it. As soon as it comes to Closing, the project quits the life cycle, as this part is administrative only and no longer impacts the value delivered to the portfolio.

This paper focuses on the project selection process, the planning and execution of the projects in the portfolio, the monitoring and controlling of the portfolio and the realization of benefits. The process step for the identification of needs, goals and objectives is not covered in this paper as it is part of the Balanced Scorecard (BSC) methodology. For this part reference is made to [KN96].

2.4 The Selection of Projects – Optimizing the Portfolio

A simplified summary for selecting a good project portfolio would be to choose such projects that use the least resources to return the optimal output in terms of strategy contribution. The implementation thereof is naturally much more complex and will be described in more detail in this chapter.

Before the criteria can be selected efficiently, it must be clear what the target portfolio should look like. This depends – in the same way as it is with financial portfolios – on the attitude of the board towards risk. A commonly used approach to prioritize the portfolio is shown below:

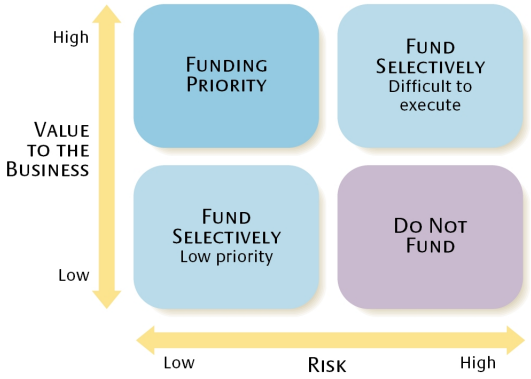


Fig. 2.6. Natural prioritization of projects in a portfolio [JL04], p. 44

The matrix follows two criteria: the value to the business and the risk that goes along with implementing a project. In reality this model is actually difficult to implement because two criteria are not enough to prioritize portfolios.

2.4.1 The Efficient Frontier

The model of "The efficient Frontier" was introduced by Markowitz as an integral part of his Modern Portfolio Theory (MPT). The concept applied to PPM is based on the fact that every project portfolio has resources (called Available Budgets in the graph on the horizontal axis) and has to optimize the output (called Cumulative Business Value (CBV) in the graph on the vertical axis) under the consideration of certain constraints.

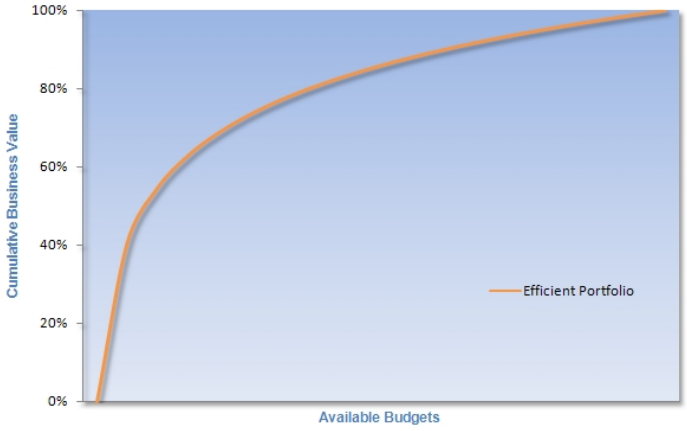


Fig. 2.7. The approach of the Efficient Frontier for PPT

Figure 2.7 gives an example of a possible curve representing the most efficient portfolio possible – the maximum satisfaction of CBV for a given amount of budget. This implies that every position under the curve can be achieved but none above.

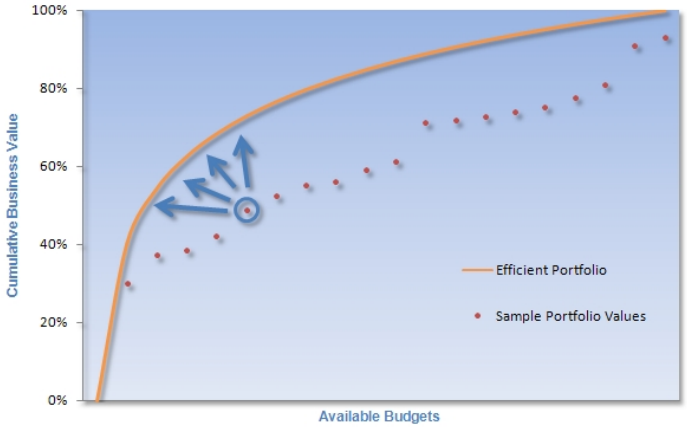


Fig. 2.8. Sample Portfolio Values and the possibilities of optimization

With given budgets (represented by the red points in figure 2.8) different business values can be achieved. Normally they are not on the optimal curve as there are several constraints in place preventing that. Such constraints can be a limited number of skilled employees, non-value adding projects in the portfolio or the time of the window of opportunity being too short – just to give a few examples. The exercise of PPM is identifying and quantifying the criteria that prevent the portfolio from performing its optimal task and setting goals that insure removing as many barriers as possible.

Further, figure 2.8 contains a given budget, so the only directions for optimization are in the directions of the arrows. The most extreme positions would be if PPM either manages to reduce cost by achieving the same level of CBV, or it manages to reach the CBV level of the efficient frontier with the same budget – the reality is normally somewhere in the middle: the CBV can be increased providing some savings as well.

Another important topic is that the achievable CBV is limited according the to the budget at hand. Higher values can only be achieved if the budget is increased. In this field the responsibility of PPM is to show the required budget for the optimal cost/benefit ratio of a portfolio.

The list of criteria below represents a set of quantifiable measures to determine the total CBV and the variation based on the current constraints.

2.4.2 Criteria for Portfolio Selection

- Alignment with the Strategy
  describes the strategic goals the project follows up on. This factor must be defined carefully for each company, since the criteria to measure these factors are often difficult to define. Normally this cannot be simply expressed by a figure but needs discussion and voting of the board members as well as of the sponsor to get a clear understanding and to avoid misguided expectations. A method that can be used to prioritize projects for this criteria is the Analytical Hierarchy Process (AHP) invented by Thomas L. Saaty [SAA90].

- Net Present Value (NPV)

$$\text{NPV} = \text{initial investment} + \sum_{t=1}^{\text{end of project}} \frac{\text{Cash Flows at period t}}{(1+r)^t} \tag{2.1}$$

  the NPV represents the expected value of a project. There are two issues that complicate the NPV calculation(: the number of cash flows in the future (which have to be taken into consideration), as well as the estimation of future cash flows. The first issue can be solved by taking the same number of periods as those used for depreciation of the project investment. Determining the value of representative future cash flows is much more difficult, because small differences can result in completely different decision baselines for the PPM. A possibility to resolve this issue is to calculate a worst-case-, a most-probable- and a best-case-NPV and take the median for PPM purposes.

- Value of a project after [TG05]

$$\text{Project value} = \frac{\text{Benefits - TCO - Taxes}}{\text{Risk}} \tag{2.2}$$

as with the NPV, this figure includes the benefits and the cost of implementation and maintenance. In addition, it mentions the taxes to be paid and the quantified risk to be taken in the project. Especially the risk quantification is a very intense issue and has to be considered carefully.

– Productivity Index [COO05]

$$\text{Productivity Index} = \frac{\text{NPV}}{\text{Development Cost}} \tag{2.3}$$

the Productivity Index puts the net present value and the development cost or project execution cost into relation and expresses the factor of NPV received by each unit invested. If different projects are in place which try to meet the same business goal, the project with the higher productivity index should be favoured – not necessarily the one with the higher NPV:

Project	NPV	Development Cost	Productivity Index
Beta	57.0	5.0	11.4
Echo	42.0	5.0	8.4
Alpha	22.0	3.0	7.3
Foxtrot	58.0	10.0	5.8
Gamma	6.0	2.0	3.0
Delta	1.5	1.0	1.5

Table 2.1. Sample Portfolio with different values for the Portfolio Index

– Return on Investment (ROI)

$$\text{ROI} = \frac{\text{Benefits}}{\text{Cost}} \tag{2.4}$$

measures the profit in percentage of the capital invested into the project.

– Expected Commercial Value of a project after [CEK99]

$$\text{ECV} = [(NPV \times PV_{CS} - C) \times P_{TS}] - D \tag{2.5}$$

where ECV is the expected commercial value of the project, P_{TS} is the probability of technical success, P_{CS} is the probability of commercial success (given technical success), D are the development cost remaining in the project, C are the commercialization (launch) cost and NPV is the net present value of the project's future earnings (discounted to today).

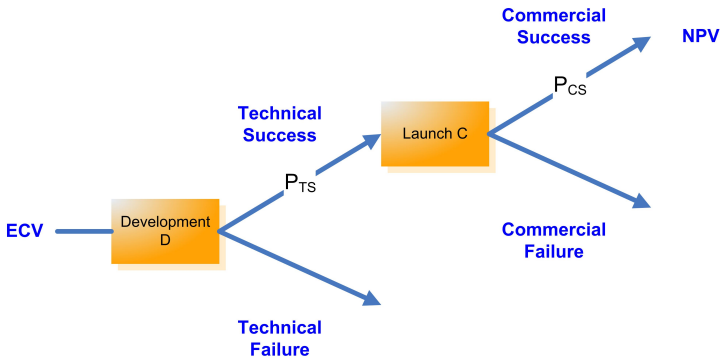


Fig. 2.9. Expected Commercial Value of a Project after [CEK99]

This index attempts to include in its calculation the risk of finishing a project and then goes on to divide the total into a commercial and a technical risk. Therefore, it is built on a decision tree approach with conditional probability. The benefit in using this indicator is that a deeper analysis needs to be done beforehand. This approach results in an enhanced awareness of risk and the assignment of cost and risk to business as well as to IT becomes more transparent.

- Type of the project
  In general three types of projects can be distinguished:
  - Maintenance or Utility Projects
    support ongoing products or services. These projects are required to keep the company's existing business up and running. The risk potential is usually very low, as the environment is a familiar one. The effort to run the project should be low as well. Therefore, they can be executed during gaps between other projects.
  - Growth or Enhancement Projects
    support strategic initiatives and represent increasing value. This type of projects focus on pushing existing cash cows in the company to enlarge their potential. The risks of going along with these projects is limited, because the products are known. Still, the risks should not be underestimated. These projects require a lot of resources and time to achieve their goals.
  - Transformation Projects
    these projects move companies to a new level or introduce new products or services that might dominate the market. The risk running such projects is high, since the company enters a field it is not experienced in. The efforts and the duration are high as well – but as described in Markowitz's MPT, higher risks have the potential to return higher benefits.
- Payback period

$$\text{Payback Period} = \frac{\text{Investment}}{\text{Cash Flow(year)}} \tag{2.6}$$

defines the length of time required to recover an initial investment through cash flows generated by the investment.

- Internal Rate of Return (IRR)

$$\text{NPV} = 0 = \text{initial investment} + \sum_{t=1}^{\text{end of project}} \frac{\text{Cash Flows at period t}}{(1+IRR)^t} \tag{2.7}$$

The concept of IRR and NPV are related. The IRR seeks to establish the interest rate for the cash flows which return a NPV of zero. This is done to compare the financial return of the project with the cost of capital that needs to be invested to run the project. If the IRR were 15% and the cost of capital 7%, there would be a positive NPV and, therefore, it would be worth running the project. The closer the IRR comes to the cost of capital – e.g. 7.5% – the less sense it makes to run the project, especially since neither the NPV nor the IRR-formula consider risks which might lower the achieved cash flows.

- Ability to execute a project
  this criteria summarizes many more detailed facts such as:
  - Are the required skills available in the company?
    - If yes, are there capacities available for a new project?
    - If no, should they be hired or bought in from a consultant?
  - Is there any existing experience in the field of the new project?
  - Is the size of the project and its complexity manageable within the company?

  The factors that determine the ability of a company to execute certain projects have to be accessed carefully when setting up PPM.

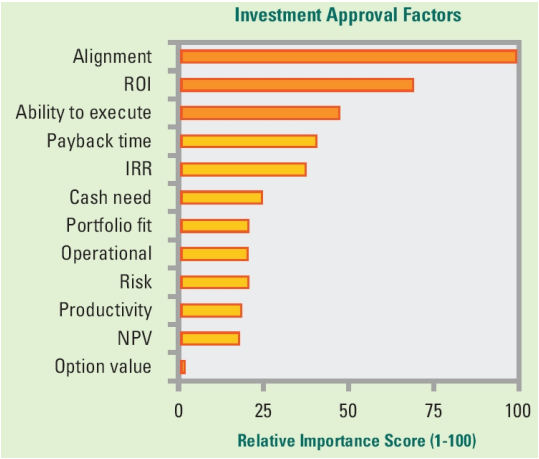


Fig. 2.10. IT-investment decision-making factors, relative to the one ranked number one (alignment with business objectives) taken from [KEL03], p.6

It is interesting to note that all the papers dealing with project prioritization do not touch the possibility of combining a set of selection indicators. The methodology for the weighting or the definition of a set of rules for prioritizing different options is referred to as – "needs to be done during the implementation" – but a methodology or best-practice experiences on how to implement it is missing. This leaves the impression that the real prioritization is rather based on the perception of the decision makers than on indicators which are based on facts.

2.5 The Planning of Project Portfolios

A simplified justification why PPM is executed is to ensure that the expectations set into a project portfolio by the stakeholders meet the the reality after the execution of the portfolio. In fact, all phases that deal with managing these anticipations perform some sort of evaluation. The planning phase is a so called "ex-ante" evaluation, because the future is estimated with the best knowledge given at this point in time. The phase of monitoring and controlling of the benefits' realization is referred to as "ex-post" evaluation, since the facts derived from the project can be compared to the planning figures (for comparison purposes see also [RMS00], p. 25).

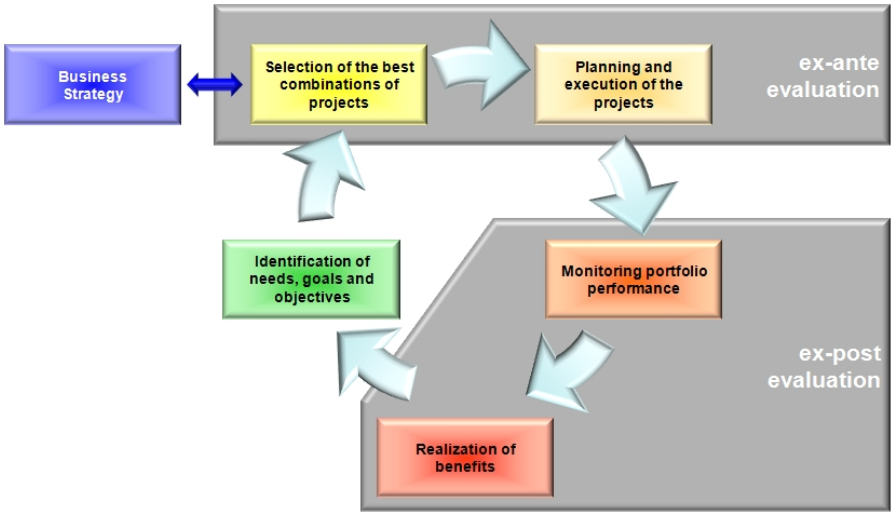


Fig. 2.11. Types of evaluation during the PPM life cycle

Naturally the prioritization of the projects within the portfolio takes place includes benefits and costs. The higher the positive effects are compared to the negative ones, the higher the probability that the project is being selected for execution as a part of the portfolio:

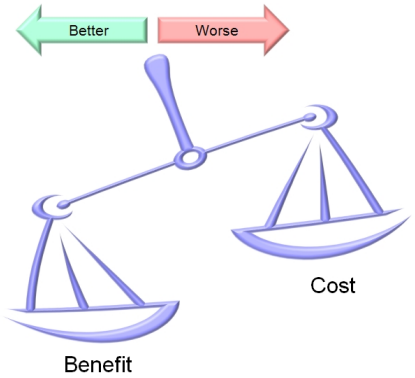


Fig. 2.12. The function of benefits and costs in the selection of a project for a portfolio

Typical indicators chosen for the selection are the Return On Investment (ROI) or the Net Present Value (NPV). Stepping into the planning phase of the project portfolio demands that the rough assumptions from the selection phase are broken down into detail on a project basis, in order to get an idea of the whole project portfolio by summarizing the elements from every project.

2.5.1 Benefits

Considering the planning of a project portfolio, most managers think about costs created by the people working on the projects and cash flows that might be returned after the finalization of the project. [DAV97] noted that this perspective is not adequate because

> *"We have spent a great deal of time and money bringing water to the horse, but we don't even know if he is thirsty, and we have no idea how to get him to drink."*

This means the assumptions made are vague and often not deliberated clearly in order to ascertain why certain targets can be reached and how the expected cash-flows can be realized. [RMW07] extends the picture by implicitly widening the notion of projects in terms that the generated cash flows are a part of something more important: namely the set of benefits:

> *"Projects are investments. Like all investments there are anticipated costs, benefits and risks."*

Following the last statement, the prevailing opinion must be extended by a detailed view on how benefits can be measured and on how they are achieved. The available methodology and literature does not go into detail on how to plan benefits independently from the type of project but leaves this up to the subject matter experts. They normally draw their conclusions based on experience which means that the methodology used is analogous estimation. This is still unsatisfactory, since the estimation of benefits is critical regarding the details and has to be based on facts rather than on analogies.

As the existing approaches obviously lack the detailed level of criteria to measure the benefits, the following set should help to check the applicability of new methodologies:

- Validity
  the assessment of the benefits depends on the experience of the subject matter expert and not a commonly proven set of indicators
- Effectiveness
  benefits are expected to appear at a certain point in time - the timely development of benefits is not considered
- Fluctuation range
  risks are only considered for the determination of financial impacts on the project, not for the identification of variations in the target values of benefits
- Tangibility
  benefits are generally divided between tangible and intangible benefits, but there is no approach available on how intangible benefits could be converted to tangible ones or be roughly measured as intangible ones

– Dependencies
  the benefits of a project within the portfolio might be increased or decreased by the execution of another project

Besides the analogous estimating, there are no other models defined and available for estimating benefits of projects and portfolios in general. However, this paper discusses two models that attempt to define indicators for IT-relevant projects and portfolios:

The Value For Money Model (VFM)

Although [RMS00] stated that

> *It is most important to emphasize that the measurement of business performance is not a science but rather an art*

the approach was started to give examples for benefits and their measurement in the field of IT projects. This processing model is based on the development of a questionnaire including company specific aspects that covers the following fields:

– Hardware
– Software
– Staff
– Service
– Technical Support
– User Support
– Costs
– Applications
– Networks
– Security
– Integration
– Information System Planning

This questionnaire is distributed to a sample set of stakeholders so as to determine their expectations as regards benefit. For the results the mean values and standard deviations are calculated to give the most accurate picture possible of the benefits to be expected. Validating the approach against the criteria defined above, gives the following picture:

– Validity
  the fields of questions are standardized but not the questions and indicators. This implies that subject matter experts are still required to formulate the specific indicators in the defined fields
– Effectiveness
  the timely development is not considered

- Fluctuation range
  because the mean values and standard deviations for the indicators are calculated, the fluctuations are determined
- Tangibility
  the separation between tangible and intangible benefits is addressed in the discussion by the authors but the intangible benefits themselves are dealt within the questionnaire implicitly only
- Dependencies
  the dependencies are not considered

Although this approach goes into more detail and gives an indication of the benefits which could be achieved in the various fields, it still lacks objectivity if the expectations are adequate.

COBIT

Another approach for standardizing the benefit analysis in an IT environment is to use the objectives defined in the COBIT-framework [COB07]. With the implementation of COBIT the company needs to define a set of indicators, measures and scales to determine the contribution of IT to the companies' success:

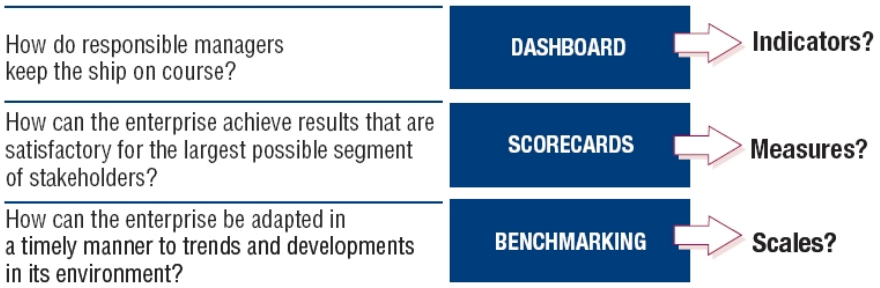


Fig. 2.13. Indicators, measures and scales in COBIT. Copied from [COB07], p. 6

The measurement of the projects' contribution in a portfolio against the indicators and measures of the COBIT framework are a step in the direction of an approach that is not based on the opinion of subject matter experts but still lacks an important factor: the ratios are defined from an IT point of view as they are based on a framework that tries to standardize IT aspects by optimizing the alignment with the business. Business specific aspects that are not IT-relevant are still not covered here regarding the benefits. In terms of the criteria defined above, the following conclusions can be drawn:

- Validity
  as the COBIT framework foresees the establishment of scorecards, the influence of projects in the portfolio can be described in the various indicators in the scorecard

- Effectiveness
  the timely development is not considered
- Fluctuation range
  the COBIT framework asks for precise values inside the scorecards – not for ranges; therefore the definition of a range for the describing the target would be an extension of the framework
- Tangibility
  the COBIT-framework tries to turn every intangible benefit into a tangible one by defining the relations between the indicators
- Dependencies
  the dependencies are not considered

An idea as to how to cover business and IT aspects in equal measure will be presented later in this paper.

2.5.2 Costs

Compared to the benefits estimation, the methodologies available for the approximation of cost are more detailed. The determination of costs has the advantage that it can be done bottom-up starting with the smallest item of a work breakdown structure (WBS) and aggregated over projects. Costs can be summed up from their origination. Compared to the benefits, side-effects are obvious and can be separated in the aggregation of the costs. The elements of cost can normally be separated into three different parts:

- Investments
  can normally be activated and depreciated. This opens another perspective in the cost/benefit analysis, since after the project's finalization the tax reduction could either be counted as a benefit or a reduction of cost.
- Material cost
- Efforts in terms of person days achieved by the project team

[PMI06] recommends the following types of cost estimation:

- Analogous estimating
  when discussing benefits the application of analogous estimating was criticised because the level of detail required was not given. In terms of cost the picture differs, since the nature of various cost types (the criteria) is clear, as outlined in the enumeration above. Here the amount is the subject of the analogous estimation, not the criteria.
- Bottom-up estimating
  is the most precise method in the phase of detailed planning but also the most time consuming one. In fact neither projects nor portfolios should be executed without having this performed, since it builds the baseline for the Earned Value Methodology (EVM) needed for the controlling and monitoring of projects and portfolios (details can be found at [PMI05]).

– Parametric estimating is similar to the analogous method with the difference, that the parametric estimation can only be used if empirical values for exactly the same type of project with a different size are available. In such a case, the factor is determined and the historic values are recalculated.

For IT projects further steps have been taken to increase the precision of the approximation. Therefore, estimation methodologies have been developed, which depend to a high degree on the software development methodology that is used for the project. The most important ones are:

– Function-Point-Analysis (FPA)
– Common Software Measurement International Consortium Full Function Point (COSMIC-FFP)
– Constructive Cost Model (COCOMO)
– ObjectMetrix
– Use-case-Points

Details on the various estimation methodologies can be found in [JAN08].

2.6 The Monitoring of Projects - Controlling the Project Portfolio

It is important to strictly control the projects within the portfolio to ensure that the portfolio achieves it goals and variances are detected as soon as possible to set corrective actions. The process itself consists of five steps:

Fig. 2.14. Steps of the Portfolio Monitoring Process visualized after [RMW07], p.116ff

– Gather Project Portfolio Information
in the first step all the data from the projects is collected based on the measures appointed in the first phase of the Process Model of PPM (Identification of needs, goals and objectives). The data is aggregated to a dashboard view of the portfolio, presenting the data on progress, cost and the actual resource plan including additional demands. The details not represented in the dashboard view are documented in detailed status reports for the projects and the report itself.
– Measuring and Analysing the Project Portfolio
Here the data gathered is compared to the baselines and expectations of the projects and the portfolio. Interdependencies between the projects are recognized and their impact is measured. From these figures the alignment of the current portfolio with the strategy behind is evaluated and the

business value of the portfolio is compared to the target. If there are gaps, changes have to be discussed and estimated for their effectiveness in terms of closing the differences. The range of change requests might start with small corrective actions such as increasing the number of specialists in a project all the way to more significant change request such as postponing the go-live of a project for a month.

- Analysing the Impact of Changes on the Project Portfolio
  Unlike Change Management within a project, the PPM ought to be aware of the impact of changes in a project on the whole portfolio. New projects might shift priorities, schedules and the assignment of resources within the portfolio – this could lead to a complete reorganization of the current portfolio, if the initiated project has top priority. Projects may need to change their scope and therefore shift time lines and/or resources, which impacts the availability of resources for other projects. There could also be reasons that lead the PPM team to conclude that it might be necessary to recommend the elimination of an already approved project. The major reasons to do so are (defined by [RMW07], p. 117):
  - The project does not deliver the expected value or is no longer aligned with the strategy
  - Priorities have shifted in such a way that higher prioritized projects entered the picutre and forced out existing projects with lower priority
  - Two projects might have been merged due to re-scoping
  - The underlying technology promising the business advantage might have changed or new cognitions might have come up that lower the expected benefits of executing this particular project.
- Reviewing Portfolio Changes and Forecasting
  Out of the analysis done in the last step, new projects are evaluated against the existing project portfolio. As soon as the new set of projects is introduced, the goals of the portfolio have to be reviewed and possibly adapted. If there were changes in the objectives triggered by one of the new projects, all business cases of the projects in the portfolio ought to be re-evaluated according to this changed objective. This represents a shortcut of the first phase in the life cycle (Identification of goals, needs and objectives) and it must be decided after careful consideration whether this is really required as it suggests that the selection of proper objectives failed to include the one which makes the new project so important. This is a risk for PPM itself, as it destabilizes the traceability of the approach and therefore has considerable effects. Regardless of the reason for the re-prioritization, the new ranking has to be established and the project inventory needs to be updated. Out of these scenarios for the changes in the allocation of resources and the impact on the business are developed and brought to the attention of the Project Portfolio Steering Committee. All scenarios taken into consideration must be cross-checked with the project managers as well their estimation on the impact of milestones, cost and miscellaneous other issues.

– Communicating and Implementing the Portfolio Changes
  In this step the decisions are implemented. This means that the project managers are updated on the re-prioritization and of the changes of their constraints. Based on this review of the project plans, which is triggered top-down, the teams are informed using standard-methods of Project Management Methodology.

2.7 Organizational setup of the Project Portfolio Steering Committee

In the previous chapters the paper has dealt with the processes of PPM but has not covered the organizational structure necessary to effectively execute them. Most organizations are still structured in a hierarchical way. For the execution of projects and especially whole portfolios this is a significant disadvantage, because projects naturally need to involve various parties from different departments. Therefore, the PPM steering committee must be organized differently, bringing all relevant parties together, regardless of their location in the hierarchical organization.

The PPM organization consists of five roles:

– PPM Sponsor
  this person is one of the company's board members (ideally the CEO). The role of this person is to ensure that the company's strategy is properly translated into projects and that the prioritization within the portfolio is done properly. He/she is the communicator to the other board members and ensures that all divisions of the company stand behind the project portfolio and the targets that are to be achieved. Further he/she acts as an escalation instance and takes the decision in case of conflicts of interest within the PPM.
– PPM Leader
  he/she is in charge of ensuring that the PPM is set up following PPM- and Project Management- standards, the processes are defined properly and the roles are clear. In the daily business this person controls the execution of the defined processes and is the key contact person for all parties in the company that would like to set up a project or a program. The PPM Leader often also the head of the PMO, because it makes perfect sense that the staff collecting and presenting the data is the identical with the one that does the final portfolio-analysis and, moreover, reports to one and the same person.

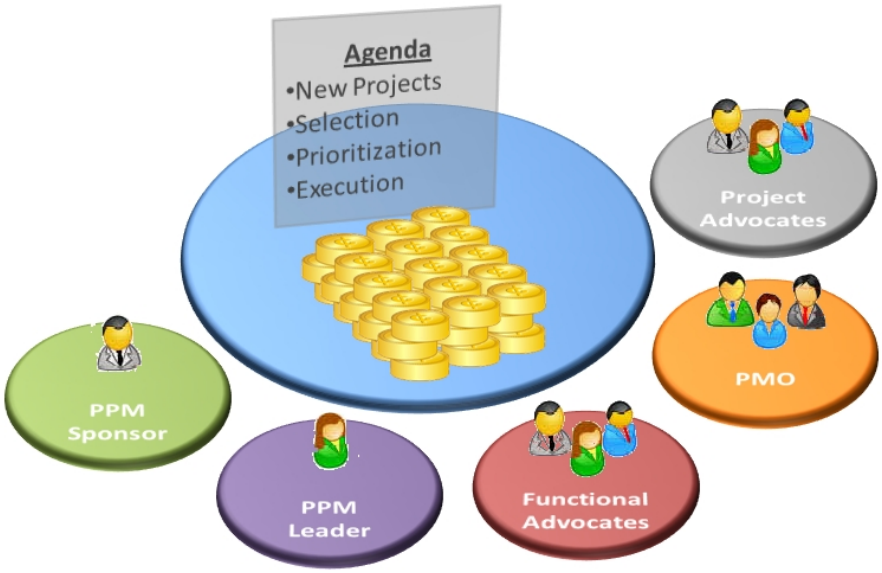


Fig. 2.15. Roles in PPM [RMW07], p.34 - modified

- Functional Advocates
  these are the representatives of the business departments who have an interest in the execution of one or more projects in the portfolio. Although the projects are clearly prioritized by several criteria (as discussed in the chapter dealing with the selection of projects) it is inevitable that during the meetings of the PPM committee there are discussions on various details that would, hopefully, lead to the adoption of the right decisions.
- Project Advocates
  the project advocates assume the role needed for the execution of projects as the functional advocates do for the business. In their discussions they focus on the feasibility of options discussed, keeping an eye on the constraints they are confronted with during the project's execution.
- PMO
  the staff of the PMO is responsible for keeping the PPM processes alive and providing those processes with all data necessary to execute them. Their responsibility to set and maintain the Project Management (PM) Standards is one of the key functions that enable PPM. Without an effective PMO – PPM is impossible.

2.8 The Project Portfolio Management Maturity Model

The PPM implementation process takes some time and cannot achieve everything perfectly from the very beginning. Therefore [JL04] describe a maturity

model taking into consideration the steps a company should follow to build up PPM efficiently. The model consists of four stages - ad hoc, defined, managed and synchronized. The graph below documents the last three stages. The ad hoc phase is not taken into consideration because it has no structured approach.

- Stage 1: Defined
  During this stage the standardized documentation of projects is secured and a central database for all projects is established. The stakeholders in the company agree that this database is the single location of truth - everything that is outside will not be considered in project budgeting and execution. However, the tracking of the projects in the portfolio follows more a qualitative than a quantitative approach - so no financial metrics nor the achievement of strategic goals are looked at. The milestone to achieve in stage one is to have an overview of all projects in the company with the same dataset and granularity available for every project.
- Stage 2: Managed
  The "Managed" stage identifies itself by the availability of PPM life cycle previously outlined in this paper. The execution of this process might still lack some detail and some of the steps like budgeting or planning might be executed annually rather than on an ongoing basis but the basic functionality of the process needs to be available and a standing team needs to be defined to execute those processes. Further financial metrics are calculated and used as criteria for the prioritization and the steering of the projects in the portfolio. The alignment between business and IT to achieve strategic goals of the company is not yet achieved and the tracking of the realization of project benefits still has to be established.
- Stage 3: Synchronized
  The target stage for PPM ensures full alignment between the executed projects and the strategy of the company. This is not only covered by ongoing projects but also upcoming initiatives are reviewed regarding their value for future opportunities. The budgeting and checking is no longer an annual or quarterly action but is integrated into the daily business, because changes due to urgent market needs do not follow the schedule of fiscal years. In all these processes risk management is incorporated as an integral component and no longer treated as an add-on to project management. The measures of progress moved from qualitative to quantitative figures and the Earned Value Methodology (EVM) is used for all projects. The PPM's focus is not only on the selection and execution of projects, but also on the inspection of the gained benefits after the projects are finished. It is vital to constantly improve the quality of the PPM processes and measures. Consequently, the PPM is thus turned into a self-optimizing function within the company.

Factor	Maturity Stage		
	Defined	Managed	Synchronized
Advanced Valuation			Inclusion of qualitative option value in funding decisions; monitoring of project's earned value in deployment.
Feedback Mechanism			Feedback on alignment with strategy – score cards evaluate the project.
Benefits Measurement			Tracking of project benefits after project development is complete; measurement of value through the full project life cycle.
Active Portfolio Management			Understanding of risk and return – portfolio weighted accordingly.
Strategic Alignment		Annual review sessions between business-unit heads and IT to discuss IT and strategy alignment.	Frequent review sessions with business unit to discuss strategy alignment (quarterly or monthly)
Financial Metrics		Use of financial metrics in prioritizing: NPV, ROI, IRR	
Demand Management		Well-defined scheme for screening, categorizing and prioritizing projects; portfolio-management approach to rank projects for investments.	
Centralization	All projects in one database; all spending tracked centrally and rolled into one database; centralized project office monitors projects.		Use of portfolio software – real-time updates on portfolio modifications, performance and health.
Standardization	Applications and infrastructure are well defined and documented.	Portfolio segmented by asset classes – for example, infrastructure, strategic projects.	

Fig. 2.16. Portfolio Management Maturity Model [JL04], p.43

3

Definitions and references to existing methodologies

3.1 Balanced Scorecards (BSCs)

In the early 1990s Robert S. Kaplan and David P. Norton recognized that several characteristics regarding company management had changed over the years. Financial factors such as economy of scale or profit no longer seemed to be the only figures to be monitored and controlled to achieve success. Something has changed: customer requirements had become more complex. They became sensitive to aspects such as time-to-delivery or quality. Business has also become more international which has increased competition considerably. Because of such developments, strategies driving companies in the past which focused only on increasing income by reducing costs, did not meet customers' and markets' expectations anymore. Managers tried to grasp these new circumstances and the result of their analysis was clear. What was needed was the implementation of a more complex strategy which had to become an integral part of the daily business. Questions such as "How well do employees understand what is important for the company's success?" or "What are the key processes the company needs to excel in?" needed to be answered. As a matter of fact, 59% of senior management, but only 7% of the middle management, know how to implement the company vision [KN96].

This was exactly the starting point for Kaplan & Norton. They began developing a new model in cooperation with several companies. The result of their efforts was the "Balanced Scorecards" methodology.

3.1.1 Principles defining a company

There are four key factors in every company defining what kind of business should be carried out, for which reason, following which values and in which way it has to be implemented. The terms behind this are well known: mission, corporate values, vision and strategy. Since there is a broad variety of definitions, this paper makes use of the ones defined by Paul R. Niven [NIV02] who implemented various scorecards in internationally active companies:

- Mission: defines why the company exists. This should inspire change, be long term in nature and should be easily understood and communicated.
  - 3M: *"To solve unsolved problems innovatively"*
  - Wal-Mart: *"Give ordinary folks the chance to buy the same things as rich people"*
  - Microsoft: *"We work to help people and businesses throughout the world realize their full potential"*
  - Merck: *"To preserve and improve human life"*
  - Walt Disney: *"To make people happy"*
  - Marriott: *"To make people away from home feel that they are among friends and are really wanted"*
- Corporate Values: characterize the guiding principles the employees of the company should follow. As they are in the soft-skills they cannot be as clearly categorized as the mission statement but need to be individually adapted to the approach employees should live when they approach customers.
  - Merck:
    - *Corporate social responsibility*
    - *Unequivocal excellence in all aspects of the company*
    - *Science-based innovation*
    - *Honesty & integrity*
    - *Profit, but profit from work that benefits humanity*
  - Walt Disney:
    - *No cynicism*
    - *Nurturing and promulgation of "wholesome American values"*
    - *Creativity, dreams and imagination*
    - *Fanatical attention to consistency and detail*
    - *Preservation and control of the Disney "magic"*
- Vision: describes the world picture of the future. It is the goal the company wants to achieve in about ten to fifteen years. The very best vision statements are concise, appeal to all stakeholders, are consistent with mission and corporate values, are verifiable, feasible and inspirational.
  - Starbucks: *"2000 stores by 2000"*
  - Microsoft: *"A computer on every desk in every home"*
  - Proctor & Gamble: *"Nearly 300 brands you know and trust"*
  - US bank: *"The trusted name in personal banking"*
- Strategy: are the activities required to achieve the vision. These need to be defined by the senior management and are the starting point for the development of the scorecard. For a bank, retail business is defined as one of its main focus areas. Specific improvements in this area such as optimizing mass-transactions, increasing the number of branches and training people for increased cross-selling might be part of their strategy.

3.1.2 Perspectives of a Balanced Scorecard

Following the concept of Kaplan and Norton, it is necessary to break down the strategy into four areas that influence the vision's achievement as displayed below:

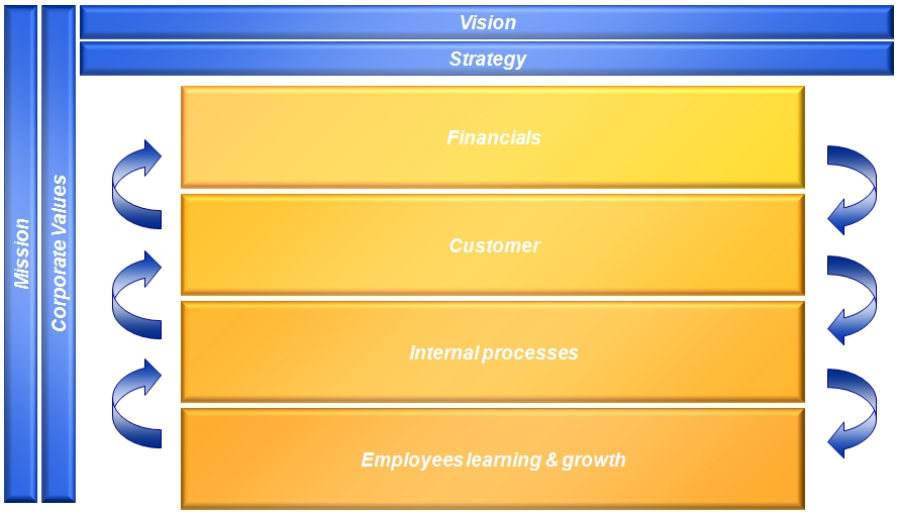


Fig. 3.1. Four Perspectives in the Balanced Scorecard

Financials reflect the financial measures that ought to be achieved to satisfy the stakeholders of the company. Kaplan and Norton criticize that these figures represent the past but do not say anything about the results the company might deliver in the future. How can this be achieved?

The answer lies in the added-value-chain. Financials are not delivered by the company itself but by its customers. Therefore, a major target is to satisfy the customers so that they would continue working with the company as a provider and not move to a competitor. To ensure the clients are serviced properly, internal processes must deliver what the customers expect. In order to do this, they need to be enabled, in other words, have sufficiently skilled resources. Achieving this goal is discussed in the last section entitled "Employees learning & growth".

Analysing the graph above shows a "lagging" (or requirements) view downwards from the financials to employees learning and growth and a "leading" (or enablers) view running in the opposite direction.

Kaplan's & Norton's point is that a company has to clarify which objectives in which of the perspectives are considered to be important, so that the impact on the vision achievement can be observable. To reach this goal, the objectives must be identified and linked with each other.

3.1.3 Objectives and measures in a Balanced Scorecard

When it comes to the determination of objectives and measures it also becomes clear why the BSC is "balanced". The objectives should meet three key requirements making sure that the scorecard developed supports the initial idea [NIV02]:

1. Balance between financial and non-financial indicators
2. Balance between internal and external constituents of the organization
3. Balance between the lag and lead indicators of performance

To determine the objectives and measures the following process model can be used:

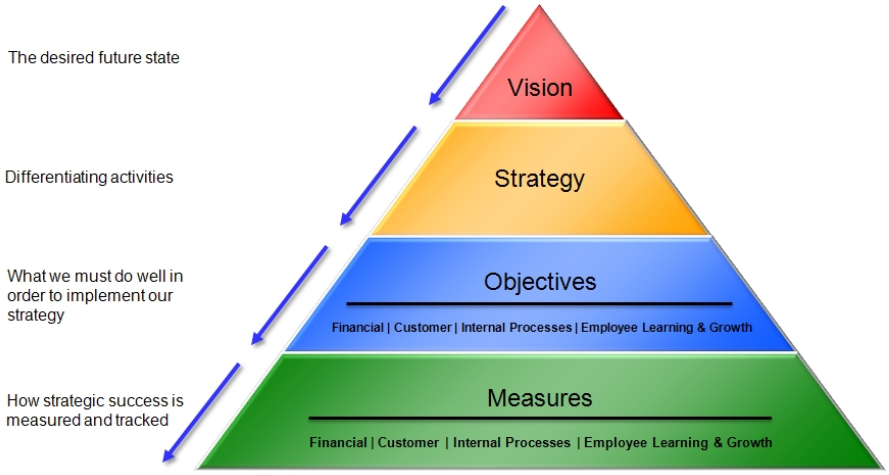


Fig. 3.2. Process Model for developing objectives and measures [NIV02]

At this point, the difference between objectives and measures must be clarified since there seems to be much confusion when organizations start creating BSCs. This sitution could be illustrated by an example of a sailor who wants to build a boat that is larger and faster than those of his competitors. So being large and fast are the objectives. The question that is left open is: how are size and speed quantified? The measure would be now to define the size to be assessed in meters and the speed to be gauged in knots. But the question remains unanswered because the target is still open: how long and how fast? The last point – the target value – is what introduces flexibility, since companies set targets closer and closer from year to year to achieve their strategic goals.

Step 1: Developing Objectives

The first step in the implementation process is to develop objectives for the four perspectives. Before approaching the executives of an organization for

their input, some time should be spent on studying background material in order to have a proper starting point in the interviews:

Fig. 3.3. Sources for Background Information [NIV02]

The next step are the interviews with the executives. For the financial perspective it is important to find out whether the company focuses on efficiency or on cost reduction. This is the key indicator to determine whether, the objectives need to be set up to increase e.g. revenue per employee or, whether an objective is better set up to reduce e.g. fixed cost per transaction.

When discussing customers' objectives, the first step is to determine who the customer is. The indication of the term "customer" in the BSC is not only to focus on the end-customer but everybody in the value-adding-chain. Internal and external customers must be considered and so must be their importance. In contrast to the financial perspective, the real objectives often do not seem to be so clear beforehand. To give an example, many organizations tend to speak of "Increase customer satisfaction" – but what exactly does it mean? Is it the reputation that should be increased or is it the retention of the customer the company is searching for?

The information gathered from the financial and the customer perspective determine which of the internal processes and the corresponding objectives the organization needs to focus on. The number of possible defects in processes should be reduced. This would probably lead to an increased customer satisfaction (from the customer perspective) and an increased net profit, as the costs for correcting the errors are reduced.

In the area of "Employees Learning and Growth" it ought to be determined at this stage what drives the internal processes in order to achieve the desired success. Objectives such as "Increase employee's satisfaction" are often included in BSCs, because companies nowadays realize that it is their human

capital which creates future profits. So this is not only about educating the staff but also about keeping the right people in the company.

Step 2: Determining Measures

As soon as the objectives are established, measures must be in place to monitor, control and set targets for them later on. There are seven criteria for selecting performance measures in BSCs [NIV02]:

- Linked to strategy
  With this criteria it is possible to check whether the objective and its measures help fulfill the vision and are therefore a part of strategic activities. If this cannot be directly linked, the objective should be removed, since it obviously does not satisfy strategic goals. If it seems it does, it might also be necessary to adapt the strategy accordingly.
- Quantitative
  A measure differentiating between "fast", "medium" and "slow" does not provide the possibility to measure changes, because it is not precise. It should be adjusted to number of seconds, for example.
- Accessibility
  Very often measures that would provide the information required are not available because they have not been determined. Either the organization decides to obtain additional measures or uses the ones that are available.
- Easily understood
  One of the goals of implementing a BSC in the company is to motivate employees and make their working results transparent to them. In addition, it needs to be ensured that measures are not too sophisticated but can be understood relatively easily.
- Counterbalanced
  Possible side-effects of measures should be checked before putting them on the scorecard. If a car manufacturer who relies on a supply chain measures the downtime of the assembly line, one must also ensure that there is a measure to determine the timely precision and the quality of suppliers in place.
- Relevant
  Measures must support the objectives. If the measurement changes, the change in the objective should be noticeable.
- Common definition
  Since the scorecards should be cascaded down the whole organization, it is inevitable that all measures are clearly defined. An employee working in the marketing department ought to have the same understanding of customer satisfaction as an employee working on an assembling line.

The proper definition of measures is not the only important thing that requires attention when creating the scorecard – also the number of measures per perspective needs to be considered carefully. Although there is no

agreement on specific numbers, as experts highlight the importance of the environment the scorecard is created in, there is a tendency that can be clearly observed:

- Financials: the financial criteria the company focuses on ought to be very clear – therefore not more than five measures should be utilized.
- Customer: is the driving part in the scorecard and should be assigned higher weight than financials since there are also "enabling" measures – seven to ten measures seem to be applicable
- Internal process: there should be substantial differentiation when cascading the scorecards down the hierarchies in the organization – in general the same number as in the customer's area should be available
- Employee learning & growth: the measures here are the enablers for everything else in the scorecard. Because they reflect the influence on soft factors they should be very focused with a maximum of five measures.

Kaplan and Norton recommend to not have more than 25 measures in total in the scorecard.

Having discussed the criteria and the number of measures in a scorecard, below is an overview of commonly used measures. It is not recommended to simply copy them when creating new scorecards. The process should be more of a support in obtaining a more precise impression as to what drives companies in the various areas and also getting a better understanding of what could guide the company for whom the new scorecard is being created.

Fig. 3.4. Examples for measures [NIV02]

Step 3: Linking

Kaplan and Norton [KN96] explain that

> *"Every measure selected for a scorecard should be part of a link of cause and effect relationships, ending in financial objectives, that represents a strategic theme for the business unit"*

Those involved in the creation of scorecards agree that creating the linkages between the objectives is essentia. It is the precondition to successfully transferring the strategy into the organization, because it "tells the story of the strategy". The critical point here is that the previously identified objectives could turn out not to be adequate enough to describe the story in terms linking them with each other among the various perspectives. In this case it is important to determine what the proper replacements would be to fit into the linkage and to ensure that it is really what the strategy demands.

Another important issue is to ensure that the indicators are balanced between "lagging" and "leading" ones. When identifying objectives, people tend to take the lagging ones because they are more familiar with them. However, since the scorecard should get balanced, leading indicators must be preferred here. We must ensure that they play their part in the "story" as well.

The chart below shows a sample and a downsized scorecard with objectives linked to one another. During the creation of a scorecard in a company this is the point of truth where one can see e.g. the linkage between "Performance Rewards for employees" and the "Profit growth". Detractors say that this is a simplified view of life which leaves out many other environmental factors. Therefore, they consider it as not applicable. Advocates argue that many of these environmental factors do not create value in terms of the strategy and should be, therefore, eliminated. In the end the objectives and linkages that are identified are the "vital few". These are very important for understanding and implementing the strategy. If the senior management feels that they need more than the 25 objectives recommended by Kaplan and Norton because the linkages do not bring their strategy to life, it should be reconsidered whether the strategy that should be implemented is too complex for implementation: history shows that strategies require to be easily understood – otherwise they tend to fail.

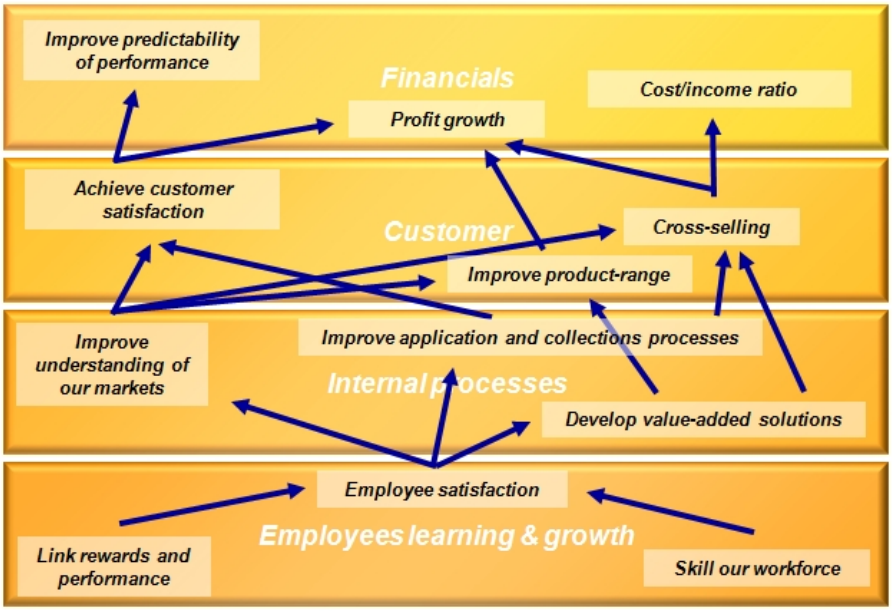


Fig. 3.5. Objectives linked in a BSC

Step 4: Setting targets

Implementing a new strategy is not something that can be achieved from one year to the next. It is a step-by-step approach making sure that the measurements develop in the right direction. When setting the targets for a specific period it is important to have a clear reference between objectives, measures and the targets given, so that the employees understand the way they have been developed. What needs to be emphasized here is that significant changes (they are sometimes demanded in new strategies) often cannot be resolved in the day to day business operations. When defining the targets with clear linkage between them, well defined activities or projects need to be established.

Targets should be set in such a way that they are challenging but realistic. They call for periodical monitoring and a review at the end of the period to see if the expectations were realistic and the approach taken can be continued. Corrective actions applied are differentiated between the level of the target, the objectives or the strategy itself. Implicitly, this describes a key element of the BSC: it is not a one way from senior management to the employees but the other way round: management describes what it wants to have implemented and gets feedback in order to gain the possibility to adapt the vision or strategy accordingly. This leads to a life cycle model for the BSC which is described later on in this paper.

	Objective	Measurement	Target	Action Program
Financial	Improve predictability of performance	Actuals vs. Budget	+/- 20%	MIS implementation
	Profit Growth	Profit this year / profit last year	+ 20%	
	Cost / income ratio	Total cost / EBIT	58%	
Customer	Achieve customer satisfaction	Survey rating (scale 1 - 5)	1,5	Quarterly survey
	Improve product-range	Customer product requests fulfilled	95%	Customer questionaire
	Cross-selling	Product penetration per customer	1,2	
Internal processes	Improve understanding of our markets	Market share	30%	
	Improve applicaton and collection processes	Average processing per application	1 Day	Application Process Improvement Program
		Average processing per collection	1 Week	
	Develop value-added solutions	Process Efficiency Improvement	20%	Six Sigma
Employees learning & growth	Employee satisfaction	Survey rating (scale 1 - 5)	2,0	Yearly survey
	Link rewards and performance	MBOs linked to Balanced Scorecard	80%	
	Skill our workforce	Training days per employee	10	

Fig. 3.6. Targets and initiatives complement the basis set by objectives and measures

Step 5: Cascading

As soon as the scorecard is completed on strategic level the next step is to cascade it downwards to the various business units and departments. This means that every unit must define for itself how it can contribute to the strategic targets in the scorecard and build their own scorecard based on this.

Perspective	Corporate Scorecard	Business Unit Scorecard	Department Scorecard
Financial	F1. Return on Equity	F1. Manageable Cost Reduction F2. Lower Service Agreement Costs	F1. Lower Administrative Spending F2. Rationalize Capital Spending F3. Increase Miscellaneous Revenue
Customer	C1. Customer Loyality Rating C2. Sales Volume	C1. Customer Loyality Rating C2. Outage Performance Index	C1. Customer Loyality Rating C2. Meeting Commitments C3. Meter Reading C4. Call Centre Performance C5. Reliability Index
Internal Process	IP1. Environmental Performance IP2. Number of new products & services	IP1. Environmental Performance IP2. Service Quality Programs in place	IP1. System Maintenance IP2. Inspections IP3. Service Quality Programs
Employee Learning & Growth	E1. Safety Rating E2. Employee Commitment Rating E3. Employee Development	E1. Number of Accidents E2. Employee Commitment Rating E3. Employee Development	E1. Number of Personal Accidents E2. Number of Vehicle Accidents E3. Employee Commitment Rating E4. Employee Development

Clear transparency on how the units contribute to the success of the company

Fig. 3.7. Cascading of objectives in a BSC [NIV02]

When cascading the items, two major topics must be kept in mind:

– Not every unit can contribute to every objective to the same extent and in the same way. Therefore, the scorecards for the departments have to focus

on their abilities and strengths. The accounting department in a company – for example – will not be in a position to support the "Return on Equity" target by increasing sales, as this is not their target. However, they might increase the customers' credibility for having their invoices paid in time or lower costs by making best possible use of payment target dates.

– It needs to be ensured that the linkage of the objectives to the next level of the scorecard is not lost. Employees must be in the position to link their particular targets at any stage to those of the company so as to see how these targes influence and drive the company's success.

Perspective	Objective	Measure	Weight	Threshold	Midpoint	Stretch	Related PDP Goal
Financials 25%	Minimize administrative spending	Local costs	55%	Budget	Budget less 1%	Budget less 2%	• Complete 2 courses in finance
	Grow revenue	Increase departmental miscellaneous revenue	45%	5% increase	10% increase	25% increase	• Lead departmental brainstorming sessions on revenue enhancement
Customer 25%	Customer loyality	Presentations to local trade groups	40%	10	15	20	• Develop 5 new professional contacts this year • Join 2 trade associations
	Outage reliability	Plant visits	60%	20	30	50	
Internal Process 25%	Meter reading and meter changes	% on-time readings	50%	90%	95%	100%	
	System maintenance	Conduct plant audits	50%	25	40	45	
Employee Learning and Growth 25%	Safety	Departmental injuries	60%	2	1	0	• Attend safety training course
	Develop skill sets	% Employee completing education	15%	80%	90%	100%	• Complete facilitator training
	Develop skill sets	Complete Personal Development Plan	10%	-	-	-	• Complete PDP by mid-year
	Employee commitment	Departmental commitment rating	15%	75	80	85	• Support employee volunteer efforts

Clear transparency on how the employee contributes to the success of the company

Fig. 3.8. Transparency down to the goals of every employee [NIV02]

3.1.4 Using the Balanced Scorecard in daily business

With developed scorecards as a starting point, these would then require to be introduced into daily life. Kaplan and Norton recommend not to immediately tie the scorecards to personal reward programs because they should first undergo a testing period to eliminate major inefficiencies. Kaplan and Norton suggest passing through the proposed life cycle once, by just communicating the BSC and having a first look at the resulting measures. By collecting the employee feedback in the review session, it is possible to increase the acceptance, remove employees' fear and establish a new management concept based on clear leading values and rules.

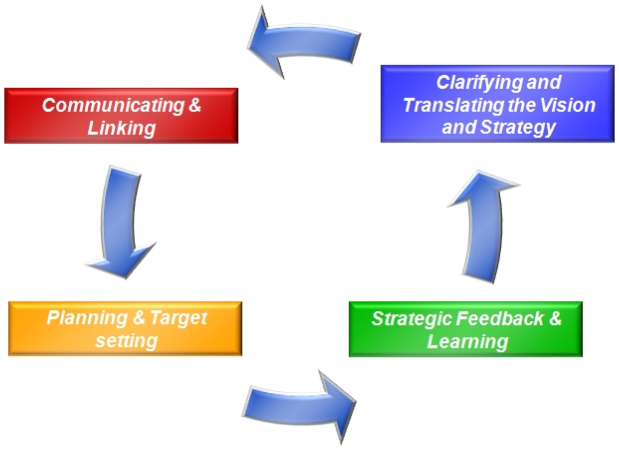


Fig. 3.9. Balanced Scorecard life cycle [KN96]

Looking at the life cycle proposed by Kaplan and Norton it turns out that there is only one major difference compared to life cycles normally shown in management-by-objectives (MBO) programs: the part of clarifying and translating the vision and strategy. This is, at the same time, the crucial extension of classical MBO-programs: they should no longer focus on what the employees should do to maximize the success of their department. Instead, they should focus on the maximization of company's success together with all other employees.

But there is still one major item missing that drives business and also needs to find its way into the methodology of BSCs: Budgeting.

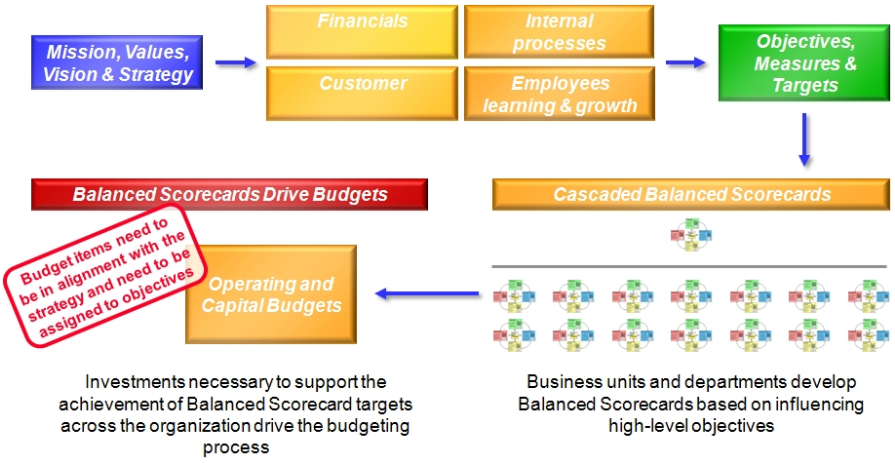


Fig. 3.10. Budgeting based on implemented BSCs [NIV02]

Bearing in mind that the scorecards are cascaded to all departments and, therefore, reflect everything that is important for corporate success, implies

that anything in the budget can be linked to the scorecards once in place. In other words this means that:

- anything that cannot be linked can be eliminated from the budget and
- any budget position can be clearly explained based on its contribution to fulfilling the company's strategy

3.1.5 Linking Business and IT using Balanced Scorecards

BSCs are a significant improvement in the implementation of strategies, but do they comply with IT? This question is a critical one in the scorecards' analysis, since this area is not specifically covered in the publications of Kaplan and Norton. Members of the Information Systems Audit and Control Association (ISACA) began working on this topic because BSCs raised the claim to support Corporate Governance, because it is so strongly pushed in the Sarbanes-Oxley Act. On the other hand the ISACA had a methodology in place called "Control Objectives for Information and related Technology (COBIT) "to support the needs of Corporate Governance from the IT perspective. The crucial information for this explanation of BSCs is: are they in sync or in conflict with each other?

Fig. 3.11. IT Operating Model [SAU00]

According to [SAU00] the parties can be clustered into four groups, all having the expectations of the best possible delivery of results but with different detailed interests in mind:

- Board of Directors / Executive Management
  - What value does IT provide?
  - Does IT enable or retard growth?
  - Does IT advance organizational innovation and learning?
- Audit & Regulatory
  - Are the organization's assets and operations protected?
  - Are the key business and technology risks being managed?
  - Are proper processes and controls in place?
- Line of Business Customers
  - Are we getting value for our IT investments?
  - Are the key business and technology risks being managed?
  - Are proper processes and controls in place?
- IT Organization
  - Are we doing the right things? Are we effective?
  - Where do we need to improve to meet our goals?
  - Have we satisfied all key stakeholder interests?
  - Can we attract / retain the talent we need?

Studying the questions that have been raised, these could be grouped into the four areas of a BSC: financials, customer, processes and employee's learning and growth. This awareness raised the question if BSCs could not be tied to technical issues to support the same target but cover IT-specific requirements and wording. Out of this an initial mapping was developed by [SAU00], tying a Business Strategic BSC to an IT Strategic BSC and also suggesting key topics that needed to be covered, concerning the expectations of the ISACA and the COBIT framework:

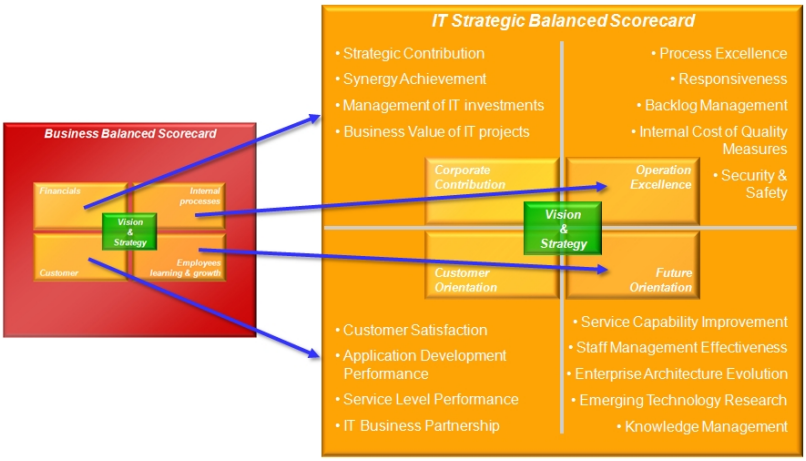


Fig. 3.12. Mapping of a Business BSC to an IT BSC [SAU00]

Remembering the approach of [KN96] and also referring to [NIV02] and his experience that the cascading of a BSC from top to bottom in all layers is one of the critical success factors makes clear that this cannot be the last step of an IT-implementation because this IT BSC covers strategic items only and does not go into enough detail to link them to the MBOs of employees.

Before cascading an IT BSC there is a major difference compared to the cascading of Business BSC, since the ones relevant for IT ought to be split up in so called "IT Development Balanced Scorecards" and "IT Operational Balanced Scorecards". The reason for this is that development and operations in IT require to be handled in completely different ways. They demand a different basic setup, so that the scorecards and employees could be linked to the measures of both scorecards.

With reference to the COBIT framework the question remains whether it is compliant with BSCs or not. It fully meets the terms and the ISACA also provides the mapping between the four domains of COBIT (Planning and Organization, Acquisition and Implementation, Delivery and Support and Monitoring). This demonstrates the consistency between these methodologies:

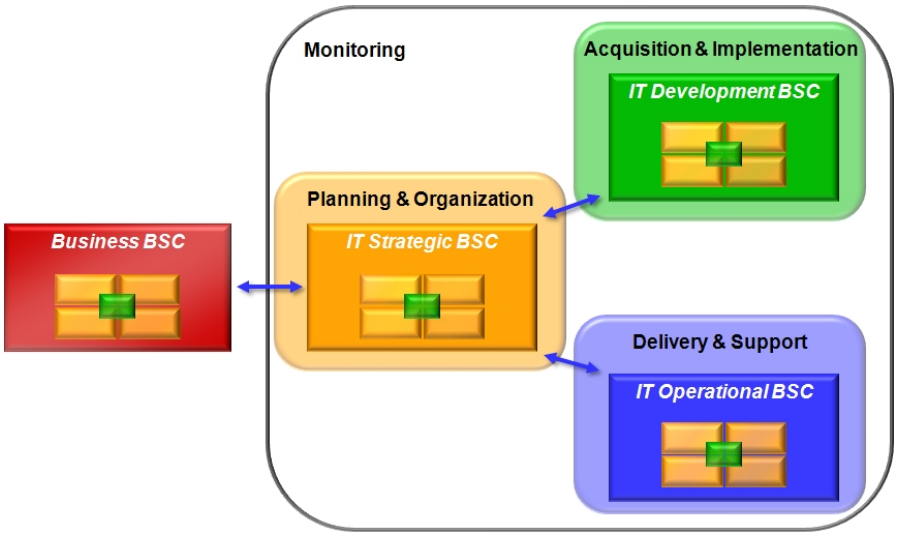


Fig. 3.13. Mapping between COBIT and IT BSCs [SAU03]

All other attributes of Business BSCs can be transferred one by one to IT BSCs such as life cycle, number and definition of objectives and measures, cascading over the units as soon as the difference between development- and operational BSCs has occurred and the input to the budgeting process has taken place.

3.2 Earned Value Methodology (EVM)

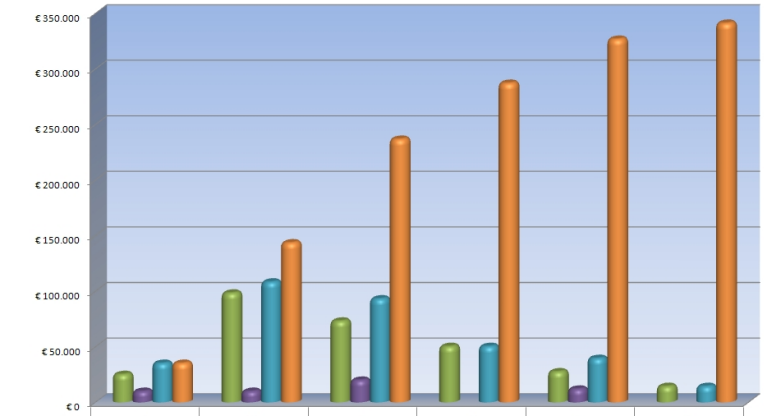
The EVM has its roots in the 1960s in the United States Department of Defense in several concepts that evolved over time. It began with an idea called PERT/COST and developed over time to the Cost/Schedule Control Systems Criteria (C/SCSC) which was based on 35 criteria. Both predecessors did not succeed, because they had been considered too complex for daily business.

Therefore, the methodology was enhanced and resulted in the late 1980s in the EVM adoption. The target for the methodology was to be used by EVM-experts as well as by managers and executives. Finally the ANSI-standard ANSI EIA 748-A was adopted to normalize the implementation of EVM in the industry.

3.2.1 The gauging of the three base-parameters in the EVM

The EVM methodology is based on the efforts that need to be applied during the lifetime of a project. These can be measured either in terms of financials or in terms of person days (PDs) to be spent. Financials are normally preferred because other investments other than labor can be included easily by just adding the amount of the investment to the labor costs in the month when they are expected. This step is carried out during the planning phase of the project and possibly adapted during the project's lifetime, if a decision is taken that the project baseline needs to be revised for any reason.

The chart below shows the sum of labor and investment costs to total cost and the cumulation of cost to get the cost baseline. The planned cumulated costs represent the first important figure in the EVM - the so called Planned Value (PV):

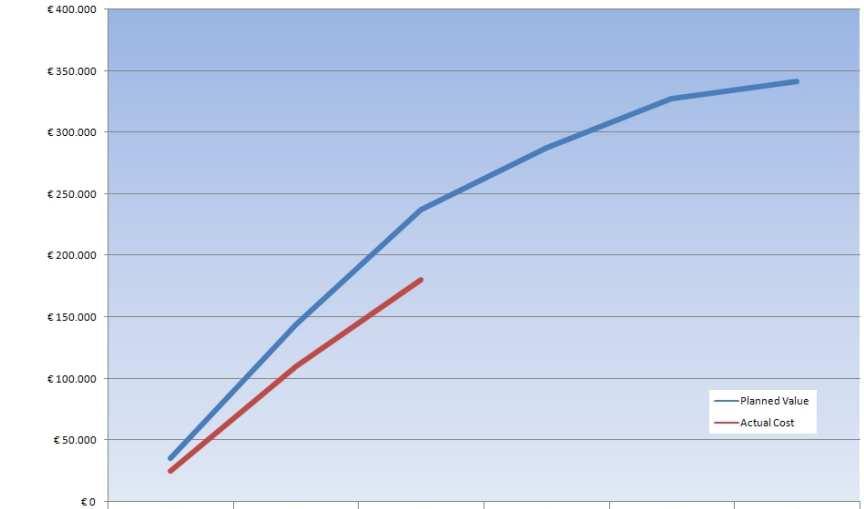


	1	2	3	4	5	6
Cost for Labor	€ 25.200	€ 98.400	€ 73.200	€ 50.400	€ 27.600	€ 14.400
Investment Cost	€ 10.000	€ 10.000	€ 20.000		€ 12.000	
Total Cost	€ 35.200	€ 108.400	€ 93.200	€ 50.400	€ 39.600	€ 14.400
Planned Value	€ 35.200	€ 143.600	€ 236.800	€ 287.200	€ 326.800	€ 341.200

Fig. 3.14. The determination of the Planned Value in the EVM

As soon as the project is started, costs are generated - they represent the second important figure in the EVM, since they allow the comparison between the planned and the actual development of the project in terms of cost. Therefore this factor is called Actual Cost (AC).

The chart below shows the Actual Cost for the first three months of the project example in comparison to the Planned Value:



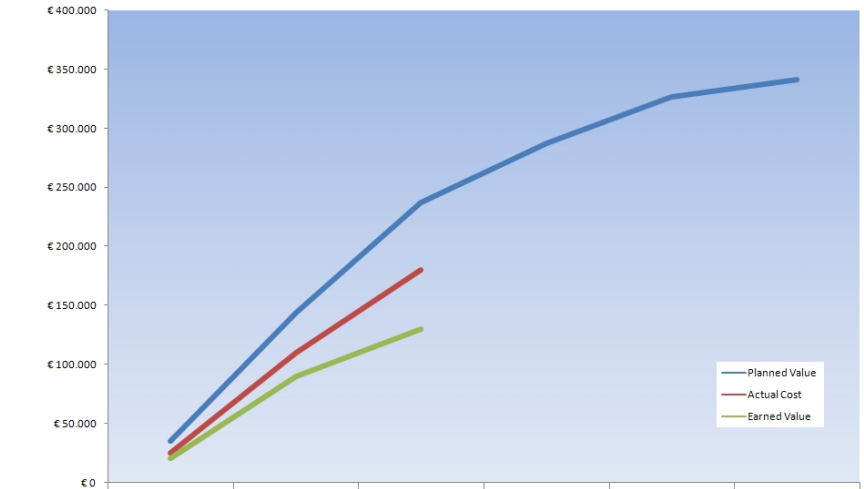
	1	2	3	4	5	6
Planned Value	€ 35.200	€ 143.600	€ 236.800	€ 287.200	€ 326.800	€ 341.200
Actual Cost	€ 25.000	€ 110.000	€ 180.000			

Fig. 3.15. Planned Value and Actual Cost in the EVM

The third and last baseline figure of the EVM is the Earned Value (EV) – it determines the value of the work already done. For finalized tasks in the plan, the original PV for the task should be taken. For ongoing tasks, the progress ought to be multiplied by the PV for the task (e.g. 0,6 x €15.000).

The measurement of the EV is the most difficult of the three, as it does not only rely on hard facts but also on the appraisement by the project manager regarding the results already achieved. Attention during the planning of the project is required to the end that the average size of every task in the project plan does not exceed a defined limit – the larger the limit, the more vague the determination of EV is. Depending on the nature of the project, the industry it is executed in, and the complexity of the project, an acceptable maximum task-size should be defined. Based on experience over various projects and industries the task size should never exceed the financial value of 60 PDs, which implies an effort of three person months (one person month is usually calculated as 20 person days).

The graph below shows an assumption for the EV over the first three months in comparison with the other two parameters already discussed:



	1	2	3	4	5	6
Planned Value	€ 35.200	€ 143.600	€ 236.800	€ 287.200	€ 326.800	€ 341.200
Actual Cost	€ 25.000	€ 110.000	€ 180.000			
Earned Value	€ 20.000	€ 90.000	€ 130.000			

Fig. 3.16. Planned Value, Actual Cost and Earned Value in the EVM

3.2.2 Indicators derived in the EVM

The indicators defined in the EVM present a project situation from a schedule and a financial point of view. The formulas for calculation are composited in the box below.

Cost Variance (CV) $CV = EV - AC$	Cost Performance Index (CPI) $CPI = EV/AC$
Schedule Variance (SV) $SV = EV - PV$	Schedule Performance Index (SPI) $SPI = EV/PV$
Budgeted Cost At Completion (BAC) BAC =Total Amount of PVs	
Estimate To Complete (ETC) $ETC = (BAC - EV)/CPI$	
Estimated Cost at Completion (EAC) $EAC = AC + ETC$ $EAC = AC + BAC - EV$ $EAC = AC + (BAC - EV)/CPI$	

Table 3.1. Indicators in the EVM

The Cost Variance (CV) shows if the project is under or over budget according to the work completed. It calls for notice that this indicator compares

the AC with the EV and not the PV because it is important to understand which costs have been generated compared to the progress in the project, not compared to the cost budgeted. It can be seen from the previous example what the project would look like if under the budget and, therefore, looked rather good. However, the CV shows that there are higher costs than expected compared with the progress achieved. So a negative CV means that the project is above the budget whereas a positive CV represents a project under budget.

The Cost Performance Index (CPI) puts the EV into relation with the AC to see if there are differences between the costs and the earned value - values higher than one indicate an execution below budget, a value smaller than one show that it is more costly than budgeted.

The Schedule Variance (SV) does not deal with the cost but with the progress in relation to what was originally planned. The underlying idea is the same as with the CV - a negative SV represents a project that is behind schedule whereas the opposite refers to a project performing well in terms of schedule. With the SV it is important to understand that it does not measure the days the project is ahead or behind schedule but the financial progress that is achieved compared to the planned financial progress. If the project manager wants to see the time of delay, he needs to compare the EV with the point in time where it is equal with the PV and calculate the difference. In case of a positive SV, the picture is the other way round and the difference on the timeline measures the time the project is ahead of schedule.

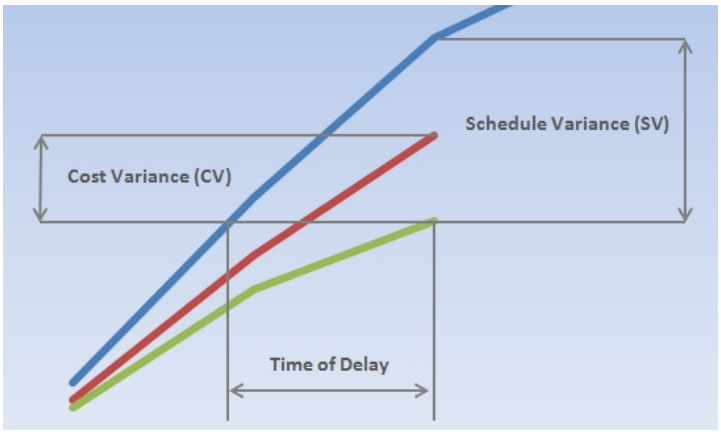


Fig. 3.17. Cost Variance, Schedule Variance and the Time of Delay in an EVM graph

The Schedule Performance Index (SPI) puts the EV into relation with the PV and follows the same interpretation rules as the CPI: a value larger than one represents progress, i.e. being ahead of schedule. A value smaller than one shows that the project is not achieving the planned progress. The ranges that the CPI and SPI should remain within depend on the industry and the type

of project. However [KON07] gives a general indication how the ranges should be interpreted:

EV Threshold	SPI Meaning	CPI Meaning	Management Strategy
$> 1{,}10$	Well ahead of schedule	Well under budget	Revalidate plan, scope & estimates. Be suspicous
0,95 to 1,10	On schedule	On budget	Monitor. Stay tuned to be on track
0,90 to 0,95	Slightly behind schedule	Slightly over budget	Mitigate risks. Early warning alerts.
$< 0{,}90$	Way behind schedule	Way over budget	Initiate corrective actions.

Table 3.2. Earned Value Thresholds and Corrective Strategies [KON07], p.29

The EVM does not only focus on the controlling of progress and real cost based on the actuals, but also allows a forecast into the future for the project based on the actual values. The assumption is that the performance measured by the respective indicators (SPI, CPI) stays the same for the rest of the project. In even more sophisticated approaches, the trend of the performance indicators can be considered.

The Budgeted Cost at Completion (BAC) is the total amount of all PVs or in other words the total budget that is required to accomplish the project. It is necessary to calculate the Estimate to Complete (ETC) and the Estimated Cost at Completion (EAC).

The ETC calculates the total amount of cost the project needs in order to finish. Normally, this should be the BAC minus the EV. Generally speaking, projects do not perform as planned – therefore the value is adjusted by the CPI to get a more accurate estimate of the budget required to finish the project.

The EAC is AC plus the ETC to gain the total budget required for the project. This helps the stakeholders to determine the variance of the total project they need to agree to, so as to successfully finalize the project.

3.2.3 Issues with the Earned Value Methodology and possible solutions

– Changes in the baseline
  The curve created by the PV-values is the baseline for the project's execution. This should to be considered as a change in the baseline (e.g. due to a change request), which implies that the calculated figures in EVM may no longer be comparable with the ones from the previous period. A detailed view of the situation shows the following indicators:

  - CV, CPI
    These indicators should not be affected as they rely on the EV and the AC. Both indicators represent actuals and are measured. However, it ought to be kept in mind that this statement is only true if a change request does not alter PVs in the past (and this should never be the case). In case it does, the EVs, which are usually measured as a percentage of the PV, would represent wrong values.
  - SV, SPI
    In comparison to CV and CPI, these indicators use the PV directly for calculation. However, the same statement is true for $CV and CPI$: if the figures for the PVs in the past are not changed, the indicators remain comparable.
  - BAC
    this indicator naturally changes, because it represents the total PVs
  - ETC
    this indicator normally changes, if the baseline changes. The only exception is the initiation of a change request because of a too high ETC.
  - EAC
    for the EAC the same statement is true as discussed before for the ETC
- Determining a proper value for the EV
  the EV is difficult to quantify because it represents the value creation of a task at a certain point in time. This uncertainty is often criticized by the stakeholders. To resolve this issue and still maintain the explanatory power of EVM, various possibilities have been developed, as described in [PMI05]. The two most important and most used are:
  - Fixed Formula
    using this approach, fixed values of progress are assigned to the task depending on the state of the task. For example using a 50/50 approach, 50% of the EV are assigned as soon as the task starts, and the remaining 50% are added as soon as the task is reported to be finished. To make this approach work properly, the size of the tasks should be limited as described already in this section. Other popular splits are 25/75 or 0/100.
  - Weighted milestones
    in cases where tasks cannot be divided into smaller portions, this approach might help deal with the earned value. It defines milestones during the duration of the task where fixed figures for the earned value are assigned. As soon as the milestone is reached, the earned value increases to the figure defined.

3.3 Risk Management

The evolution of projects over the years demonstrates that actively executed Risk Management plays a very important part in making sure that the project achieves its goals and, at the same time, stays within the constraints defined in terms of schedule, cost and quality. Dealing with risk is divided into several steps during the planning and execution of a project, which will be explained in more detail in the next sections.

At the start of the project – basically in the planning phase of the project – the project manager should to set up an institutionalized Risk Management process for the project. Referring to [PMI04], the baseline for establishing an accurate Risk Management Plan consists of having information on

- the scope (covered in the project charter)
- the roles and responsibilities
- the stakeholder risk tolerances and
- the work breakdown structure (WBS) defined.

1. The Scope (covered in the project charter)
   The project charter is a very important document in the life cycle of a project. It defines the goals of the project and its scope, thereby implicitly defining possible risks that may be encountered by undertaking the endeavor. The important step in the planning of risk is to move the risks from the implicit perception to an explicit one. Clearly defined goals and a clearly stated scope in the project charter are the precondition for an effective Risk Management.
2. Roles and responsibilities
   Furthermore, the execution of the Risk Management process needs a clear understanding of the roles within the process and the assignment of physical persons to these roles. It is common practice to assign the risk management activities to the project manager. However as described in [GAU02] experience has shown that it is more effective to have a controller in place controlling the risks of all ongoing projects, since assigning the project manager to this task often leads to a blindness in terms of identifying changes to risks defined. In addition, the COBIT framework [COB07] defines control objectives, audit guidelines, an implementation toolset and management guidelines for the implementation of risk management processes in IT-environments.
3. Stakeholder risk tolerances
   The dimensions of the project, the role of a stakeholder and their sensitivity towards risks have a major impact on defining the risks in a project. This, for example, means that the business owner would possibly have a heavier focus on risks that have an immediate business impact. Other stakeholders, such as an IT-architect, might focus on the stability and integrity of an IT-system to support and fulfill the business needs. Naturally the sensitivity to the financial value of a risk changes with the overall value

of the project and the value it brings to business goals. In other words, the stakeholders are normally willing to take higher risks in projects if the goals defined promise a significant benefit to the business.

4. Work Breakdown Structure (WBS)
   By definition each activity of a work breakdown structure should have a deliverable as an outcome, otherwise the activity would not be of benefit to the project. All of these activities carry certain risks and that is why an analysis of the WBS has to be carried out. Before accepting the WBS as a source for the identification of risks it is vital to check if the WBS covers the whole scope identified in the project charter. Activities that haven't been executed here would lead to unidentified risks! Moreover, projects should consider the product work breakdown structure (PBS) as well, since many risks for such projects result from product details (e.g. incompatibility between different versions of software used, lack of integration between different products, wrong system sizing, etc.).

These aspects define the environment the project is executed in and take into account existing processes already defined within the company. In terms of defining and controlling the risks the most valuable deliverables refined in the planning stage and documented in the Risk Management Plan are

- the methodology used to define the risks
- the roles and responsibilities in the project
- the availability of budget for risk mitigating activities
- the methodology for scoring the risks
- the definition of the threshold criteria and
- the way risks should be controlled during the execution of the project.

As soon as the development of the Risk Management plan is finished and the document is approved by the sponsor, the next step – the identification of the risks themselves – can be started.

3.3.1 Identification of risks

For the risk identification it is recommended to develop a risk breakdown structure (RBS) - as is the case regarding the work breakdown structure (WBS) and the product breakdown structure (PBS). The RBS helps to categorize the identified risks and also provides a baseline for benchmarking risk categories later on. In contrast to a WBS and a PBS, which may be very individual for every project, [BAK02] developed a category framework which can be used in a very wide range of projects.

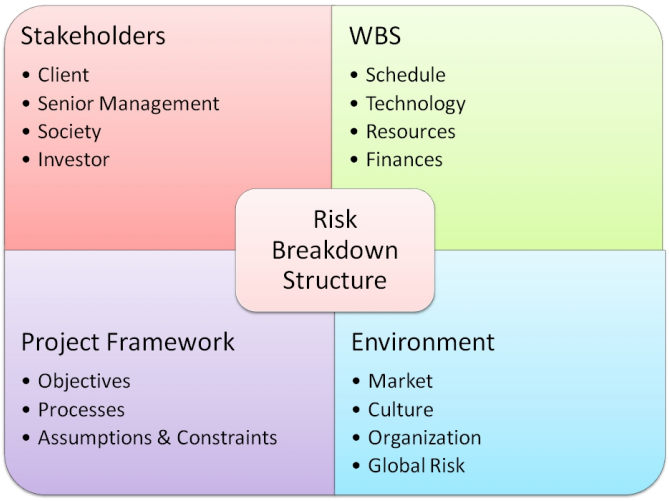


Fig. 3.18. Generic RBS after [BAK02]

Using this kind of generic RBS is a very good baseline covering a wide area of possible risks. However, depending on the field the project runs in, it is necessary to break down some risk areas into more detail. An example for a more specific RBS in the area of software development was suggested by [DWA96].

Level 0	Level 1	Level 2	Level 3
Project Risk	Product Engineering	Requirements	Stability Completeness Feasibility ...
		Design	Functionality Interfaces Testability ...
		Code & unit test	Feasibility Testing Coding / implementation ...
		Integration test	Environment Product System ...
		Engineering specialties	Maintainability Reliability Security ...

Level 0	Level 1	Level 2	Level 3
Project Risk	Development Environment	Development process	Formality Process control Product control ...
		Development system	Capacity Reliability System support ...
		Management process	Planning Project organization Management experience ...
		Management methods	Monitoring Configuration Management Quality Assurance ...
		Work environment	Cooperation Communication Morale ...
	Program constraints	Resources	Staff Budget Facilities ...
		Contract	Type of contract Restrictions Dependencies ...
		Program interfaces	Customer Subcontractors Corporate management ...

Table 3.3. Sample RBS for software development after [DWA96]

For most industrial disciplines, RBS templates are available and can provide a starting point for the risk identification process. An important point to emphasize is that it is reasonable to merge an industrial specific RBS with the one presented in [BAK02], as it merges general and specific risks categories. Companies running projects in a specialized environment (e.g. IT-projects) might think about defining a common risk structure based on this approach.

Based on this generic approach the individual risks have to be mapped to the categories defined and included in the RBS. Methods for gathering this information can be brainstorming, interviewing or the use of cause-and-effect diagram, for example. When entering the identified risks into the RBS, it is important to check whether there is a risk category, which has no risks assigned. If this is the case, it should be double checked whether there is really

no risk to the project in this area or whether they may have been forgotten during the process of risk identification.

3.3.2 Qualitative risk analysis

Risk Management is about the balancing of three factors in a project – schedule, cost and quality. Project managers often call it the "magical triangle":

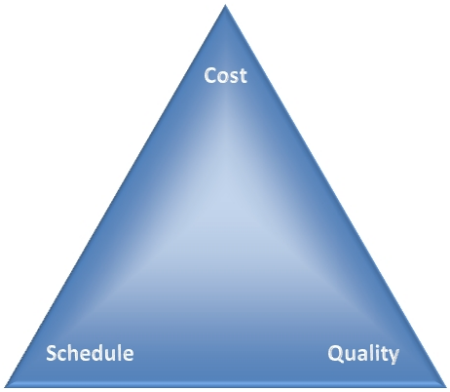


Fig. 3.19. "The Magical Triangle" as described in [PLD03] and [CR06]

During the planning phase of a project, the project is in a perfectly neutral position in the center of the triangle. As soon as a risk occurs, the risk has some impact on schedule, cost and quality – depending on the weight of the impact to each of them the balanced position is lost and moves towards the strongest affinity. Qualitative risk management deals with describing how much and in which way the balance is lost.

Returning to the process, it means that after all the risks have been identified, it is necessary to qualify and determine what an identified risk - should it occur - would mean to the project. This does not represent the financial value of the impact (this will be calculated later on), it is, rather, about identifying the probability and the impact on the magical triangle in regard to the scope. In fact, all the measures given can be expressed in monetary values, but what is meant here is the primary impact. When a team member becomes sick - this is a risk that has a primary impact on the schedule. Of course the project might take longer and therefore cause additional costs, but these costs are in the category of the secondary impact and not shown in this analysis.

The formula to calculate the average impact considering all of the three factors is defined as follows:

$$\text{Average of factors} = \frac{x \times s + y \times c + z \times q}{x + y + z} \tag{3.1}$$

where s is the impact on the schedule, c the impact on cost and q the impact on quality. x, y and z represent the weighting factors that can be varied if the factors should have different importance.

Applying this formula to the example delivers the following table:

Level 0	Level 1	Level 2	Level 3	Level 4	Probability	Impact on Schedule	Impact on Cost	Impact on Quality	Impact on Average
Project Risk	Product Engineering	Requirements	Stability	Risk 1	20%	0,1	0,3	0,4	0,27
				Risk 2	80%	0,8	0,6	0,3	0,57
				Risk 3	50%	0,1	0,2	0,1	0,13
				Risk 4	40%	0,7	0,6	0,5	0,60
				Risk 5	90%	0,7	0,4	0,4	0,50
			Completeness	Risk 1	60%	0,8	0,1	0,3	0,40
				Risk 2	50%	0,2	0,2	0,2	0,20
				Risk 3	20%	0,2	0,4	0,3	0,30
				Risk 4	60%	0,6	0,3	0,5	0,47
			Feasibility	Risk 1	60%	0,4	0,5	0,3	0,40
				Risk 2	90%	0,5	0,8	0,3	0,53
				Risk 3	20%	0,2	0,5	0,2	0,30
				Risk 4	10%	0,7	0,9	0,6	0,73
				Risk 5	90%	0,1	0,4	0,5	0,33
				Risk 6	10%	0,9	0,1	0,5	0,50

Fig. 3.20. Qualification of risks based on the methodology described in [PMI04] p. 249 – 253

As an explanation the figures in the table above show that risk one in the risk area of stability has a 20% probability of occurring. Should this happen, the impact on the schedule is very low (0,1), whereas it has a significant impact on quality (0,4) and a high impact on cost (0,7). The average impact on risk one is then 0,4. Out of the stakeholder risk tolerance analysis done in the risk planning, the probability / impact matrix matrix can be defined as follows:

Risk Score = P x I										
Probability	0,90	0,09	0,18	0,27	0,36	0,45	0,54	0,63	0,72	0,81
	0,80	0,08	0,16	0,24	0,32	0,40	0,48	0,56	0,64	0,72
	0,70	0,07	0,14	0,21	0,28	0,35	0,42	0,49	0,56	0,63
	0,60	0,06	0,12	0,18	0,24	0,30	0,36	0,42	0,48	0,54
	0,50	0,05	0,10	0,15	0,20	0,25	0,30	0,35	0,40	0,45
	0,40	0,04	0,08	0,12	0,16	0,20	0,24	0,28	0,32	0,36
	0,30	0,03	0,06	0,09	0,12	0,15	0,18	0,21	0,24	0,27
	0,20	0,02	0,04	0,06	0,08	0,10	0,12	0,14	0,16	0,18
	0,10	0,01	0,02	0,03	0,04	0,05	0,06	0,07	0,08	0,09
	0,00	0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90
		Impact								

Fig. 3.21. Probability/Impact matrix (a similar one can be found at [PMI04] p. 252)

The multiplication results between the probability and impact give the risk score for a certain risk. The colors indicate the acceptance of the stakeholders towards risk. Green means that stakeholders are willing to take risks with this score, yellow scores require deeper investigation and understanding. They would be decided on an individual basis, whereas red marked risk scores are unacceptable to the stakeholders.

Considering the results of the PI-Analysis and the sensitivity of stakeholders, the following scenario may arise:

Level 0	Level 1	Level 2	Level 3	Level 4	Probability	Impact	RI-Score
Project Risk	Product Engineering	Requirements	Stability	Risk 1	20%	0,27	0,05
				Risk 2	80%	0,57	0,45
				Risk 3	50%	0,13	0,07
				Risk 4	40%	0,60	0,24
				Risk 5	90%	0,50	0,45
			Completeness	Risk 1	60%	0,40	0,24
				Risk 2	50%	0,20	0,10
				Risk 3	20%	0,30	0,06
				Risk 4	60%	0,47	0,28
			Feasibility	Risk 1	60%	0,40	0,24
				Risk 2	90%	0,53	0,48
				Risk 3	20%	0,30	0,06
				Risk 4	10%	0,73	0,07
				Risk 5	90%	0,33	0,30
				Risk 6	10%	0,50	0,05

Fig. 3.22. PI-Scores compared to the stakeholders' risk acceptance based on the methodology described in [PMI04] p. 249 – 253

The graph reflects the different risks identified towards the acceptance of the stakeholders. Taking this example as a baseline, this does not necessarily mean that the project would not be executed, because it contains risks stakeholders would not be willing to accept. These results just provide an indication as to which risks the project manager has to focus on when it comes to risk response planning. In this phase methods will be introduced how to lower the RI-Score by reducing the probability and/or the impact.

3.3.3 Quantitative risk analysis

During qualitative analysis the identified risks were evaluated against their impact on schedule, cost and quality. What is missing is the answer to the question how much cost – both primary and secondary costs – will be assigned to each risk. There are several methods of determining costs associated with risks (for details see [PMI04], p. 138ff). One approach often used in projects is the estimation of the lowest possible, the most likely, and the highest possible cost than can be associated with a certain risk. Again, the three factors are weighted and an average is calculated similar to the formula defined in (3.1):

$$\text{Average cost} = \frac{x \times cl + y \times cml + z \times ch}{x + y + z} \tag{3.2}$$

where cl are the lowest possible cost, cml are the cost that will appear most likely and ch are the highest possible cost. x, y and z represent the weighting factors.

The use of this formula in the last example delivers the following result:

						Cost			
Level 0	Level 1	Level 2	Level 3	Level 4	Probability	Low	Most Likely	High	Average
Project Risk	Product Engineering	Requirements	Stability	Risk 1	20%	10.000	12.000	20.000	14.000
				Risk 2	80%	120.000	200.000	210.000	176.667
				Risk 3	50%	5.000	63.000	87.000	51.667
				Risk 4	40%	65.000	68.000	120.000	84.333
				Risk 5	90%	35.000	55.000	75.000	55.000
			Completeness	Risk 1	60%	21.000	25.000	27.000	24.333
				Risk 2	50%	58.000	59.000	61.000	59.333
				Risk 3	20%	15.000	45.000	80.000	46.667
				Risk 4	60%	5.000	8.000	9.000	7.333
			Feasibility	Risk 1	60%	160.000	200.000	260.000	206.667
				Risk 2	90%	13.000	18.000	29.000	20.000
				Risk 3	20%	53.000	59.000	60.000	57.333
				Risk 4	10%	21.000	60.000	150.000	77.000
				Risk 5	90%	10.000	12.000	18.000	13.333
				Risk 6	10%	17.000	24.000	42.000	27.667

Fig. 3.23. Costs assigned to risks based on the methodology described in [PMI04] p. 254 – 260

The matrix shows some estimates for the lowest, most likely, and highest expectations regarding costs in this project. These estimates are normally carried out by experts in the field to achieve the best possible accuracy. The estimated cost in this example is assumed to be the average cost. In real-life situations this assumption is incorrect, as the values (we know from experience) are not distributed linearly. However, this approach is often chosen because it can also be used by project managers who are not all too familiar with statistical methods. So taking the average values of cost compared with the probability of occurrence leads to:

Level 0	Level 1	Level 2	Level 3	Level 4	Probability	Average	Estimated Cost
Project Risk	Product Engineering	Requirements	Stability	Risk 1	20%	14.000	2.800
				Risk 2	80%	176.667	141.333
				Risk 3	50%	51.667	25.833
				Risk 4	40%	84.333	33.733
				Risk 5	90%	55.000	49.500
			Completeness	Risk 1	60%	24.333	14.600
				Risk 2	50%	59.333	29.667
				Risk 3	20%	46.667	9.333
				Risk 4	60%	7.333	4.400
			Feasibility	Risk 1	60%	206.667	124.000
				Risk 2	90%	20.000	18.000
				Risk 3	20%	57.333	11.467
				Risk 4	10%	77.000	7.700
				Risk 5	90%	13.333	12.000
				Risk 6	10%	27.667	2.767
						Total	487.133

Fig. 3.24. Risk exposure in monetary values based on the methodology described in [PMI04] p. 254 – 260

The multiplication of the probability of occurrence and the average cost give the estimated cost per risk. Summing up the estimated cost per risks shows the risk exposure the project faces, expressed in monetary value.

Now that the risk value assigned to the project is calculated the project manager should also take this into account when pricing the project. This

means that the risk exposure must be placed at the top of the estimated cost for hardware, software and services. Benchmarking done by [TE99] in the area of software development showed that the risk exposure is between 42% and 53% of total project cost.

3.3.4 Risk response planning

Risk response planning deals with bringing the project back to a balanced status in the magical triangle on the one hand, (response to the results of qualitative risk management) and lowering the risk exposure on the other hand (response to the results of quantitative risk management).

In general risk responses can be categorized into four approaches as defined in [PMI04] and also discussed in detail in [HIL99]:

- Avoidance
- Transference
- Mitigation
- Acceptance

Before going into detail regarding the different approaches, there is one general statement missing. It is the one explaining how a risk can be resolved. This situation starts when a risk is triggered and becomes an issue or even a set of issues. All these issues are (hopefully) resolved using a set of actions, which, however, might raise new risks.

Avoidance

As described in [HIL99] avoidance strategies in risk management can be differentiated into direct and indirect ones.

Direct avoidance strategies address lack of knowledge defining certain actions to remove known uncertainty. Such actions can mean undertaking further research, increasing communication or sending an expert who would assess the situation in the field. An example in software development projects might be the collocation of project team members to ensure better communication. Especially in international projects this is often very difficult, but can be facilitated by the use of alternative technologies such phone calls, virtual whiteboards and so on.

For risks that cannot be addressed directly, since they cannot be determined in detail, it may be necessary to change the approach within the project to achieve the goals. Such avoidance responses are called indirect strategies and include the use of proven standards instead of more enhanced but untested technology or the building of redundancy to have a fallback scenario in case of failure.

Transference

Risk transference deals with handing over parts of the project risk to other parties. In IT-projects this could be done by buying a set of standard libraries covering special functionality which should be reused in the application that is going to be developed – in this case the risk of delivering this functionality is transferred to another vendor.

Another option to transfer financial risk is to have vendor contracts on fix-price basis. The prerequisite for such contracts is a clear definition of the product requirements which the vendor must deliver, including an agreement on penalty payments in case the vendor does not meet the defined goals. What is important in this example is that it is not possible to transfer the entire risk, because lost time can never be reclaimed!

Mitigation

The mitigation of risks is the most proactive approach and one which is preferred to the avoidance and transference approaches, because these are very limited in terms of number of risks which can be used outside of their scope. Risk mitigating deals with changing the identified risk score identified in qualitative risk analysis. This means either changing the probability of the risk occurring, or decreasing the impact of the risk.

The availability of experts for projects is an often discussed risk. Considering the score for this risk, the probability could be lowered by locating additional resources in advance to be contacted in case of emergency. The impact could thus be lessened by having more than one key resource available to resolve a certain issue.

Acceptance

All risks that cannot be covered by avoidance, transference or mitigation are those which must be accepted by the stakeholders and the project sponsor. However, despite the risks the project team may be aware of, there are always some unexpected risks.

So, in addition to the risk exposure as defined in the quantitative risk analysis, a given amount of money must be set aside to protect additional time resources or costs from unexpected risks. This is normally called contingency or risk contingency. There are no rules as to how much time should be reserved for this. Assuming a risk management process for projects has been defined, an approach should be chosen which utilizes historical information for calculating a gross factor for contingency, based on the worth of the project.

Criteria for effective responses

As mentioned in [HIL99], the cost of a risk response should never be higher than the amount of money that can be saved by this response. This is defined in the Risk Reduction Leverage factor:

$$\text{RRL} = \frac{\text{Cost impact}_{\text{before response}} - \text{Cost impact}_{\text{after response}}}{\text{Cost of response}} \tag{3.3}$$

This means that a RRL less than one has higher response costs than the risk reduction is worth. [HIL99] benchmarks the measure for "good risk responses" to be higher than 20.

[HIL99] also describes seven criteria that have to be fulfilled in order to achieve an effective response:

- Appropriate
- Affordable
- Actionable
- Assessed
- Agreed
- Allocated
- Accepted

These seem to be obvious to any project manager but experience has shown that defined risk responses are often lacking in the "assessed" and "allocated" criteria. The problem here is that a risk response that has not been accessed cannot be judged to be appropriate, affordable or actionable. This means that the appropriate assessment of a defined risk response is the most important of the above mentioned criteria.

3.3.5 Documenting the risk

Besides the need to assess risks correctly as described in the preceding chapters, it is also necessary to document the findings, approaches and plans to enable parties not involved in the project to gain an overview of the risks possibly accompanying the project. Another sign of a good documentation is that an interested party has access to information and can review the risk history and activities that have been taken to deal with a particular risk.

Baseline for doing this are so-called risk documentation templates covering all important information. The template below is based on Wiegers (1998), but has been revised in order to also contain historical information:

Risk ID: <sequence number>	**Classification:** <risk category, e.g. from SEI taxonomy>	**Report Date:** <date this risk report was last updated>
Description: <description in the sense of condition – consequence>		
Probability: <likelihood of the risk becoming an issue>	**Impact:** <damage the risk can cause to the project in case of occurrence>	**Risk Exposure:** <multiplication of probability times expected loss>
First Indicator: <describes the earliest indicator or trigger condition that turns the risk into an issue>		
Mitigation Approach(es): <describes the approaches out of risk response planning to the risk>		
Date started: <date the implementation of the mitigation plan started>	**Date to complete:** <date the mitigation plan has to be implemented>	**Owner:** <physical person responsible for execution the mitigation plan>
Contingency plan: <actions to be taken if the risk factor becomes an issue>		
Current status: <describes the current status of risk mitigation actions>		
Historical actions: <historical actions set to deal with the risk – important to have an action history for a certain risk>		

Table 3.4. Risk description based on [WIE98]

3.3.6 Risk monitoring and control

In the project execution phase risks undergo an ongoing monitoring and controlling to ensure the following goals defined in [PMI04] are achieved:

- Risk responses have been implemented as planned
- Risk response actions are as effective as expected, or if new responses should be developed
- Project assumptions are still valid
- Risk exposure has changed from its prior state, with analysis of trends
- A risk trigger has occurred
- Proper policies and procedures are followed
- Risks have occurred or arisen that were not previously identified

All these activities result in actions the project manager has to execute during the project. In this context there are three expressions often used during the execution of projects, which can be clarified as follows:

- Workaround / workaround plan
  a workaround leaves the scope of the project untouched; it just changes the approach in which an issue is to be resolved and is usually unplanned
- Corrective action
  this leaves the scope unchanged as well, but is normally a planned action according to the contingency planning of a certain risk
- Change request definitely alter the scope of the project. This might be in the area of schedule, cost or quality; an issue which cannot be resolved by a workaround or a corrective action

During the project's execution there must be a clear assignment of responsibility for risk controlling and monitoring. A very common approach is to have the project manager in charge of this issue, because he is the person most closely connected to the project. It has the advantage that most of the information available is known to the project manager. At the same time, however, it also has the great disadvantage that the subject is no longer viewed objectively. Problems may not be identified, or the chance of a risk may not be recognized – as mentioned by [GAU02].

To resolve such an issue, it might be necessary to regard risk management in a broader context than in the context of a single project. For companies focusing on IT projects, it may be useful to consider the COBIT framework ([COB07]). This framework covers risk management from an organizational standpoint, supporting the implementation of business requirements in IT-environments and also taking a look at project management in the same context.

4

Constructing the Framework

The state of the art in Project Portfolio Management was presented (chapter 2) as was an overview of complementing theories (chapter 3). This chapter is dedicated to the development of a novel IT Project Portfolio Management framework which delivers substantial new features to the existing methodologies. These enable the alignment of the IT project portfolio with the strategy of a company, starting from the selection of the portfolio through its life cycle all the way to measuring the expected benefits.

Before actually developing the framework, an excerpt of definitions for a conceptual frameworks shall be given. Thus it is

- *"a skeletal structure designed to support or enclose something"* [RHD09]
- *"a frame or structure composed of parts fitted and joined together"* [RHD09]
- *"a particular set of beliefs, ideas, or rules referred to in order to solve a problem"* [HCP06]
- *"an essential support structure"* [COD05] that is *"connected to outcomes or problem resolution because [...] it aids in making judgment"* [ST06]

Frameworks can be divided into

- socio-cultural -
- business oriented - and
- technologically oriented frameworks

For the framework described in this thesis, mostly concepts for business oriented- and technologically oriented frameworks have served as foundations. Examples for the first category can be found in [BGG99] and for the latter one in [EVA07] or [VOI08]. However, cultural frameworks, as for example in [ZPS01], have to a certain extent supported this thesis by providing ideas on designing frameworks.

In the field of Project Portfolio Management numerous frameworks are available, such as the ones described in [MVC94], [AG99], [CLE99] or [PD02]. In general, all of them demonstrate at least one of the following weaknesses:

- they only describe a specific part of the project portfolio management life cycle,
- they do not relate to the strategy of a company or
- they do not provide a possibility to tailor parts of the framework to the company's specific needs

Especially [PD02] presents many valuable ideas that lead in the direction of strategy oriented project portfolio selection and execution. Because the model depicted here was not represented by a meta-model, the approach could not be extended towards the needs expressed in this thesis. It was more convenient and less effort to create a new framework and include useful concepts and thoughts from the state of the art in project portfolio management and from the sources mentioned above.

4.1 Components of the framework

The IT Project Portfolio Management Framework described in this chapter covers all these weaknesses. It consists of a meta-model, the model, the method and the tool-support. Especially the meta-model needs to be highlighted, since it provides flexibility to the framework. This can then be tailored to specific needs of companies and industries besides the one it was tested for – the banking industry.

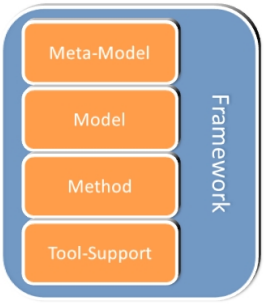


Fig. 4.1. The components of the IT Project Portfolio Management Framework

First of all general definitions for the notions of a meta-model, a model and a method are presented, followed by their specific meaning in this thesis. The detailed description is follows in the upcoming sections.

According to [MMC02]

> *"A meta-model is a precise definition of the constructs and rules needed for creating semantic models."*

Because it is an abstraction of a model, it ensures that parts of the model may be modified and yet not lose its context and its readability. In this framework the **meta-model** defines the general setup of the model that links the strategy of companies with the selection and execution of their IT project portfolios. As the representation of a strategy or relevant indicators for the evaluation of project portfolios might differ between companies or industries, the usage of a meta-model ensures that the framework can still be applied. In such a case the model would be extended or replaced, because as long as it stays compliant with the defined meta-model, all other parts of the framework are not harmed. The notation used is the one of UML – the unified markup language.

The notion of a **model** is used with many different meanings. Examples are business models, causal models, data models, mathematical models, mechanistical models, statistical models or abstract models. The type of model used in the context of this framework is an abstract model and was defined by [GOO00] as follows:

> *"A model in science is a physical, mathematical, or logical representation of a system of entities, phenomena, or processes. Basically a model is a simplified abstract view of the complex reality. It may focus on particular views, enforcing the 'divide and conquer' principle for a compound problem"*

The model used in this framework represents the implementation of the meta-model by combining and extending various existing and proven models such as the Balanced Scorecard (see section 3.1), Earned Value (see section 3.2), the Risk Management model of PMI (see section 3.3) and the Project Portfolio Management model (see section 2).

The term **method** is derived from the greek word methodos ($\mu\epsilon\theta o\delta o\varsigma$) which describes the way of doing something. It defines the application of the elements in the model in a set of processes and describes how the results are achieved and interpreted. The processes in this framework are defined so as to be be applicable with any changes of the model, as they refer generally to any kind of indicators with one exception: the processes shown using depreciation depend on financial indicators. If they are not represented in the model, these portions of the method are obsolete. The notation used is the same as for the meta-model – UML.

The **tool-support** gives an insight into how the model and the method can be implemented in a software solution to support the processing of large volumes of data and effectively apply the framework in a real life environment.

It is used to test the other parts of the framework against the reality – in this special case against data from a real life portfolio taken from a bank active in international business. In general the same tool might be used to do adapted testing for other industries as well.

4.2 Assumptions and prerequisites needed for this framework's application

Before going into the description of the framework's components, the assumptions and prerequisites needed for this framework's application shall be defined. Without having these in place the framework cannot be utilized effectively.

The company needs to have an operational Balanced Scorecard (BSC) in place which has proven to be well tailored to fit the necessities of the organization. This means to have identified the proper measures and linkages by describing the business correctly. Especially the α-factors are vital, in order to estimate the expected project's influence on the achievement of strategic goals.

The measures identification is a fundamental step but the quality of the data collected is even more important. Without reliable data the influence on the companies' goals by the projects cannot be determined. Conclusions drawn from a data basis with a high aberration would lead to wrong conclusions and inaccurate decisions.

The management must be skilled enough to interpret the BSC and able to take decisions that support the targets defined in the BSC. Further, it has to act as a role model for the employees to improve the team spirit and thereby help the implementations of this framework.

Moreover, the people working in the field of IT Project Portfolio Management need to develop a "big picture" for the project portfolio. They must be able to see not only the influence of a single project on the measures, but also understand the dependencies between the projects so as to identify possible amplification or effects on measures. This turns them into qualified supporters of the top management capable of taking strategic decisions.

Subject matter experts need to understand the BSC and its α-factors in great detail since they provide the estimates for projects where no evidence for the influence on the measures can be obtained from experience. Unrealistic estimates can ruin the whole project portfolio because wrong projects might become selected.

Besides the application of a standardized project management methodology,

Project Managers need to enhance and hone their skills. They must think about and concentrate on how their decisions might influence the measures defined in the BSC. This includes also the setup of a project plan and measurement system that does not only focus on traditional measures such as time and cost, but also covers all related α-factors from the BSC.

In general the introduction of this framework requires a mindset and an attitude different from those which are normally found in most companies. This might be difficult to achieve but will be rewarded by a higher transparency for the management and a success for the company.

4.3 The Meta-model

The UML class diagram below provides an overview of the meta-model:

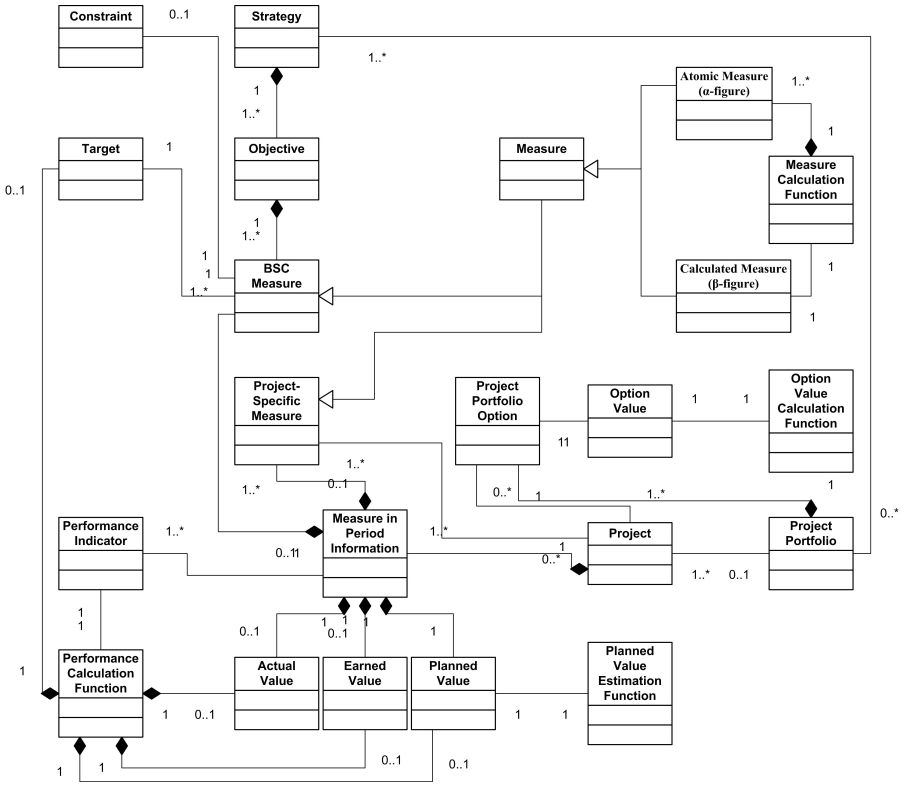


Fig. 4.2. The Meta-Model

The *strategy* of a company is represented by a set of *objectives* which can be determined by the usage of *BSC measures*. Every *measure* is either *atomic* (the measure cannot be further divided) or *calculated* by the composition of

atomic measures. Any one of them has a target value that should be achieved within a defined period. At the same time measures might underlie *constraints*.

The strategy implementation requires the execution of *project portfolios*. During the preparation of these portfolios different sets of *project portfolio options* consisting of *projects* are considered and each of the options is prioritized by its *option value*. As soon as the option with the optimal option value is selected, the set of projects for the actual execution of the project portfolio is determined.

Every project supports the strategy fulfillment by contributing to *BSC-measures*. Besides these, there are also *project-specific measures* that need to be considered. Both types of measures are collected at the end. There exists a *planned-*, an *earned-* and an *actual value* for any of the measures and a set of *performance indicators*.

A more detailed description of the entities in the meta-model is given below:

Strategy: the company's strategy represents the transformation of the vision for the future to the actual implementation of the actions necessary to achieve this vision.

Objective: the strategic targets which are defined on an abstract level are broken down to the tactical level – the objectives. Each one of them describes an important factor for the implementation of the strategy verbally, without describing how it might me measured or mentioning a target value.

Measure: to make objectives transparent and implementable, each of them need to be quantifiable by one or more measures. These can either be atomic measures or calculated measures. Identified measures are either related to the implementation of the BSC (BSC Measure) or are necessary to run a project within a portfolio (Project-Specific Measure).

Atomic Measure: this type of measure is also called α-figure and is defined so that its content cannot be further divided. An example would be the number of customers in a company – they can be identified as an entity and counted.

Calculated Measure: the so called β-figures can be distinguished from the α-figures since they need several α-figures to be calculated. For instance the total income of a bank might be calculated from the non-retail, the retail and the treasury income.

Measure Calculation Function: the function for the calculated measures are precisely described to ensure the consistency of the model over time. Changes in these functions would inevitably lead to the loss of comparability of the β-figures over the observation period.

BSC Measures: the measures that are part of the Balanced Scorecard are collected in this entity.

Target: all measures have assigned target values that indicate the goal that should be achieved within a certain planning horizon. They are defined by a measure descriptor in the scale set by the measure.

Constraint: because the execution of business underlies certain restrictions, these limitations need to have their representation in the model. They are described in the same way as the targets.

Project Portfolio: because strategy is about changing the current way of work, it is related to a set of project portfolios. These are normally related to more detailed subsets of the strategy and contain projects.

Project Portfolio Option: before a project portfolio is created, all possible project combinations for the portfolio are evaluated. The option that has the highest option value is normally the one selected and the project portfolio is created based on the set of projects in it.

Option Value: the option value is a measure that quantifies the worth of the option. It is comparable to other option values as all option values use the same scale.

Option Value Calculation Function: this function describes the calculation rules to determine the option value.

Project: the project consists of a set of measures in period information over its life cycle and is assigned to a single project portfolio as soon as it is executed – as long as it is not selected for execution it might not be allocated to a project portfolio.

Project-Specific Measure: measures that are not directly relevant for the implementation of the strategy but necessary for the execution of a project are captured in this entity.

Measure in Period Information: the period information is composed of a measure and its planned value, earned value and an actual value.

Planned Value: every period of the project life cycle needs to have assigned a value for each according measure that represents the estimated figure at this certain point in time. Its value is estimated using the function described in the **Planned Value Estimation Function**.

Earned Value: independently from the timely progress of a project the progress of the content can be measured, which is captured by this figure.

Actual Value: this figure is captured during the execution of the project and represents the actually achieved value.

Performance Indicator: a performance indicator compares planned, target and actual values to provide information as to whether or not the plans can be achieved. There might be several performance indicators available for a measure at a single point in time. All of them are described using **Performance Calculation Functions**.

4.4 The Model

The meta-model described in the previous section is now implemented as a model combining and extending four already existing and proven models – the Balanced Scorecard (see section 3.1), Earned Value (see section 3.2), the Risk Management model of PMI (see section 3.3) and the Project Portfolio Management model (see section 2). The graph below provides a rough overview of the meta-model areas where these models are implemented:

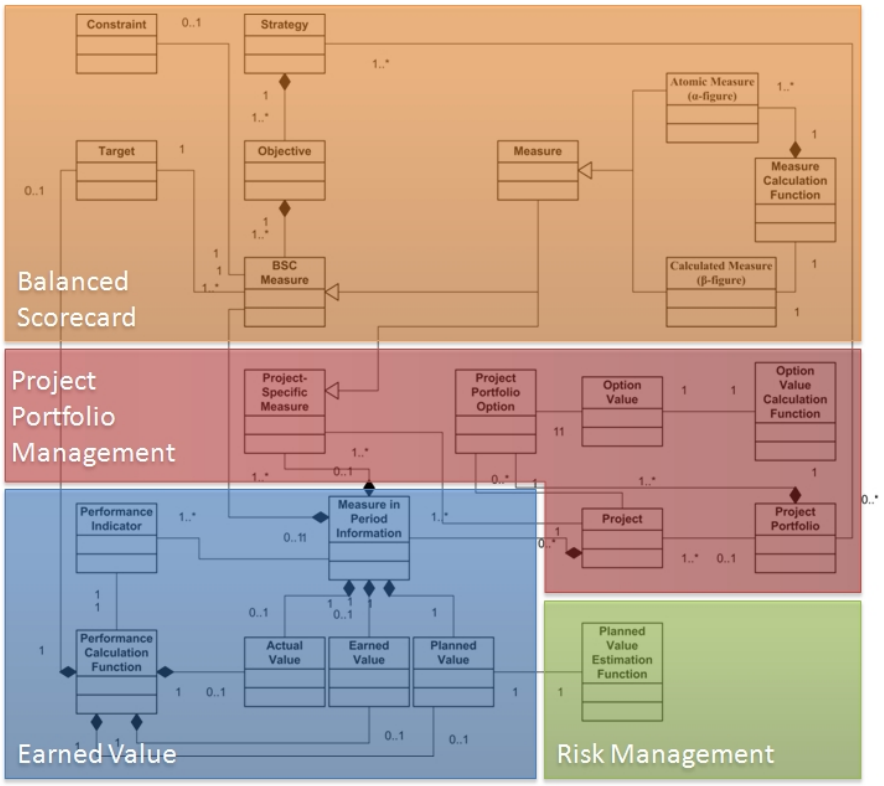


Fig. 4.3. Applied models in the meta-model of IT Project Portfolio Management

The next sections show how the various models are applied in the meta-model for IT Project Portfolio Management and how they are extended to improve the field of IT Project Portfolio Management.

4.4.1 Balanced Scorecard (BSC) -based part of the model

The BSC based part of the models relies to a large extent on what Robert S. Kaplan and David P. Norton defined in their work [KN96] and was explained already in section 3.1. The BSC identifies objectives based on the strategy and

the influences between them. It tries to reduce these objectives to factors that do not represent aggregate figures but absolute values that cannot be further decomposed (so called α-figures). Their transformation into operational KPIs (so called β-figures) is defined in the mathematical model of the BSC that is represented in the Measure Calculation Function of the meta-model. All measures in the model have a target value that needs to be achieved and which underlie certain constraints that are defined by measures. The assumption in the BSC is that all relevant factors driving the company are captured and, therefore, also all limiting factors are thus represented. The model represents the full implementation of the BSC concept. For this reason a more detailed description of this concept is not included in this thesis.

The original model of BSCs is extended by two topics:

- Definition of different types of targets and constraints
- Adaptation of the model in order to be able to apply it to IT project portfolios

Definition of different types of targets and constrains

Recent approaches outside the BSC model attempt to formulate every target or constraint as a financial one, arguing that any issue can be removed by monetary investments. In reality, this is not the case: e.g. specific skills might not be available. The BSC approach acknowledges that there are many other factors. However, such target values are not defined very precisely. The model talks about stretch targets but leaves open the problem as to how these targets ought to be defined. Implicitly, it is assumed that a pinpointed value is to be assigned. The question of constraints is even completely left out of the original model. The thesis extends the model in a way that all relevant indicators for targeting and constraining measures are represented in the α- and the derived β-figures. This also implies that the relevant constraints for the portfolio can only affect one of these figures.

Real life experiences show that targets and constraints can rarely be determined as a pinpointed value. It is more suitable to define them as one out of four possibilities:

- a fixed value
- a range between two defined values
- a minimum value (which is a a range between the minimum value and $+\infty$) or
- a maximum value (which is a a range between $-\infty$ and the maximum value)

This extension of the BSC related part of the meta-model is represented in the following chart:

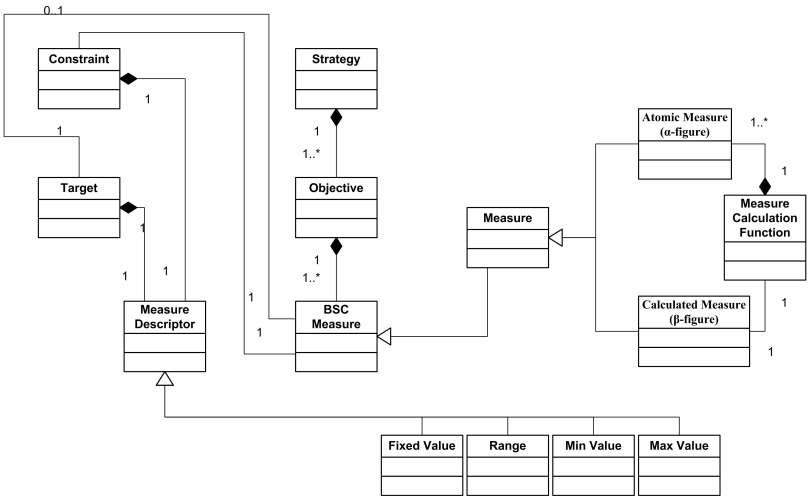


Fig. 4.4. Implementation of the Balanced Scorecard-Part of the model

Adaptation of the model and its application to IT project portfolios

The second extension of the traditional view is to use the measures and KPIs identified in a BSC, so as to determine the project's influence on this particular BSC. This implies that the projects can be evaluated regarding their contribution to the strategy defined in the BSC.

As discussed at the beginning of this section, the BSC identifies objectives and their reciprocal effects. To determine the project's contribution to the strategy, every determined α-figure needs to be checked, whether or not it has been changed by the execution or results of a project during the life cycle of the project or a fixed observation period following the end of the project in the project portfolio. The figure below describes the projects in a portfolio ($P_1 \ldots P_m$), the BSC input variables ($\mathrm{B}\alpha_1 \ldots \mathrm{B}\alpha_n$) and the BSC output variables ($\mathrm{B}\beta_1 \ldots \mathrm{B}\beta_n$). The B stands for BSC – there will be additional input- and output-variables coming from projects itself described afterwards, so this identifier is required.

Project	BSC Input Variables		
	$\mathrm{B}\alpha_1$	$\ldots$	$\mathrm{B}\alpha_n$
P_1	$P_1\mathrm{B}\alpha_1$	$\ldots$	$P_1\mathrm{B}\alpha_n$
$\vdots$	$\vdots$	$\ddots$	$\vdots$
P_m	$P_m\mathrm{B}\alpha_1$	$\ldots$	$P_m\mathrm{B}\alpha_n$

$\Longrightarrow$

Project	BSC Output Variables		
	$\mathrm{B}\beta_1$	$\ldots$	$\mathrm{B}\beta_o$
P_1	$P_1\mathrm{B}\beta_1$	$\ldots$	$P_1\mathrm{B}\beta_o$
$\vdots$	$\vdots$	$\ddots$	$\vdots$
P_m	$P_m\mathrm{B}\beta_1$	$\ldots$	$P_m\mathrm{B}\beta_o$

Fig. 4.5. Transformation from BSC input- to output variables

For the evaluation of projects it is important to understand how the finished project will change the α-figures of the BSC. The expected change in the strategic figures (the β figures) can be calculated from the transformation (a n:m transformation between input- and output-variables).

The total benefit of the project portfolio can be determined by summarizing the α-figures of all selected projects and calculating the corresponding β-figures based on the rule-set defined from their relations:

Project	BSC Input Variables		
	$B\alpha_1$	...	$B\alpha_n$
P_1	$P_1 B\alpha_1$	...	$P_1 B\alpha_n$
$\vdots$	$\vdots$	$\ddots$	$\vdots$
P_m	$P_m B\alpha_1$	...	$P_m B\alpha_n$
	$\sum B\alpha_1$	...	$\sum B\alpha_n$

$\Longrightarrow$

BSC Output Variables		
$B\beta_1$	...	$B\beta_o$

Table 4.1. Accumulation and transformation from BSC input-variables to gain the benefits for the project portfolio

Consolidating the information of the different β-figures per period and per project within the project portfolio provide a picture on how the different β-figures grow over time. This is nothing else than the growth of the benefit created by the underlying portfolio over time. An example for such a development is shown below:

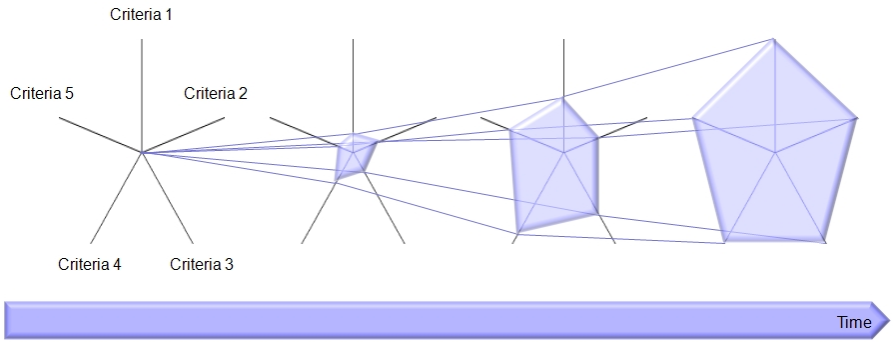


Fig. 4.6. Example for the development of benefit criteria in a project portfolio over time

4.4.2 Earned Value (EV) -based part of the model

The model of Earned Value Management (EVM) as described in section 3.2 is used as a basis by this model. However, the concepts behind this are extended to other areas of the model as well. The EVM measures in its model everything in the relationship between monetary effort and time. The measures are defined as the planned value, the earned value and the actual value.

The indicators to steer a project are basically represented by variances and performance indices of schedule and cost.

There are two major extension compared to the original model:

- The usage of EVM for project portfolios
- The usage of EVM for other factors than cost and time

Before going into details, an overview on the extensions of the model is provided in the figure below:

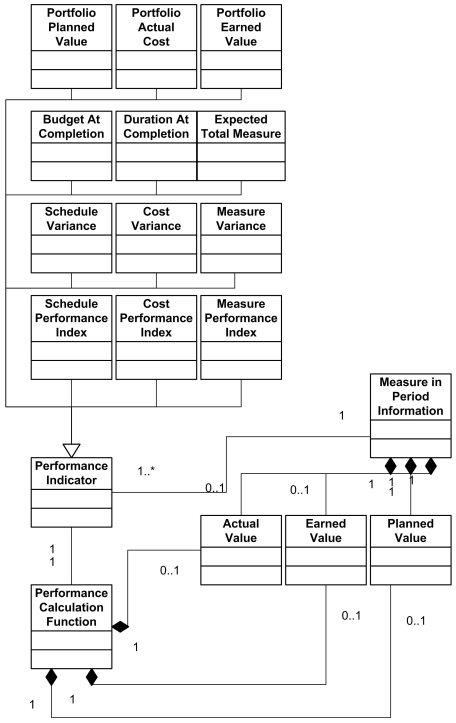


Fig. 4.7. Implementation of the Earned Value-Part of the model

EVM for project portfolios

The figures collected in a project normally are the planned value (PV), actual cost (AC) and the earned value (EV). The PV must be available for the whole lifetime of a project whereas the AC and EV are only available up to the actual point in time (APIT):

	Period				
	1	...	APIT	...	n
PV	PV_1	...	PV_{APIT}	...	PV_n
AC	AC_1	...	AC_{APIT}		
EV	EV_1	...	EV_{APIT}		

Fig. 4.8. Matrix displaying Planned Value (PV), Actual Cost (AC) and Earned Value (EV) for a project

To apply this to project portfolios and to obtain the figures for the Portfolio Planned Value (PPV), the Portfolio Actual Cost (PAC) and the Portfolio Earned Value (PEV) for the APIT the data needs to be summed up by category (PV, AC and EV) and period over all projects:

$$PPV_{APIT} = \sum_{n} PV_{n,APIT} \tag{4.1}$$

$$PAC_{APIT} = \sum_{n} AC_{n,APIT} \tag{4.2}$$

$$PEV_{APIT} = \sum_{n} EV_{n,APIT} \tag{4.3}$$

Adapted from the definition in EVM the Portfolio Cost Variance (PCV), Portfolio Schedule Variance (PSV), Portfolio Cost Performance Index (PCPI) and Portfolio Schedule Performance Index (PSPI) are calculated accordingly:

$$PCV_{APIT} = PEV_{APIT} - PAC_{APIT} \tag{4.4}$$

$$PSV_{APIT} = PEV_{APIT} - PPV_{APIT} \tag{4.5}$$

$$PCPI_{APIT} = \frac{PEV_{APIT}}{PAC_{APIT}} \tag{4.6}$$

$$PSPI_{APIT} = \frac{PEV_{APIT}}{PPV_{APIT}} \tag{4.7}$$

The EVM foresees the possibility of forecasting the estimated budget and schedule by multiplying the planned value by the performance index for the indicator. For project portfolios this works the same way by taking the total planned value and the performance indices aggregated for the entire portfolio:

$$BAC = \frac{TPV}{PCPI_{APIT}} \tag{4.8}$$

where BAC is the budget at completion, TPV is the total planned planned value in terms of cost and $PCPI_{APIT}$ represents the cost performance indicator of the portfolio at the actual point in time.

$$DAC = \frac{TPD}{PSPI_{APIT}} \tag{4.9}$$

where DAC is the duration at completion, TPD is the total planned duration and $PSPI_{APIT}$ represents the schedule performance indicator of the portfolio at the actual point in time.

EVM for other factors than cost and time

The concept of planning cost and schedule for project can also be applied to the α-figures of a BSC. Through the lifetime of a project these figures can also be captured and placed back in the project portfolio, to see whether the planned values could be achieved. The resulting matrix is comparable to the one in figure 4.8 and looks as follows:

α-factors		1	...	Period APIT	...	n
α_1	Planned	$P\alpha_{1,1}$	...	$P\alpha_{1,APIT}$	...	$P\alpha_{1,n}$
	Actual	$A\alpha_{1,1}$	...	$A\alpha_{1,APIT}$		
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$		
α_m	Planned	$P\alpha_{m,n}$	...	$P\alpha_{m,APIT}$	...	$P\alpha_{m,n}$
	Actual	$A\alpha_{m,n}$	...	$A\alpha_{m,APIT}$		

Fig. 4.9. Matrix displaying all adjusted and adapted α-factors over time plus their actual values

The α-figures have to be tracked as well as the project-specific parameters. Therefore two indicators defined in the EVM in table 3.1 are applied in a slightly adapted way – the variance and the performance index. As EVM normally only measures schedule and cost for both these indicators, this approach extends the view by applying these indicators to every α-factor. This leads to a redefinition for both indicators:

$$\text{Measure Variance} = A\alpha_{APIT} - P\alpha_{APIT} \tag{4.10}$$

$$\text{Measure Performance Indicator} = \frac{A\alpha_{APIT}}{P\alpha_{APIT}} \tag{4.11}$$

where $A\alpha_{APIT}$ is the actual value and $P\alpha_{APIT}$ is the planned value of α in the actual point in time. The interpretation stays the same as it was defined by EVM:

- Variance
  - a negative variance implies that the actual results do not meet the expectations of the plan
  - a null-value represents the α-factor developing as expected
  - a positive variance shows that the plan has exceeded the forecast
- Performance
  - a value < 1 implies that the actual results are behind the expectations of the plan
  - a value of about 1 represents the α-factor developing as expected
  - a value > 1 shows that the plan has exceeded the forecast

In addition, the digits behind the comma show the deviation of the plan in percent. There is one weakness of the performance indicator that must be mentioned: if there are actuals for an α-indicator ($A\alpha$) before there is a planned value ($P\alpha$) for it, the indicator shows zero, although the value is above expectations.

In the area of benefits the topic of forecasting is, of course, very important. The foundation of EVM can be applied in this case to update the α-factors. The projected value for an α-factor can be expected to be:

$$ET\alpha = TP\alpha \times \alpha PI \tag{4.12}$$

where $ET\alpha$ is the total expected value for α-factor at the end of the portfolio's lifetime, $TP\alpha$ is the total planned value for the α-factor and αPI represents the α-factor performance indicator, as it was introduced in equation 4.11. This extends the matrix defined in figure 4.9 to:

α-factors		Period 1	...	n	ETα
α_1	Planned	$P\alpha_{1,1}$	...	$P\alpha_{1,n}$	$ET\alpha_1$
	Actual	$A\alpha_{1,1}$	...	$A\alpha_{1,n}$	
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$
α_m	Planned	$P\alpha_{m,n}$	...	$P\alpha_{m,n}$	$ET\alpha_m$
	Actual	$A\alpha_{m,n}$	...	$A\alpha_{m,n}$	

Fig. 4.10. Matrix displaying all adjusted and adapted α-factors over time, their actual values and the expected α values at the end of the lifetime of the project portfolio

4.4.3 Risk Management (RM) -based part of the model

Section 4.4.2 already defined the aggregation functions for the Planned Value in a Project Portfolio. What has been left out so far is the answer to the question of how the planned value is estimated. For software-development projects a set of methods can be found at [JAN08]. However this model makes use of an approach that can be used independently from the industry or type of project. Therefore, it uses methodology applied in Risk Management.

The first thing to do in risk analysis is to determine the risks that should be evaluated. When applying this to benefits, the solution is rather simple: the main items to be evaluated are the benefit indicators or α-figures from the BSC. The matching with the projects in the portfolio results in a matrix that shows which of the α-figures is influenced by which project:

	P_1	...	P_n
$\mathrm{B}\alpha_1$	yes/no	...	yes/no
$\vdots$	$\vdots$	$\ddots$	$\vdots$
$\mathrm{B}\alpha_m$	yes/no	...	yes/no

Table 4.2. Contribution matrix for projects to the benefit indicators - step 1.1

Following this, the matrix is extended in a way that any contribution is replaced by three information items:

- lowest possible influence(il), if the project influences the benefit-indicator
- most probable influence(ip), if the project influences the benefit-indicator
- highest possible influence(ih), if the project influences the benefit-indicator

This yields the following matrix:

	P_1			...	P_n		
	il_1	ip_1	ih_1	...	il_n	ip_n	ih_n
$\mathrm{B}\alpha_1$	$il_{1,1}$	$ip_{1,1}$	$ih_{1,1}$	...	$il_{1,n}$	$ip_{1,n}$	$ih_{1,n}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\vdots$
$\mathrm{B}\alpha_m$	$il_{m,1}$	$ip_{m,1}$	$ih_{m,1}$	...	$il_{m,n}$	$ip_{m,n}$	$ih_{m,n}$

Table 4.3. Contribution matrix for projects to the benefit indicators - step 1.2

The information in the matrix represents the input for the calculation of α-factors themselves. These are calculated with adaptations of the formula for qualitative risk analysis defined in [PMI04]:

$$\text{adjusted } \alpha\text{-factor} = \frac{x \times il + y \times ip + z \times ih}{x + y + z} \tag{4.13}$$

where x, y and z are weighting factors.

Repeating this calculation for every pair of figures returns the final matrix of expected α-figures when executing the projects:

	P_1	...	P_n
$\mathrm{B}\alpha_1$	$\mathrm{B}\alpha_1 P_1$	...	$\mathrm{B}\alpha_1 P_n$
$\vdots$	$\vdots$	$\ddots$	$\vdots$
$\mathrm{B}\alpha_m$	$\mathrm{B}\alpha_m P_1$	...	$\mathrm{B}\alpha_m P_n$

Table 4.4. Contribution matrix for projects to the benefit indicators - step 1.3

With the use of matrix-transformation of the axes, the matrix can be easily used as data for the calculation of KPIs in the BSC as described in section 4.4.1. This extension is represented in the model by adding the calculation values – the adjusted α-factor is covered by the Planned Value Estimation Function:

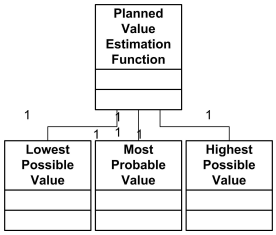


Fig. 4.11. Implementation of the Risk Management-Part of the model

4.4.4 Project Portfolio Management (PPM) -based part of the model

PPM is very important, because it is based on the other parts of the model and introduces the greatest number of extensions, applied to the meta-model. Compared to the state of the art described in section 2 there are only certain approaches that are reused in this model – most parts are completely redefined.

In the PPM-part of the model (figure 4.12 provides an overview of this part of the model) there are five areas that need detailed explanation:

- Five types of project-specific measures
- Distribution of projects
- Option value
- Inflation
- Portfolio cost reductions because of depreciation

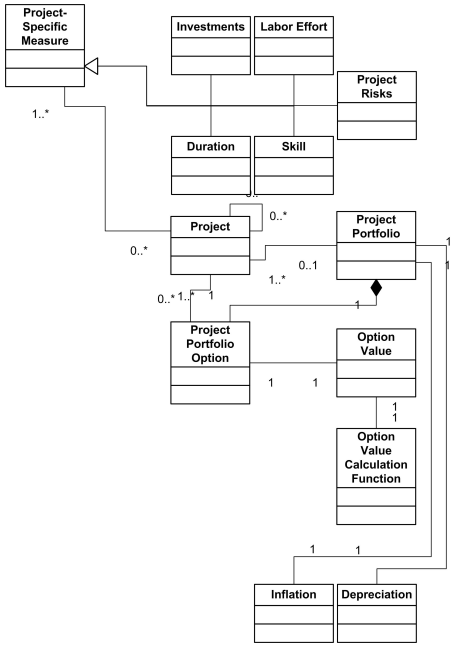


Fig. 4.12. Implementation of the Project Portfolio Management-Part of the model

Five types of project-specific measures

The first extension of the existing model is the definition of project specific measures that are required to effectively select, plan, execute and monitor projects in a project portfolio besides the measures of the BSC representing their contribution to the strategy. The more specific input parameters (or α-figures) can be categorized as follows:

- Investments
  depict the investments planned within the project and their costs.
- Labor effort
  quantify the effort of labor that is needed to achieve the target of the project. It can also be described as the total amount of effort over all the tasks in a project plan.
- Project Risks
  the risks that go along with the project need to be identified.
- Skills
  gives a description for every skill the projects requires to be executed.
  - Demand of the skill
    quantifies the amount of hours/days/weeks/months a skill is demanded within a defined period. It is important to understand that the demand summarizes the total demand of a specific skill in a requested period.

This means that if a project requires e.g. five persons full-time for a month then the demand is five man-months within a month.
- Rate of the skill
  describes the rate to be paid for the specific skill. The scale chosen has to be the same as the scale the demand is given in and needs to be available or estimated for all periods the project is planned to be executed in.
- Duration

From these factors the following output-parameters (or β-figures) can be derived. Formally, they are subject to same kind of transformation that can be seen with the factors from the BSC (discussed in section 4.4.1) – projects in a portfolio ($P_1 \ldots P_m$), the project input variables ($\mathrm{P}\alpha_1 \ldots \mathrm{P}\alpha_n$) and the project output variables ($\mathrm{P}\beta_1 \ldots \mathrm{P}\beta_n$).

Project	Project Input Variables		
	$\mathrm{P}\alpha_1$	$\ldots$	$\mathrm{P}\alpha_p$
P_1	$P_1\mathrm{P}\alpha_1$	$\ldots$	$P_1\mathrm{P}\alpha_p$
$\vdots$	$\vdots$	$\ddots$	$\vdots$
P_m	$P_m\mathrm{P}\alpha_1$	$\ldots$	$P_m\mathrm{P}\alpha_p$

$\Longrightarrow$

Project	Project Output Variables		
	$\mathrm{P}\beta_1$	$\ldots$	$\mathrm{P}\beta_q$
P_1	$P_1\mathrm{P}\beta_1$	$\ldots$	$P_1\mathrm{P}\beta_q$
$\vdots$	$\vdots$	$\ddots$	$\vdots$
P_m	$P_m\mathrm{P}\beta_1$	$\ldots$	$P_m\mathrm{P}\beta_q$

Fig. 4.13. Transformation from project input- to output variables

Total Labor Cost (TLB)

The cost of labor depends on the demand for specific skills and their rate. This formula only calculates the cost of labor – at this stage it is not yet considered that the availability might be an issu. It will be discussed later on during the further development of the algorithm.

$$\mathrm{TLB} = \sum_{p} \sum_{s} rate_{ps} \times demand_{ps} \tag{4.14}$$

where p represent the periods of the project and s the skills needed.

Total Investment Cost(TIB)

The investments planned within the project – also important to calculate depreciation for the spendings on inventory goods within a project, which can also be used as an indicator in the prioritization of the portfolio (e.g. percentage of the project budget that can be activated for depreciation):

$$\mathrm{TIB} = \sum_{p} \sum_{i} investment_{pi} \tag{4.15}$$

where p represent the periods of the project and i the investment required.

Total Risk Cost (TRB)

Every risk in the project has to be quantified in a way that the accompanying monetary value is determined. Therefore the lowest possible impact, the probable impact and the highest possible impact are estimated and weighted for every risk:

$$\text{TRB} = \sum_r \frac{x \times li_r + y \times pi_r + z \times hi_r}{x + y + z} \tag{4.16}$$

where r represents the risks in the project, li the lowest possible impact, pi the probable impact, hi the highest possible impact and x, y and z the weights. Further explanations of the estimation and calculation of risk can be found in [BRA07].

Total Project Budget (TPB)

The previously discussed figures add up to the Total Project Budget.

$$\text{TPB} = \text{TLB} + \text{TIB} + \text{TRB} \tag{4.17}$$

or

$$\begin{aligned}\text{TPB} = &\sum_p \sum_s rate_{ps} \times demand_{ps} \\ &+ \sum_p \sum_i investment_{pi} \\ &+ \sum_r \frac{x \times li_r + y \times pi_r + z \times li_r}{x + y + z}\end{aligned}$$

Planned Value (PV)

This indicator is the baseline for Earned Value Methodology (see also [PMI04] p. 172–176 and [PMI05]) and the application for all budget related control mechanisms in a project. It is similar to the TPB but does not contain the risk budget. The reason is that the PV is the basis against which all efforts within the project are tracked – if risk costs were included in this figure, non-occurred risks would be counted as success to manage the project below budget. Moreover, the timing of a possible incident cannot be considered a priority and therefore a valid cost plan could not be provided.

$$\text{PV} = \text{TLB} + \text{TIB} \tag{4.18}$$

or

$$\begin{aligned}\text{PV} = &\sum_p \sum_s rate_{ps} \times demand_{ps} \\ &+ \sum_p \sum_i investment_{pi}\end{aligned}$$

This definition in the model goes also hand in hand with the one presented in section 4.4.3 when discussing the Risk Management portions of the model, since labor and investments should be estimated following the method introduced there.

Total Effort (TE)

The total effort represents the amount of effort invested in a project and is normally measured in man-years.

$$\mathrm{TE} = \sum_{p} \sum_{s} demand_{ps} \tag{4.19}$$

where p represent the periods of the project and s the skills needed.

Distribution of projects

The first weakness identified in section 1.1.1 discusses the wrong assumption accepted for project portfolios in context of their distribution. [GRU05] explains that

> *"The Efficient Frontier curve shows all of the best possible combinations of project portfolios and the value that can be created with available capital resources in an unconstrained mode."*

and further

> *"The Efficient Frontier shows the opportunity cost of investing an additional dollar versus the additional value received."*

The second statement implies that an arbitrarily chosen amount of money adds additional value to the project defined by a certain function. This would also mean that projects can be split into smaller units by delivering a smaller value that can be determined.

In reality this does not work. Imagine a car manufacturer wanted to develop two new cars: the first one would cost 500 million dollars to develop and the second one 600 million dollar. The company has a budget of 800 million dollars. Following the Efficient Frontier approach would mean that the company could run the project for the first car and invest the remaining money into the project for the second car. Obviously, there is a value for project one if we assume that it is finished successfully and it goes into production and sales. The money invested into the second project does not provide any value so far: a car whose product development is not finished can neither be produced nor sold.

The issue can only be solved by changing the approach from random changes in size to changes in terms of full projects. This implies further that the type of distribution that needs to be used is not a continuous distribution

such as [MAR52] used for financial portfolios, but rather a discrete one: a distribution that shows all possible portfolio combinations. To simplify matters, the following topics will not be considered right away – they will be added later on:

- dependencies on other projects
- observations beyond the point in time t_0
- obligatory flags for projects
- limiting constraints

This determines the number of portfolio alternatives to be a combination of n different projects taken k at a time, without repetitions or

$$\binom{n}{k} = \frac{n!}{k!\,(n-k)!} \tag{4.20}$$

This has to be repeated for possibilities of k (the number of projects that can be executed in parallel). In theory k can be any number between 1 and n because without dependencies and limitations all projects could be executed; limiting k only makes sense if the stakeholders do not want to support more than a maximum of k projects at the same time:

$$\sum_{k=1}^{n} \frac{n!}{k!\,(n-k)!} \tag{4.21}$$

The first complexity to be added are the dependencies. Formally it means that for a portfolio at t_0 only projects that do not rely on any other project can be executed. All other projects have to wait for the finishing of their predecessors; this reduces the complexity of the project portfolio by

$$\sum_{k=1}^{n} \frac{n!}{k!\,(n-k)!} - \sum_{k=1}^{m} \frac{m!}{k!\,(m-k)!}$$

or

$$\sum_{k=1}^{n-m} \frac{(n-m)!}{k!\,(n-m-k)!} \tag{4.22}$$

where m are the number of dependent projects in the portfolio. This issue requires to be handled with extreme caution, because it may lead to failure: at this stage prioritization of the portfolio based on the value of the projects in t_0 would lack the vision that is necessary in PPM: a future oriented approach should bear in mind all combinations of projects including the value of each path. A sample path diagram based on dependencies in a project portfolio is shown in the figure below:

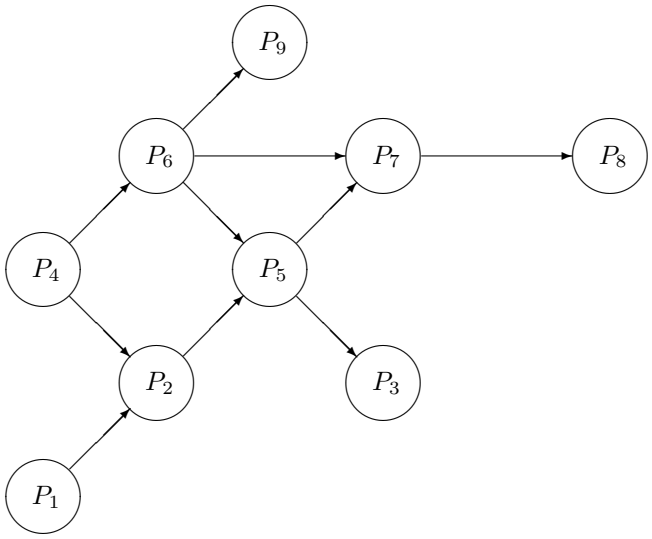


Fig. 4.14. Sample dependency tree for a project portfolio

Thus the algorithm needs to be expanded to not only take a look at t_0 but to consider the entire timeline until the finalization of the last project in order to optimize the portfolio by the maximum expected benefit of all options in the future. Therefore every project requires to be listed with all its dependencies:

Project	Dependencies
P_1	-
P_2	P_1, P_4
P_3	P_1, P_2, P_4, P_5, P_6
P_4	-
P_5	P_1, P_2, P_4, P_6
P_6	P_4
P_7	P_1, P_2, P_4, P_5, P_6
P_8	P_1, P_2, P_4, P_5, P_6, P_7
P_9	P_4, P_6

Table 4.5. Dependency matrix for the sample dependency tree

Option value

Naturally, the prioritization would take place by sorting them according to certain selection criteria (e.g. the Project Value as defined in (2.2)). The issue with using this approach is that the duration of the project(s) is not considered and, therefore, the return on the various options is not evaluated on the same baseline. For this reason the indicators have to be discounted over the duration of the project, respectively the duration of projects within the option:

$$\text{Option Value} = \sum_{p} \frac{\text{Indicator}}{(1+r)^{d_p}} \tag{4.23}$$

where p represents all projects in the option, r is the interest rate per period and d_p is the period from the beginning of the portfolio's perspective to the end of the considered project (not the portfolio!). Caution is required in case the indicator chosen is already discounted as the NPV (defined in (2.1)) or a derived one. An effective indicator for the Option Value will be introduced later in this section.

There may be situations where projects in a portfolio are obligatory e.g. for regulatory reasons. These projects might not return any direct value to the company. Therefore they need to be incorporated separately, as they would otherwise never make it into the project portfolio. The solution is to mark them and all the projects they depend on directly and indirectly as mandatory, considering them before the priority list supplied by the indicator.

By now the model addresses the issues one and two identified at the beginning of section 1.1.1. The model must be extended to find a solution to problem number three: the indicator used for the option value must not rely on financial KPIs only, but has to consider influences of the project on the company.

In section 4.4.1 and 4.4.4 it has already been shown that there is a need for having separate measures resulting from the BSC, as well as from the project. In order to effectively use the formula for calculating the option value, both sets of measures need to be combined in a formula, which would result in a meaningful indicator.

Obviously all of the factors determined ($P_m\mathrm{B}\beta_1$, ..., $P_m\mathrm{B}\beta_o$; $P_m\mathrm{P}\beta_1$, ..., $P_m\mathrm{P}\beta_q$) have to be used to prioritize a portfolio effectively. This introduces two new problems:

- a standardization of the β-figures is required, because most of them have different measures and scales. This is next to impossible, because how should e.g. "Customer Satisfaction" and "Education days of an employee" be measured on the same scale and remain meaningful?
- a weight for every β-figure has to be calculated, in order to be in the position to aggregate the factors into a significant indicator. The word "significance" implies already that the weights need to be derived from the attitude of the decision-makers. Because there is more than one decision-maker in a team, a compromise would have to be made which is again a sub-optimal solution.

The problem can be solved by takig a look at the different β-figures, not so much to consider their measurement or their weights, but to offer a transparent and comparable figure. The solution is in the calculation of the area that is spanned by the different relative β-figures in a a radar-chart (also called spider-chart):

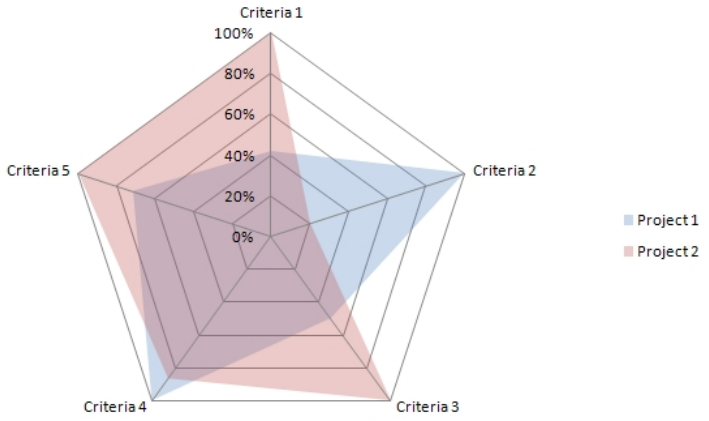


Fig. 4.15. Sample radar chart using five different criteria

Using this type of representation has several advantages:

- Every figure can be presented using its measure. The only matter of importance is that the scale is utilized in a such way that the more promising the result, the larger the distance to the zero-point of the graph needs to be.
- It can be used for an arbitrary number of criteria larger than, or equal to three.
- The change of the scale does not change the result, as all projects are measured against the same baseline.

The area requires to be calculated for each of the projects to have an quantified indicator for calculating the option value. The formula for determining the area of a polygon is (see also [BOU98]):

$$\text{Area} = \left| \frac{1}{2} \sum_{i=0}^{N-1} (x_i y_{i+1} - x_{i+1} y_i) \right| \tag{4.24}$$

where N represents the number of edges in the polygon and x and y their coordinates. The last coordinate must be identical with the first one to close the area of the polygon.

To do the calculation with the items from a radar chart, the data points have to be transformed into a two-dimensional co-ordinate system. In the first step x- and y-values of the data points are calculated taking the centre of the polygon to be the zero-point of the grid. This can be derived by using trigonometric functions. Assuming – as shown in figure 4.15 – the line for criteria one is vertically aligned (what means 90 degree or $\pi/2$) the formula is defined as follows; let x_i and y_i be the x and y coordinates relative to the centre of the radar-chart for every relative value χ_i of the corresponding criteria β_i in the radar-chart where N is the total number of criteria:

$$x_i = \cos\left(\frac{\pi}{2} - \frac{2\pi\,(i-1)}{N}\right) \times \chi_i \tag{4.25}$$

$$y_i = \sin\left(\frac{\pi}{2} - \frac{2\pi\,(i-1)}{N}\right) \times \chi_i \tag{4.26}$$

The formula is derived the following way:

$$\begin{aligned} x_i &= \cos\left(\left(90 - \frac{360}{N} \times (i-1)\right) \times \frac{2\pi}{360}\right) \times \chi_i \\ &= \cos\left(\left(90 - \frac{360 \times (i-1)}{N}\right) \times \frac{2\pi}{360}\right) \times \chi_i \\ &= \cos\left(\frac{180\pi}{360} - \frac{720\pi \times (i-1)}{360N}\right) \times \chi_i \\ &= \cos\left(\frac{\pi}{2} - \frac{2\pi\,(i-1)}{N}\right) \times \chi_i \end{aligned}$$

The deduction for y_i works in accordance with the one for x_i.

Inflation

Because the timely perspective is spread over many years, the planning of portfolios ought to consider inflation as well. An important detail to consider is that the inflation must not be calculated on top of the cumulated cost, but only on the cost for the respective period. Summarizing these results is the inflation adjusted cumulative cost. The cost inflation in a project within a portfolio in period t can be calculated by

$$\text{Project Inflation Factor for cost in period } t = \left[(1+ir)^t - 1\right] \times 100 \tag{4.27}$$

where ir is the inflation rate per period and t is the number of periods.

If only the annual inflation rate is known, but the project portfolio's duration is not a full year, the formula has to be adapted:

$$\text{Project Inflation Factor for cost in period } t = \left(\left[\sqrt[12]{(1+ir)}\right]^t - 1\right) \times 100 \tag{4.28}$$

where ir is the annual inflation rate and t is the number of periods calculated by:

$$t = \text{years} \times 12 + \text{months} \tag{4.29}$$

Portfolio cost reductions because of depreciation

Although the cost elements are naturally part of the BSC measures as well, this approach calculates them separately on the basis of the project-specific

measures in order to compare the efforts with the benefits – both on the basis of a project or a program within the portfolio or the entire project portfolio itself. In addition, the contemplation of costs should be shifted from a cash flow perspective, which is normally used in a profit & loss (P&L) oriented view, to make the real value of cost transparent to the decision makers.

The thought behind creating a P&L-view of the project portfolio is to not only allow the decision makers to base their decision regarding cash-flow (although these figures have to be delivered as well) but also include the value creation and the possible depreciation in order to obtain an overview of the costs that are really left in the company. These costs are the ones that should to be compared to the benefits.

The real costs of a project are normally lower than the total of the cash flows in the project, because value creating parts of the projects (or even the whole project) can be activated in the assets of a company and therefore create depreciation over a period. This depreciation reduces the profit and therefore the amount of taxes a company has to pay. If these tax reductions are accounted for as a cost reduction in the projects, the projects in the portfolio that generated the value creation lower their total cost. The effects of this perspective can be that very expensive projects may be really affordable ones.

The thesis' intention is not to evaluate the regulatory possibilities of depreciation for projects or software developed in projects, and how the appraisal of the initial value for depreciation is determined. This is assumed to be evaluated by a professional accountant. The aim, rather, is to illustrate the proper use of depreciation in the context of total costs of a project.

Going into more detail, the following example of the structure of an income statement should be the starting point:

Operating Revenues
Net Sales
− Operating Expenses
Cost of good sold costs
Selling, general and administrative expenses
Depreciation and amortization
= Operating Income
+ Non-Operating Income
= Earnings before interest and income taxes (EBIT)
− Net interest expense
= Earnings before income taxes (EBT)
− Income taxes
= Net income

Table 4.6. Example for a structure of a statement of income

A very simplified tax-calculation algorithm for demonstration purposes could look like

$$\text{Taxes} \approx \text{EBT} \times \text{Tax-rate} \tag{4.30}$$

If a finished project gets activated (following the national regulations for accounting), the depreciation part of the operating expenses is increased. It decreases in succession the operating income, the EBIT and the earnings before income taxes. The amount of tax-reduction from the activation of the project can then be assumed:

$$\text{Tax reduction} \approx \text{EBT} \times \text{Tax-Rate} - (\text{EBT} - \text{Depreciation}) \times \text{Tax-Rate} \tag{4.31}$$

Reformulating leads to:

$$\text{Tax reduction} \approx \text{Depreciation} \times \text{Tax-Rate} \tag{4.32}$$

To consider the depreciation of a project, the observation period must be extended by the number of years, over which the project is depreciated. Normally, the depreciation amount per period is the aliquot part of the linearly distributed value of the activated investment. This is the formula for calculating the depreciation over a certain period:

$$\text{Depreciation}_t = \frac{\text{Activated investment amount}}{\text{Number of years of depreciation}} \tag{4.33}$$

Extending formula 4.32 gives the following equation:

$$\text{Tax reduction}_t = \left(\frac{\text{Activated investment amount}}{\text{Number of years of depreciation}} \right) \times \text{Tax-rate} \tag{4.34}$$

4.4.5 Composition of the model

Finally all parts of the meta-model that have been described in the previous sections need to be compounded, in order to create the model for this thesis. This gives the following UML-desription of the model:

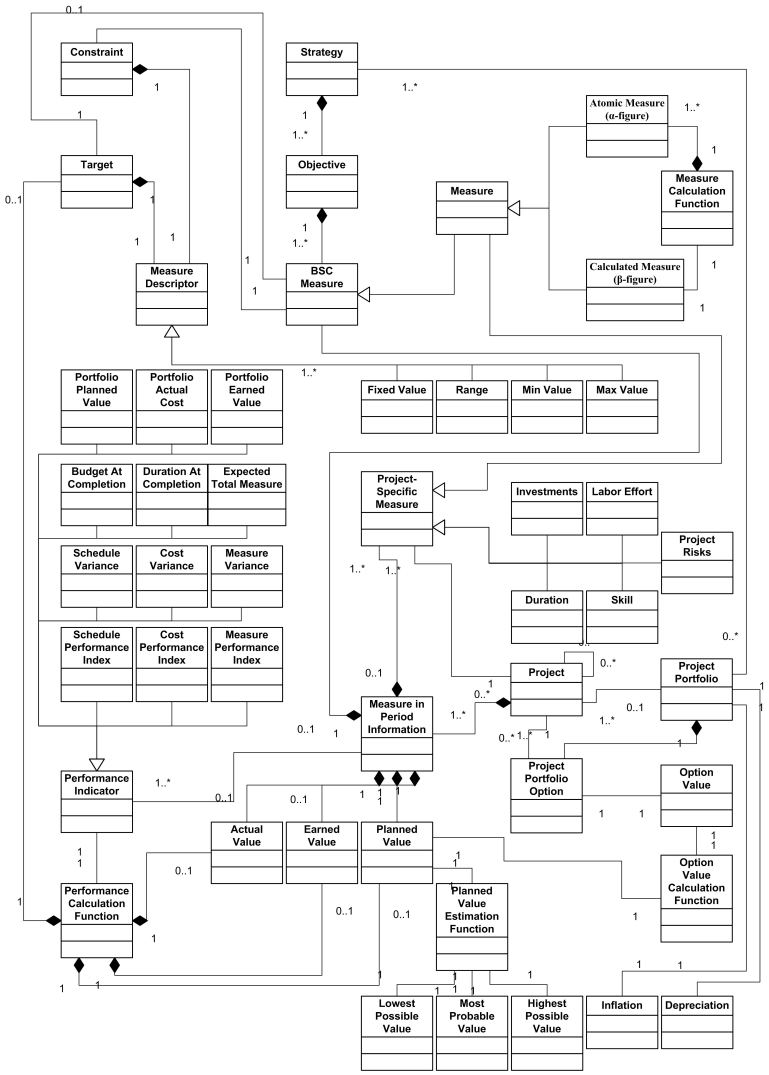


Fig. 4.16. Model of the IT Project Portfolio Management approach developed in this thesis

4.5 The Method

The method for Project Portfolio Management (PPM) presented in section 2.3 is the basis for the extensions that should be achieved in a PPM capable of linking the company's strategy to the project portfolio. However, there is an important differentiation, and we need to go back to the original model: the model shown in figure 2.4 is based on the assumption that projects create deliverables during their life cycle, and deliver benefits after their finalization. In reality this assumption is incorrect, since deliverables might have an immediate impact on the organization or the implementation of the strategy. This leads to a constitutional change of the method, because the phase of monitoring projects in a portfolio and the phase of realizing the benefits need to be combined. The resulting method is shown in the figure below:

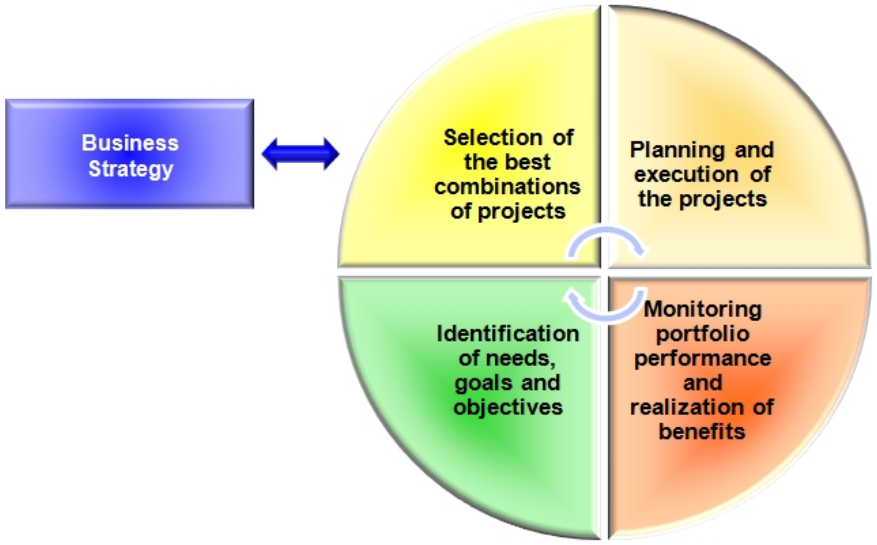


Fig. 4.17. Method of the IT Project Portfolio Management approach developed in this thesis

4.5.1 Identification of needs, goals and objectives

The identification of needs, goals and objectives is the content of the methodology of Balanced Scorecards (BSCs) as it was developed by Robert S. Kaplan and David P. Norton in [KN96]. This thesis does not focus on extending the method of BSCs but attempts to build on it – therefore this part of the method is not developed any further. However, further details can be found in [KN96] and [NIV02].

4.5.2 Selection of the best combinations of projects

The selection of the best project combinations can be split into three process steps:

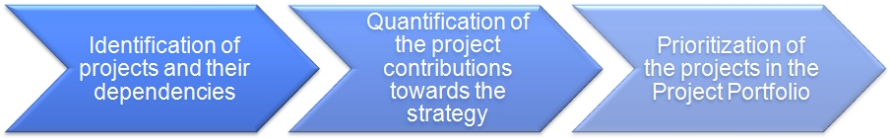


Fig. 4.18. Selection of the best combinations of projects – process steps

Identification of projects and their dependencies

We tend to think in a world of target scenarios which describe what the ideal world should be like. It is on very rare occasions that we ask ourselves the question - "how do we get there". This is exactly what this process step is dealing with: capturing all the stakeholders' ideas how things could be changed to achieve the desired target scenario.

As soon as the ideas for projects are set, the number of options can be calculated using the formulas given in (4.20) and (4.21). Normally, this involves a great deal of complexity. This is because just five projects that are to be executed result in 31 different possibilities for a project portfolio!

To reduce the number of possibilities, the dependencies between the projects must be considered already at this stage. As soon as these are identified, the number of remaining possibilities can be calculated using formula (4.22). Dependencies reduce the possibilities tremendously: assuming that there are only two projects that are dependend on other projects in the previous example, the number of options already decreases to seven.

Quantification of the project contributions towards the strategy

It should be clear by now how many options need to be considered, but the basis for the prioritization is still missing. Current approaches only focus on the relevance of financial information that stems from the execution or finalization of the project. A future-oriented approach should also consider the effects of other components relevant to the company's success. For this reason, this paper distinguishes between two types of such indicators: the ones derived from a Balanced Scorecard and others taken from standard project management methodology defined by the Project Management Institute (PMI) respectively well known indicators from standard project management.

Starting with the part of the BSC, the measures and KPIs identified in a BSC should be used to determine the influence of a project on this BSC. Therefore, every single α-figure needs to be checked according to its contribution potential. Based on these, the β-figures are calculated as they were

defined in the BSC. This is repeated for every project. The result is a matrix showing all α- and the according β-figures for all the projects as it is shown in figure 4.5.

For the measures out of Project Portfolio Management (PPM) the approach is very similar. The model of this thesis limits the α-factors to the areas of investments, labor, duration, skills and project risks. Based on these, there have been developed several β-figures. Most of these are derived from standards (for details see [BAK02], [PMI04], [PMI05], [PMI06] and [KON07]). The β-figures used by this method are described in section 4.4.4 of this paper.

As soon as the parameters from the projects for the BSC (and the project-specific measures) are determined, they are quantified as described in the model in section 4.4.4. This means creating a polygon from the number of measures. The contribution of every single project is displayed graphically. To make sure the measures can be compared, they are not drawn using an absolute scale, but are shown relative to the maximum contribution. The area covered by the polygon of a project represents the contribution to the company's strategy. This area is calculated by the formulas (4.25), (4.26) and (4.24). For the sample radar chart shown in 4.15 the baseline data and calculation results are as follows:

	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5
Project 1 abs.	50	200	80	150	100
Project 2 abs.	120	40	160	130	140
Project 1 rel.	42%	100%	50%	100%	71%
Project 2 rel.	100%	20%	100%	87%	100%

Table 4.7. Data for the sample radar chart

		Criteria					
		1	2	3	4	5	Area
Project 1	x	0,00	0,95	0,29	-0,59	-0,68	1,15
	y	0,42	0,31	-0,40	-0,81	0,22	
Project 2	x	0,00	0,19	0,59	-0,51	-0,95	1,49
	y	1,00	0,06	-0,81	-0,70	0,31	

Table 4.8. x, y coordinates for the χ-figures in the radar-chart and the area the polygon spans

As soon as the areas are known, the option values are calculated based on the formula given in (4.23) where the indicator is represented by the area.

Another question that should be addressed is how and by whom the estimates are obtained. Especially in this first phase they provide only a rough guess. Normally, these first estimates are provided by subject matter experts. For projects where similar types have already been executed in the past and

experience from them gained, it might be possible to take them as a starting point and also for cross checking the parameters. However, there are several important constraints that must be considered here:

- Because BSCs for each company are usually unique, the contribution factors need to be compared between the BSCs before taking them over. Otherwise certain effects might be reflected in α-factors in the source BSC that cannot be mapped to the destination BSC, because parts of the measures are not represented there. At the same time, measures of the target BSC might be influenced in case the information could not be gained from the source BSC. An one-by-one mapping could only be achieved if the BSCs were identical.
- Assuming two companies had the same BSC, still the contribution factors should not be transferred in absolute figures, because the size and the business volume of the companies most probably differ. For this reason the relative contribution should be taken for estimating the corresponding α-figures.
- Within a company it is improbable that a large number of projects is so much of the same nature that the contribution figures could be of use. This idea makes more sense for consultants who implement the same project in various companies. However, caution needs to be taken here because of the different BSCs and the difficulties connected with above mentioned issues.

In case a consultancy company would like to build empirical cases for the influences on certain types of projects on BSCs, the α-figures should be clustered to topics of interest, so that a possible different naming of the contribution factors does not destroy the history of collected data. Further, not only the contribution figures should be collected but also the explanation why and how this contribution has been achieved. This helps the adaptation of the parameters, should the experience be brought into slightly deviating environments. The update of the relative figures with information of recent projects should be done in a way that the information is processed and included taking into consideration

- the total number of projects and collected contribution factors
- the actuality of data (more recent data might be considered with higher priority than older data)
- the extreme values of the data collected (lowest and highest possible contribution)

The weighting of these factors could be carried out by applying various approaches (e.g. fuzzy logic or neural networks), but it is beyond the scope of this thesis, because much depends on the nature of the project and the BSC involved.

Prioritization of the projects in the Project Portfolio

To prioritize the projects for a Project Portfolio, all the αs and βs from the projects and all their totals (and in case of combinations that could be started in t_0 based on their dependencies) are summarized in a matrix together with their option value and constraints. The order of the projects is based on the total option value of the project (except for mandatory projects) summarizing all discounted option values it is the first project in. At the bottom of the matrix, all constraints for the indicators are filled in. Additionally, every constraint has to be tagged with the type it belongs to. These types were defined in section 4.4.1.

	Total	BSC						Project					
Project	Option	Input			Output			Input			Output		
	Value	$B\alpha_1$	...	$B\alpha_n$	$B\beta_1$	...	$B\beta_o$	$P\alpha_1$	...	$P\alpha_p$	$P\beta_1$	...	$P\beta_q$
P_1	ov_1		...			...			...			...	
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$
P_m	ov_m		...			...			...			...	
	$\sum$		...			...			...			...	
	Constraint		...			...			...			...	

Table 4.9. Matrix containing all α- and β figures for the application of the constraints

All totals of αs and βs must be compared with their respective constraints. For all of those which are breached, so called "discretionary" dependencies have to be added in the following way: the project with the lowest total option value is removed from the portfolio of t_0. It is then assigned a dependency on the project finishing the earliest after the prioritization. This is repeated until all constraints can be fulfilled. If this is impossible, (so that, in the worst case, the project with the highest total option value cannot be executed) the topmost project causing the conflict is removed, and the procedure is restarted with all the other projects. If this extensive procedure does not result in a meaningful portfolio, the constraints are too narrow to allow a prioritization. In this case the focus needs to be shifted to widening of the constraints.

The final result of this procedure is a prioritized list of projects that can be executed in t_0.

4.5.3 Example: Implementation of the selection approach

Initial situation

This section provides an exemplary implementation of the selection approach developed. The sample setup consists of five projects from the project portfolio of a bank:

Identifier	Name
1	Data Warehousing (DWH)
2	Management Information System (MIS)
3	Customer Relationship Management (CRM)
4	Application Processing System (APS) for loans
5	Collection System (CS) for overdue loans

Table 4.10. Sample project portfolio from a bank

Identification of projects and their dependencies

Before the paper gets into covering the α- and β-figures for this set of projects in a more comprehensive way, and according to the process introduced before, the dependencies for this constellation will be discussed. Following the formula given in (4.21), the complexity of five projects and their combinations result in 31 possibilities to structure the portfolio in t_0:

Combination	Possibilities
$\binom{5}{1}$	P_1, P_2, P_3, P_4, P_5
$\binom{5}{2}$	P_1P_2, P_1P_3, P_1P_4, P_1P_5, P_2P_3, P_2P_4, P_2P_5, P_3P_4, P_3P_5, P_4P_5
$\binom{5}{3}$	$P_1P_2P_3$, $P_1P_2P_4$, $P_1P_2P_5$, $P_1P_3P_4$, $P_1P_3P_5$, $P_1P_4P_5$, $P_2P_3P_4$, $P_2P_3P_5$, $P_2P_4P_5$, $P_3P_4P_5$
$\binom{5}{4}$	$P_1P_2P_3P_4$, $P_1P_2P_3P_5$, $P_1P_2P_4P_5$, $P_1P_3P_4P_5$, $P_2P_3P_4P_5$
$\binom{5}{5}$	$P_1P_2P_3P_4P_5$

Table 4.11. Possible combinations of five projects in a project portfolio

In this example the MIS and the CRM project rely on the implementation of the DWH project; both systems are analytical systems and depend on various data loaded from different source systems. The APS project and Collection System project are independent of the DWH-project but the APS project is

the mandatory predecessor for the Collection System (the bank could not collect overdue loans it does not have the data for). This information results in the following dependency map:

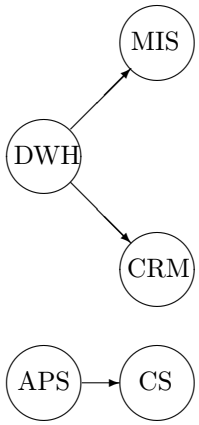


Fig. 4.19. Dependencies in the sample portfolio

The dependency matrix for the projects is as follows:

Project	Dependencies
DWH	-
MIS	DWH
CRM	DWH
APS	-
CS	APS

Table 4.12. Dependency matrix for the project in the sample portfolio

Keeping the dependencies in mind the possible complexity of the portfolio already reduces the possibilities from 31 to three in t_0 as defined in (4.22):

Combination	Possibilities
$\binom{2}{1}$	DWH or APS
$\binom{2}{2}$	DWH and APS

Table 4.13. Possible combinations of projects considering the dependencies

Quantification of the project contributions towards the strategy

To fulfill the quantification requirements defined in section 4.5.2 the model needs to rely on a BSC developed for this company and on the respective input parameters for this BSC. The success factors defined for this sample BSC are as follows:

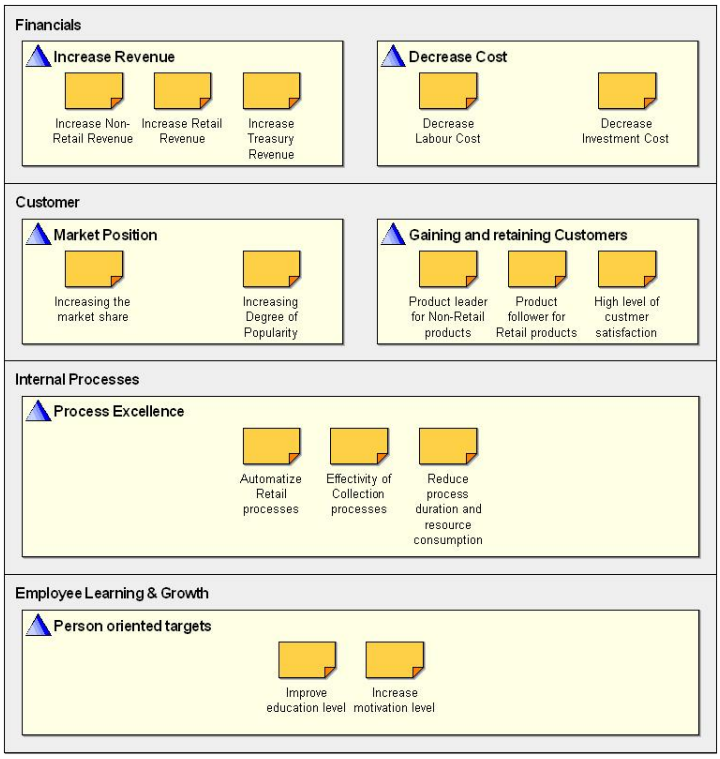


Fig. 4.20. Success factors for the sample BSC – developed using ADOscore®

The Cause-Effect model for this sample BSC was defined in this way:

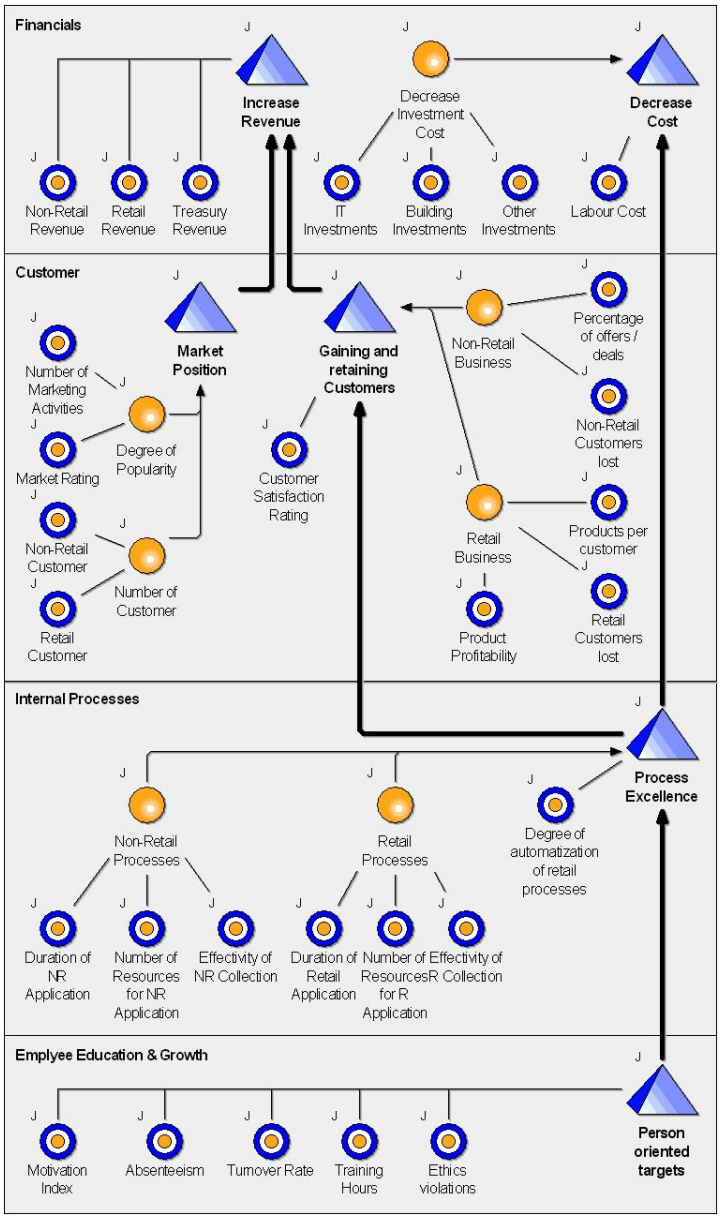


Fig. 4.21. Cause-Effect model for the sample BSC – developed using ADOscore®

The detailed aggregation algorithms from the α-figures up to the calculation of the influence of the success factors is not discussed here in detail, because it is part of a BSC. For the algorithm in this example only the input-figures and the output-figures of the BSC are of importance.

In this example the contribution to the input factors (already derived from α-figures) by the projects for the BSC are identified as follows:

BSC Input Variables	DWH	MIS	CRM	APS	CS
Motivation Index					
Absenteeism					
Turnover Rate					
Training Hours	+1.600	+100	+200	+1.000	+150
Ethics Violations			-5		
Duration of NR Applications	-2			-5	
Number of Resources for NR Applications	-5			-10	
Efficiency of NR Collection	+5%		+5%		+10%
Duration of Retail Applications	-2		-1	-2	
Number of Resources for Retail Applications	-20		-10	-20	
Efficiency of Retail Collection	+5%		+5%		+20%
Degree of automatization of retail processes	+5%		+5%	+10%	+10%
Number of Marketing Activities	+25		+30		
Market Rating		+1		+1	+1
Non-Retail Customer			+100		
Retail Customer			+30.000		
Customer Satisfaction Rating	+1		+2	+1	-1
Percentage of offers/deals	+5%		+10%	+10%	
Non-Retail customers lost			-10		+5
Products per customer	+3		+3		
Retail Customers lost			-1.000		+500
Product Profitability		+10%			+5%
IT Investments	+500.000	+100.000	+150.000	+150.000	+150.000
Building Investments	+100.000				
Other Investments					
Labor Cost	+630.000	+840.000	+1.260.000	+420.000	+210.000

Table 4.14. BSC Input factors from a sample project portfolio of a bank

The corresponding output figures (β-figures) for the BSC have been calculated and present the following results for the prioritization input:

BSC Output Variables	DWH	MIS	CRM	APS	CS
Person Oriented Targets	+16	+1	+2	+10	+2
Process Excellence	+28	+5	+7	+35	+7
Market Position	+25	+500	+430	+500	+500
Gaining and Retaining Customers	+500	+100	+610	+200	-5
Increase Revenue	1.568.600	1.766.600	2.049.000	1.745.200	1.503.450
Decrease Cost	-1.306.000	-957.000	-1.416.000	-575.200	-393.800

Table 4.15. BSC Output factors from a sample project portfolio of a bank

In table 4.15 it has to be especially noted that the operational target of "Decrease Cost" has negative values, since projects generate costs and therefore cannot contribute to reducing costs.

So far the BSC input- and output variables have been discussed. What is missing from a KPI point of view are the figures resulting from the project input variables and their transformation to the output variables:

Project Input Variables	DWH	MIS	CRM	APS	CS
Rate: Skill 1	600	600	600	600	600
⋮	⋮	⋮	⋮	⋮	⋮
Rate: Skill s	1.500	1.500	1.500	1.500	1.500
Demand: Skill 1	800	400	600	200	100
⋮	⋮	⋮	⋮	⋮	⋮
Demand: Skill s	100	400	600	200	100
Investment Cost	600.000	100.000	150.000	150.000	150.000
Probability: Risk 1	10%	20%	15%	40%	30%
⋮	⋮	⋮	⋮	⋮	⋮
Probability: Risk r	50%	30%	10%	15%	10%
Impact: Risk 1	10.000	25.000	30.000	10.000	100.000
⋮	⋮	⋮	⋮	⋮	⋮
Impact: Risk r	150.000	40.000	15.000	8.000	38.000
Duration (in months)	12	8	10	18	12
Obligatory Project		Y			
Direct Dependencies		1	1		4
Operations Cost for 3 years	300.000	60.000	90.000	90.000	90.000

Table 4.16. Project input factors from a sample project portfolio of a bank

If those input figures are calculated by the formulas explained in chapter 4.4.4 the following output matrix can be determined:

Project Input Variables	DWH	MIS	CRM	APS	CS
Project Budget	1.306.000	957.000	1.416.000	575.200	393.800
thereof - Total Labor Cost	630.000	840.000	1.260.000	420.000	210.000
thereof - Total Investment Cost	600.000	100.000	150.000	150.000	150.000
thereof - Total Risk Budget	76.000	17.000	6.000	5.200	33.800
Duration (months)	12	8	10	18	12
Obligatory Project with dependencies	Y	Y			
Full Dependencies		1	1		4
Return on Investment (ROI)	128%	188%	145%	306%	418%

Table 4.17. Project output factors from a sample project portfolio of a bank

Of course the project budgets presented in this table are equal to the negative decrease of cost in table 4.15. The χ-figures derived from the tables 4.15 and 4.17 are now used to build the radar-chart. To simplify the illustration not all criteria have been considered:

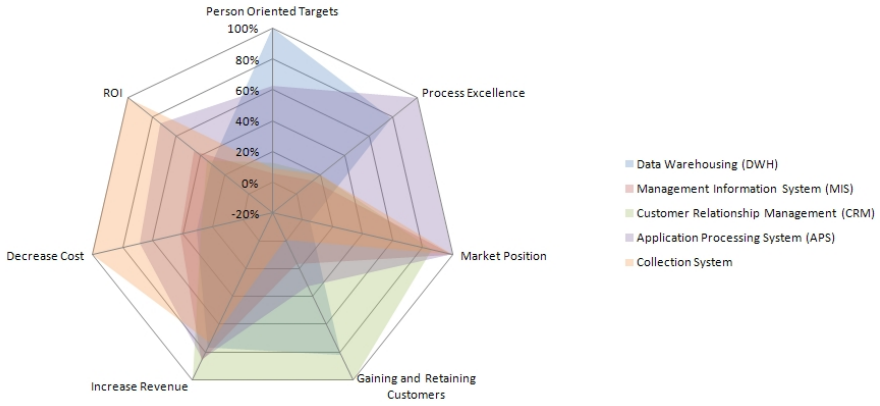


Fig. 4.22. Radar-Chart for the data in the example

The table with the base values looks as follows:

	POT	PE	MP	GaRC	IR	DC	ROI
DWH rel.	100%	78%	5%	82%	77%	30%	31%
MIS rel.	6%	14%	100%	16%	86%	41%	45%
CRM rel.	13%	20%	86%	100%	100%	28%	35%
APS rel.	63%	100%	100%	33%	85%	68%	73%
CS rel.	9%	20%	100%	-1%	73%	100%	100%

Table 4.18. χs for the projects in the set of projects

This data results in the following co-ordinates and values for the covered area:

		POT	PE	MP	GaRC	IR	DC	ROI	Area
APS	x	0,00	0,78	0,97	0,14	-0,37	-0,67	-0,57	1,48
	y	0,63	0,62	-0,22	-0,30	-0,77	-0,15	0,46	
CRM	x	0,00	0,15	0,84	0,43	-0,43	-0,27	-0,27	0,97
	y	0,13	0,12	-0,19	-0,90	-0,90	-0,06	0,22	
DWH	x	0,00	0,61	0,05	0,36	-0,33	-0,29	-0,24	0,83
	y	1,00	0,49	-0,01	-0,74	-0,69	-0,07	0,19	
CS	x	0,00	0,16	0,97	0,00	-0,32	-0,97	-0,78	0,79
	y	0,09	0,12	-0,22	0,01	-0,66	-0,22	0,62	
MIS	x	0,00	0,11	0,97	0,07	-0,37	-0,40	-0,35	0,40
	y	0,06	0,09	-0,22	-0,15	-0,78	-0,09	0,28	

Table 4.19. x, y coordinates for the χ-figures in the radar-chart and the area the polygon spans, sorted by size of the area

Prioritization of the projects in the Project Portfolio

Considering the project without taking into account the possible portfolio options would clearly favour the APS project (1,48) over the DWH project (0,83). As described above, the project on its own is not the driving factor – it is the option value of the different options that is important. Using equation (4.23), the results from table 4.19 and a discount rate of 5% shows the following results for the available options:

Option	Option Value
DWH	0,79
DWH - MIS	1,16
DWH - CRM	1,67
APS	1,42
APS - CS	2,13

Table 4.20. Benchmarks for all projects combinations in the portfolio

Taking into consideration the projects marked as mandatory as well, (see table 4.17) shows that the DWH-project ought to be executed for the MIS project. This project has an obligatory status, although the option DWH-MIS has the second-lowest value. Finally, the following prioritization would be set:

Option	Mandatory	Option Value
DWH - MIS	Y	1,16
APS - CS		2,13
DWH - CRM		1,67
APS		1,42

Table 4.21. Project Portfolio prioritization without constraints

The DWH-project is not shown separately in table 4.21. Due to its dependency, it is executed anyway.

In the next and also the last step the constraints have to be considered. Therefore a table is created as described in chapter 4.5.2. For transparency's sake, the criteria already used in figure 4.22 and table 4.18 have been reused – the only difference to be noted is, that the ROI, the Increase in Revenue and Decrease of cost are removed but that is why an α-figure from the Project-αs is added: the requested availability of a business analyst for the respective project measured in person days (PDs):

Project	Total Option Value	POT	PE	MP	GaRC	BA PDs
DWH-MIS	1,16	+17	+33	+525	+600	+550
APS-CS	2,13	+12	+42	+1.000	+195	+300
DWH-CRM	1,67	+18	+35	+455	+1.110	+500
APS	1,42	+10	+35	+500	+200	+200
	Total	+57	+145	+2.480	+2.105	+1.550
	Constraints	Min(+25)	Min(+60)	Min(+1.000)	Min(+700)	Max(+700)

Table 4.22. Constraints for the sample portfolio

The table shows an obvious conflict with the person days for the business analysts required (BA PDs). Following the procedure described in section 4.5.2, the options have to be eliminated bottom-up following their total option values. If this is done in this portfolio, it ends up with the following status:

Project	Total Option Value	POT	PE	MP	GaRC	BA PDs
DWH-MIS	1,16	+17	+33	+525	+600	+550
	Total	+17	+33	+525	+600	+550
	Constraints	Min(+25)	Min(+60)	Min(+1.000)	Min(+700)	Max(+700)

Table 4.23. Constraints for the sample portfolio – Option 1

The current status shows that the issue with the BA PDs could be solved but this brought the project into conflict with many other constraints. Obviously the portfolio cannot be structured in a way that remains within the boundaries set. This leaves two options: the first one is to take the portfolio above, also

implying that the stakeholders need to adapt the constraints given. The second option would be to include another project to optimize the number of limits being fulfilled and focus on adapting other limits:

Project	Total Option Value	POT	PE	MP	GaRC	BA PDs
DWH-MIS	1,16	+17	+33	+525	+600	+550
APS	1,42	+10	+35	+500	+200	+200
	Total	+27	+68	+1.025	+800	+750
	Constraints	Min(+25)	Min(+60)	Min(+1.000)	Min(+700)	Max(+700)

Table 4.24. Constraints for the sample portfolio – Option 2

In the second option the constraint of the BA PDs is violated again with a very small backlog, which might be resolved. Therefore other constraints could be kept and the portfolio could be adjusted in the best possible way. Most probably the company could resolve the BA PD issue and would go for the portfolio given in option 2.

4.5.4 Planning and execution of the projects

In section 2.5 the paper briefly mentioned the status quo on how the planning for project portfolios is done. The approach that should be envisaged here tries to deliver a more precise ex-ante evaluation of the project benefits and costs compared to the current approaches.

An interesting phenomenon regarding the approximation of project's contents is that these estimates are generally divided into three categories. This is also supported by [RMW07] when saying that

> *"Projects are investments. Like all investments there are anticipated costs, benefits and risks"*

Considering the last item – the risks – these describe the uncertainty that goes along with the project. Moreover, the methodology of estimating risks is designed for an ex-ante evaluation. In the common understanding, it is only used to describe negative risks to the projects and is measured in financial terms. This approach tries to eliminate the risks as a separate part of the equation and instead apply the methodology for risk, benefit as well as costs estimation, (Whereby the benefit estimate could be considered to be a "positive" risk).

Section 4.5.2 introduced a concept showing that there are two different kinds of measures to be used: figures that come from the Balanced Scorecard (BSC), which focuses primarily on the representation of the benefits and project-specific figures, which have their focus on all the effort and risks

related topics of the project itself. Naturally, both types of measures are related and parts of the project-specific figures are probably represented in the Balanced Scorecards figures as well (at least in the calculation rules for the β-figures). However, it may be necessary to use them separately, in order to divide benefits and costs.

Another reason for separating them is that costs are already created during the execution of the project, whereas the benefits are mostly realized after the finalization of the project. This should be kept in mind in all the subsequent planning and controlling steps.

Out of this cognition, two separated processes for the planning of benefits and costs in a project portfolio arise:

Fig. 4.23. Planning and execution of the projects – process steps for the planning of benefits

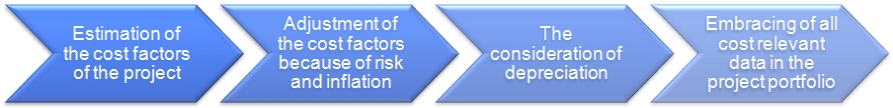


Fig. 4.24. Planning and execution of the projects – process steps for the planning of costs

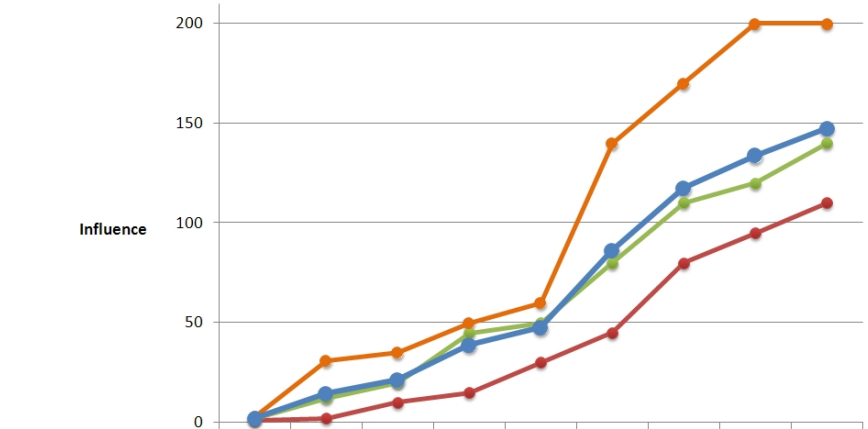
Estimation of the target input-factors for the benefit planning

The option value calculated in the selection phase of the project portfolio focused on the final contribution of a project towards the company's strategy – it did not take into consideration by when which target can be achieved. In the planning phase this step needs to be carried out to make sure that aberrations from the plan values can be determined easily and effectively later in the monitoring- and controlling phase.

However, at first the rough target estimates from the selection phase for the final contribution must be reevaluated and based on a sound estimate. Therefore the approach described in section 4.4.3 should be used. The calculation is repeated for every α-factor that is influenced by the project for the point in time where it has its maximum contribution. It needs to be clear that this is not the point in time where the project finishes – this is because benefits need to be longer lasting to be fully delivered than the life-time of a project. If e.g. a new Risk Management process is implemented in a bank, everything might be working as planned at the end of the project but the benefits for the bank can be seen only after the first contracts processed with new method are delivered.

Planning of the development of every input-factor in a project over time

As the target values for the α-figures are determined, the next process step is to include the axis of time into the planning. This can be achieved by estimating the development of every single adjusted α-factor over the life time of benefit creation with the same method described that was used to estimate the final contribution (caution: not over the life time of the project as benefits may be realized after the finalization of the project). An example for such a development is given below:



	1	2	3	4	5	6	7	8	9
Lowest Possible Influence	1	2	10	15	30	45	80	95	110
Most Probable Influence	2	12	20	45	50	80	110	120	140
Highest Possible Influence	3	31	35	50	60	140	170	200	200
Adjusted α-Factor	2	14	21	39	48	86	118	134	148

Fig. 4.25. Planning of one adjusted α-factor over the time with a sample set of data using the weighting factors $il = 1, ip = 2$, and $ih = 1$

Consolidating the data for the whole project portfolio

Next, the advancement of an adjusted α-factor over time that is influenced by more than one project has to be addressed. As projects and their results may influence each other, the adjusted α-factors for the periods cannot be simply summarized – the dependencies and effects between the projects are to be considered and the findings have to be captured in a set of influence factors for the calculation of the α-factors representing all the projects in the portfolio. The sequence of the projects is already defined by the selection method described in section 4.5.2.

Period		1	2	3	4	5	6	7	8	9
Project 1	il	1	2	10	15	30	45	80	95	110
	ip	2	12	20	45	50	80	110	120	140
	ih	3	31	35	50	60	140	170	200	200
Project 2	il						2	20	30	40
	ip						2	25	50	60
	ih						2	40	60	70
Project 3	il				0	0	10	15	50	70
	ip				4	10	15	30	70	90
	ih				10	40	60	90	120	130
$\sum$	il	1	2	10	15	30	57	115	175	220
	ip	2	12	20	49	60	97	165	240	290
	ih	3	31	35	60	100	202	300	380	400
Adjusted α-factor		2	14	21	43	63	113	186	259	300

Table 4.25. Development of the adjusted α-factor with a sample set of data if the contribution values of the projects are summarized using the weighting factors $il = 1, ip = 2$, and $ih = 1$

The values need to be accumulated in a way that the dependencies and influences are considered. This implies that one of the projects within the portfolio is used as a baseline for the contribution to the α-figures. All of the others can then only be measured relatively to this project to demonstrate their effects. As there will be no project within the portfolio that will last for the entire life cycle of the project portfolio, various projects will take over the "leading" role over time.

When thinking about which project to select for this role, there are three possible criteria:

1. Obligation
   a project that is mandatory is selected to be the baseline. The advantage here is that there is a low probability that the other projects are to be re-evaluated according to their relative distribution in comparison with the other projects since the obligation will normally not be altered. This selection criteria might not be used at any time since there might be phases where no obligatory projects are within the portfolio.
2. Time
   the use of this criteria measures all projects within the portfolio relatively to the project that started first. This eases the first planing of the portfolio but raises difficulties when the first project is shifted – in this case all projects must be re-evaluated according to the new first project.
3. Influence
   the project having the highest contribution to the α-factors is used as the

baseline. The measurement of the relative contributions of other projects is easier with this method as the α-values should stay rather small. The difficulty is that this project is not necessarily available from the very beginning of the portfolio. This implies that the selection of a project this project to have an evaluation baseline.

With all of the criteria described managing the moving baseline over time needs to be done carefully and transparently to avoid incorrect evaluations and unnecessary efforts by the elaboration of relative contributions. Because the benefits evaluation lasts longer (normally years) than the period within which the project is actually executed, it is recommended to replace the benefits-measurement with project reference after the same amount of time as the duration of the period under observation for the benefits.

Period		1	2	3	4	5	6	7	8	9
Project 1	il	1	2	10	15	30	45	80	95	110
	ip	2	12	20	45	50	80	110	120	140
	ih	3	31	35	50	60	140	170	200	200
Project 2	il						1	7	10	13
	ip						1	8	17	20
	ih						1	13	20	23
Project 3	il				0	0	5	8	25	35
	ip				2	5	8	15	35	45
	ih				5	20	30	45	60	65
$\sum$	il	1	2	10	15	30	51	94	130	158
	ip	2	12	20	47	55	88	133	172	205
	ih	3	31	35	55	80	171	228	280	288
Adjusted α-factor		2	14	21	41	55	99	147	188	214

Table 4.26. Development of the adjusted α-factor with a sample set of data if the contribution values of the projects are re-estimated based on their dependencies using the weighting factors $il = 1, ip = 2$, and $ih = 1$.

As a starting point for the evaluation of the relative impact the subtraction of the absolute contribution from the dependent project to the first project could be used. The assumption here being that the final relative contribution of any subsequent project lies somewhere between the accumulation of the contributions – and in total no contribution. That the contribution is amplified by two projects is rather rare.

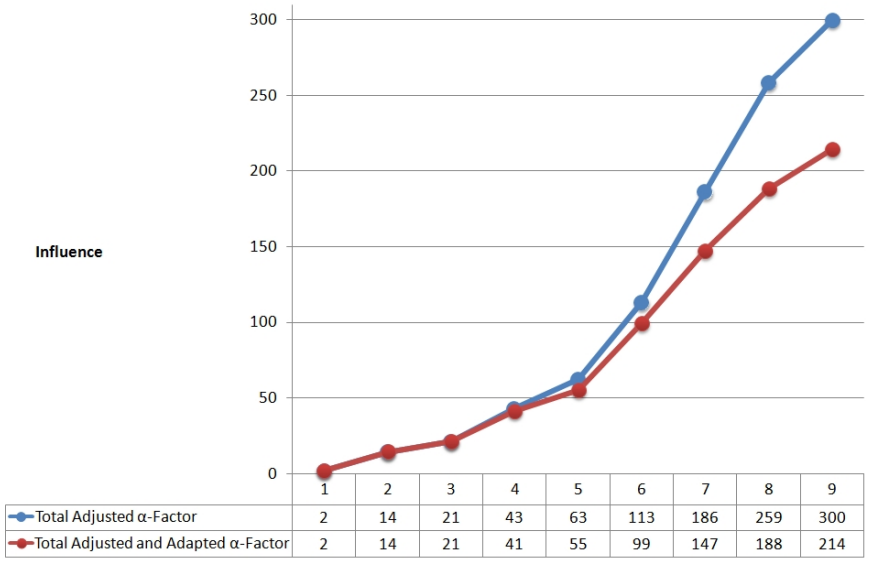


Fig. 4.26. Deviation between the development of the adjusted α-factor for a project portfolio considering dependencies and excluding them based on a sample set of data

The result is the availability of all data described in table 4.1 over the whole life cycle which are necessary for the benefits to be realised. These can be used with the transformations defined in the BSC to calculate the BSC output variables or β-figures for every period in order to track their development as well:

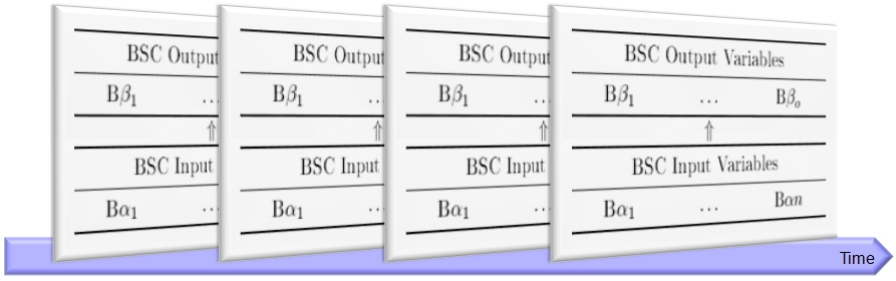


Fig. 4.27. Calculation and development of the BSC output variables over time

The completion of this step requires standardizing the measures in such a way that they can be demonstrated and compared independently from the measure and its scale. The approach used is the same one already demonstrated in section 4.4.4: the maximum value of every measure (independent of the project) is considered to be 100% and all other measures, regardless if they are the measures during the evolution of a project or the entire portfolio, are calculated in relation to this value. The graphical representation is carried

out by placing each criteria on one axis marking the values for every criteria and point in time – an example can be seen in figure 4.6.

Consistency Check

When the information from the various projects is accumulated and mathematical operations are executed, the basis is often lost in execution. Therefore, a cross-check is required at this stage to ensure that the data used is still compliant with the original assumptions. To do so the following checks should be carried out:

- Are there any α-figures estimated for a project that correlate negatively with the expected results? (e.g.: the company wants to increase its retail business but reduces training for the employees in this field at the same time)
- Are the accumulated and adjusted α-figures lower than those which include the dependencies and their subsequent adaptations?
- Are there any α- or β-figures that differ significantly from the expectations?
- Are the β-figures of the BSC calculated within the benefit analysis in line with the ones given as targets for the respective points in time?

Before touching on the topic of costs, the quality criteria for a benefit estimation approach defined in section 2.5.1 needs to be checked as well:

- Validity
  since the estimation of benefits follows the BSC-approach, the indicators no longer rely on the opinion of subject-matter experts but represent a set of measures within the company describing the business dependencies
- Effectiveness
  the timely development of benefits is considered and therewith a baseline given to control the achievements of the figures
- Fluctuation range
  the fluctuation range is considered in the approach, trying to provide a qualified guess and not just depend on the precise estimate
- Tangibility
  through the dependencies in the BSC that are re-used in this approach, the relation between tangible and intangible benefits is shown as far as this is possible – in any case, it goes beyond the possibilities of other approaches in this field
- Dependencies
  the dependencies are well considered; the estimation is based on them

The comparison of the quality indicators shows that the approach developed should bring an extensive improvement in terms of qualified estimation of benefits in a project portfolio. The implementation will be presented utilizing an example later on in this paper.

Estimation of the project' cost factors

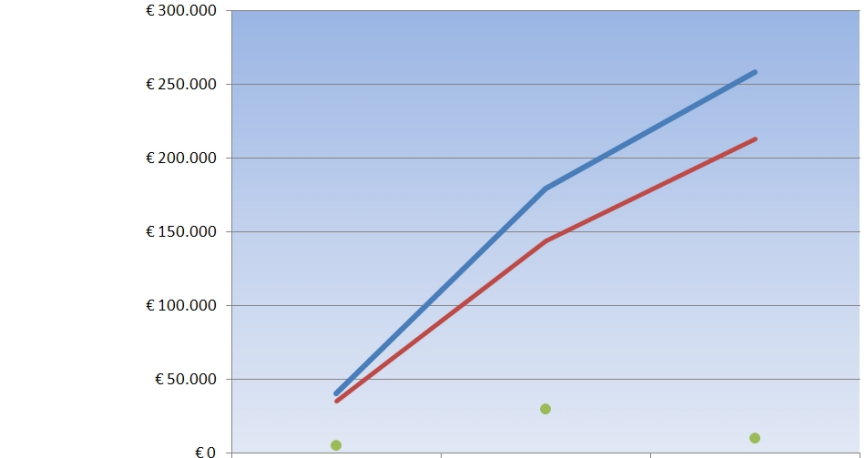
First of all the costs in the project must be determined and assigned to periods of the life cycle of the project. Bottom-up estimation of the costs is preferred because such intense deliberations accompanying a bottom-up estimation normally result in precise cost-forecasts. However, in projects with a long duration this should not be possible and therefore other methodologies such as analogous or parametric estimating (described in section 2.5.2) might be used. The costs over the periods (also called planned values or PVs) are accumulated in a cost baseline ([PMI05] describes the creation of cost-baselines in detail):

Fig. 4.28. Cost baseline for a sample project

Adjustment of the cost factors because of risk and inflation

Besides the costs already expected from project work, there is an additional expected financial impact because of risks. [BRA07] describes how to determine, qualify and quantify risks for projects. The result of the course of action is a set of risks with a calculated financial impact (called Risk Adjustment or RA) that can be assigned to a specific point in time or a period in the life cycle of the project. The Risk Adjusted Planned Value (RAPV) for a point in time t can then be calculated by

$$RAPV_t = PV_t + \sum_{n=1}^{t} RA_n \tag{4.35}$$



	1	2	3
Risk Adjusted Planned Value	€ 40.200	€ 178.600	€ 257.800
Planned Value	€ 35.200	€ 143.600	€ 212.800
Risk Adjustment	€ 5.000	€ 30.000	€ 10.000

Fig. 4.29. Cost baseline adjusted by risk factors for a sample project

The influence of inflation was defined in section 4.4.4 and is applied to the data as soon as the risk-adaptations are done. Executing this to the cost-baseline in the example results in the following picture:

	1	2	3
RAPV + Inflation	€ 41.406	€ 188.235	€ 274.779
RAPV	€ 40.200	€ 178.600	€ 257.800

Fig. 4.30. Cost baseline with an assumed inflation rate of 3% for a sample project

When comparing the total cost of this example to the normal cost baseline (which is usually taken for the planning of a project portfolio) with the cost baseline that can be seen after these two necessary adaptations, the difference is about +6,6%! Therefore project portfolio managers often realize plan values for their portfolios which are too low. This leads to high dissatisfaction among the stakeholders because they are constantly asked to increase budgets. If there are no additional funds available, scope reductions are the result, again leading to high dissatisfaction. In reality this effect is often not felt so dramatically because part of the cash-out position is refunded by the concept of depreciation introduced at the beginning of the chapter. Implicitly, budgets are balanced again on the company level. An important factor of this approach is to make this process very transparent.

The consideration of depreciation

The aforementioned process steps only described additional costs for consideration compared to the basic costs of a project. The topic of depreciation is in this sense different, because it saves cost for the company. The details for the reasons and the formulas to calculate the savings from reduced tax-payments are described in section 4.4.4.

Assuming an investment amount of €200.000 that can be activated and a tax-rate of 30% gives the following picture for the example mentioned above:

	1	2	3	4	5	6
RAPV + Inflation	€ 41.406	€ 188.235	€ 274.779	€ 254.779	€ 234.779	€ 214.779
Depreciation				-€ 20.000	-€ 20.000	-€ 20.000

Fig. 4.31. Cost baseline for a sample project including all cost factors and depreciation

The depreciation amount must not be discounted, since the figures reflect the real financial values in this period. Depreciation normally reflects neither inflation, nor internal return of investment.

Embracing of all cost relevant data in the project portfolio

To finalize the cost planning for the portfolio, these steps have to be repeated for all projects in the portfolio. The results become aggregated over the whole project portfolio which gives a picture similar to figure 4.31 but consolidating all projects within the portfolio. This aggregation then represents the cost baseline for the project portfolio.

4.5.5 Example: Implementation of the planning approach

Initial situation

Continuing the example from 4.5.3, the dependencies in the sample portfolio look as follows:

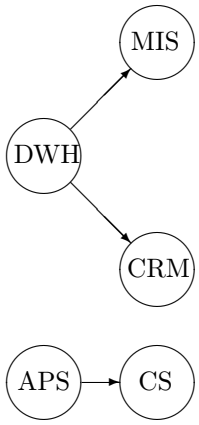


Fig. 4.32. Dependencies in the sample portfolio

Section 4.5.3 described the selection of a proper portfolio along with the constraints identified. This portfolio included the MIS project in dependency to the DWH project as an obligatory project and the APS project because of its benefit to the organization. From these results the details will only be considered and calculated for the three projects left. In the example the BSC contribution by the projects to the α-figures was identified as follows:

BSC Input Variables	DWH	MIS	APS
Motivation Index			
Absenteeism			
Turnover Rate			
Training Hours	+1.600	+100	+1.000
Ethics Violations			
Duration of NR Applications	-2		-5
Number of Resources for NR Applications	-5		-10
Efficiency of NR Collection	+5%		
Duration of Retail Applications	-2		-2
Number of Resources for Retail Applications	-20		-20
Efficiency of Retail Collection	+5%		
Degree of automatization of retail processes	+5%		+10%
Number of Marketing Activities	+25		
Market Rating		+1	+1
Non-Retail Customer			
Retail Customer			
Customer Satisfaction Rating	+1		+1
Percentage of offers/deals	+5%		+10%
Non-Retail customers lost			
Products per customer	+3		
Retail Customers lost			
Product Profitability		+10%	
Non-Retail Revenue			
Retail Revenue			
Treasury Revenue		+100k	
IT Investments	+500k	+100k	+150k
Building Investments	+100k		
Other Investments			
Labor Cost	+630k	+840k	+420k

Table 4.27. BSC Input factors from a sample project portfolio of a bank

In order to simplify the presentation of the results, all criteria that are not influenced by any of the projects will not be considered in the next steps. Furthermore, all cost-relevant aspects will not be considered in the benefit-estimation, since they require to be included with the costs as previously discussed.

Estimation of the target input-factors for the benefit planning

For the selection of the projects in the portfolio this estimated information was precise enough – for the detailed planning of the projects, the values have to be

estimated bottom-up including the fluctuation as it was introduced in section 4.5.4. Therefore the entries in the matrix are replaced by three indicators:

- lowest possible influence(il) of the benefit-indicator
- most probable influence(ip) of the benefit-indicator
- highest possible influence(ih) of the benefit-indicator

In the example given, the results for the planned indicators would look like this:

BSC Input Variables	DWH			MIS			APS		
	il	ip	ih	il	ip	ih	il	ip	ih
Training Hours	+1.100	+1.600	+1.700	+60	+100	+120	+600	+1.000	+1.200
Duration of NR Applications	-1	-2	-5				-3	-5	-8
Number of Resources for NR Applications	-2	-5	-6				-6	-10	-15
Efficiency of NR Collection	+3%	+5%	+5%						
Duration of Retail Applications	-1	-2	-2				-1	-2	-5
Number of Resources for Retail Applications	-15	-20	-22				-5	-20	-20
Efficiency of Retail Collection	+4%	+5%	+7%						
Degree of automatization of retail processes	+5%	+5%	+5%				+5%	+10%	+20%
Number of Marketing Activities	+15	+25	+28						
Market Rating				+0	+1	+1	+0	+1	+5
Customer Satisfaction Rating	+0	+1	+3				+1	+1	+4
Percentage of offers/deals	+2%	+5%	+10%				+5%	+10%	+25%
Products per customer	+2	+3	+4						
Product Profitability				+5%	+10%	+20%			
Treasury Revenue				+80k	+100k	+150k			

Table 4.28. BSC Input factors including fluctuation

Calculating the adjusted α-figures following the formula in (4.13) delivers the following result for the data in the matrix above. For the weighting the factors $il = 1$, $ip = 2$ and $ih = 1$ are assumed:

BSC Input Variables	DWH	MIS	APS
Training Hours	+1.500	+95	+950
Duration of NR Applications	-3		-5
Number of Resources for NR Applications	-5		-10
Efficiency of NR Collection	+5%		
Duration of Retail Applications	-2		-3
Number of Resources for Retail Applications	-19		-16
Efficiency of Retail Collection	+5%		
Degree of automatization of retail processes	+5%		+11%
Number of Marketing Activities	+23		
Market Rating		+1	+2
Customer Satisfaction Rating	+1		+2
Percentage of offers/deals	+6%		+13%
Products per customer	+3		
Product Profitability		+11%	
Treasury Revenue		+107,5k	

Table 4.29. BSC Input factors with adjusted α-figures assuming $il = 1$, $ip = 2$ and $ih = 1$

Planning of the development of every input-factor in a project over time

The assumption for all projects in this sample project portfolio is that the realization of all estimated benefits can be completed within six months after the project is over. Therefore, the development of the benefits needs to be shown for this period. If some of the benefits can be accomplished before the project is finished, the observation period must be shifted to start earlier. However, it would still end six months after the project ends (the point in time where all benefits should be achieved).

For all three projects in the example, the process described in section 4.5.4 is repeated for every period starting with the period after the finalization of the project. This delivers the following results for these projects:

	Month					
DWH	13	14	15	16	17	18
Training Hours	+113	+230	+375	+788	+1.175	+1.500
Duration of NR Applications			-1	-1	-2	-3
Number of Resources for NR Applications				-1	-3	-5
Efficiency of NR Collection		+1%	+2%	+3%	+4%	+5%
Duration of Retail Applications					-1	-2
Number of Resources for Retail Applications	-5	-7	-10	-13	-17	-19
Efficiency of Retail Collection				+1%	+4%	+5%
Degree of automatization of retail processes			+1%	+3%	+4%	+5%
Number of Marketing Activities	+5	+10	+16	+19	+23	+23
Market Rating						
Customer Satisfaction Rating						+1
Percentage of offers/deals				+1%	+4%	+6%
Products per customer				+1	+3	+3
Product Profitability						
Treasury Revenue						

Table 4.30. The development of all benefit criteria in the DWH project over the observation period

	Month					
MIS	21	22	23	24	25	26
Training Hours		+25	+45	+63	+80	+95
Duration of NR Applications						
Number of Resources for NR Applications						
Efficiency of NR Collection						
Duration of Retail Applications						
Number of Resources for Retail Applications						
Efficiency of Retail Collection						
Degree of automatization of retail processes						
Number of Marketing Activities						
Market Rating						+1
Customer Satisfaction Rating						
Percentage of offers/deals						
Products per customer						
Product Profitability			+2%	+5%	+8%	+11%
Treasury Revenue	+13.8k	+32.5k	+53.8k	+73.8k	+92.5k	+107.5k

Table 4.31. The development of all benefit criteria in the MIS project over the observation period

	Month					
APS	19	20	21	22	23	24
Training Hours		+238	+450	+638	+800	+950
Duration of NR Applications			-2	-4	-5	-5
Number of Resources for NR Applications				-3	-7	-10
Efficiency of NR Collection						
Duration of Retail Applications						-3
Number of Resources for Retail Applications	-2	-6	-10	-15	-17	-19
Efficiency of Retail Collection						
Degree of automatization of retail processes	+5%	+9%	+11%	+11%	+11%	+11%
Number of Marketing Activities						
Market Rating						+2
Customer Satisfaction Rating						+2
Percentage of offers/deals			+4%	+9%	+11%	+13%
Products per customer						
Product Profitability						
Treasury Revenue						

Table 4.32. The development of all benefit criteria in the APS project over the observation period

Consolidating the data for the whole project portfolio

Because the projects influence each other through the various α-figures, the picture needs to be consolidated in such a way that the contributions of every single project are determined, based on one leading project. To do so, the start dates and durations of the benefit realization periods in the projects must be compared to identify the leading project per period:

	Month													
	13	14	15	16	17	18	19	20	21	22	23	24	25	26
DWH	X	X	X	X	X	X								
MIS									X	X	X	X	X	X
APS							X	X	X	X	X	X		

Table 4.33. Benefit realization periods for the sample project portfolio

Applying the criteria defined in section 4.5.4 to determine the leading project serving as the baseline, a decision has to be taken as follows: for the period from 13 – 18 the DWH project is the only project executed and

therefore the benefit expectations (adjusted α-factors) are not adapted. Starting from period 21 the situation is more complicated, because there are two projects being executed simultaneously. According to the time aspect APS needs to be chosen because it starts earlier. As the MIS project is a mandatory project it is very likely that it will not be shifted time wise and would give a higher security to the planning of the project portfolio. Therefore the preference is given to the MIS project. This implies the following order for the leading project:

Project	Period
DWH	13 – 18
APS	19 – 20
MIS	21 – 26

Table 4.34. Leading projects for the sample project portfolio

To simplify the explanation, this example assumes that the adaptation of the *ih*, *ip* and *ih*-factor for the calculation of the adjusted α-figures is exactly the delta between the factors in the respective projects in the different periods. This means the effects of the MIS and APS project are counted in full. This implies that the contribution of the projects to the adjusted α-factors in this example can be calculated by subtracting the adjusted α-factors for the following projects from the ones of the leading projects. This is unrealistic for a real world portfolio, but makes the traceability of this example easier. Table 4.35 shows the expected development of the BSC contribution parameters (adjusted α-factors) over the observation period.

For the periods 13-18 the picture remains unchanged from the one provided in table 4.30. After the DWH project the effects of cumulative contributions from the the APS and the MIS project and their dependencies to the α-factors appear. The table with the development of the α-figures represents the baseline for the planning of the benefits that will be used later – to base the controlling on. From a management point of view, this evolution of measures now needs to be cross-checked with the targets set in the BSC.

After the figures are acquired, the relative amounts per indicator can be calculated. These are displayed in table 4.36.

	Month													
	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Training Hours	+113	+230	+375	+788	+1.175	+1.500	+1.500	+1.738	+1.950	+2.163	+2.345	+2.513	+2.530	+2.545
Duration of NR Applications			-1	-1	-2	-3	-3	-3	-5	-7	-8	-8	-8	-8
Number of Resources for NR Applications				-1	-3	-5	-5	-5	-5	-8	-12	-15	-15	-15
Efficiency of NR Collection		+1%	+2%	+3%	+4%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%
Duration of Retail Applications					-1	-2	-2	-2	-2	-2	-2	-5	-5	-5
Number of Resources for Retail Applications	-5	-7	-10	-13	-17	-19	-21	-25	-29	-34	-36	-38	-38	-38
Efficiency of Retail Collection				+1%	+4%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%
Degree of automatization of retail processes			+1%	+3%	+4%	+5%	+10%	+14%	+16%	+16%	+16%	+16%	+16%	+16%
Number of Marketing Activities	+5	+10	+16	+19	+23	+23	+23	+23	+23	+23	+23	+23	+23	+23
Market Rating												+2	+2	+3
Customer Satisfaction Rating						+1	+1	+1	+1	+1	+1	+3	+3	+3
Percentage of offers/deals				+1%	+4%	+6%	+6%	+6%	+10%	+15%	+17%	+19%	+19%	+19%
Products per customer				+1	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3
Product Profitability											+2%	+5%	+8%	+11%
Treasury Revenue									+13.8k	+32.5k	+53.8k	+73.8k	+92.5k	+107.5k

Table 4.35. Development of all adjusted α-factors in the project portfolio

	Month													
Figures in percent	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Training Hours	5	9	15	32	47	60	60	70	79	85	92	99	99	100
Duration of NR Applications			13	13	25	38	38	38	63	88	100	100	100	100
Number of Resources for NR Applications				7	20	33	33	33	33	53	80	100	100	100
Efficiency of NR Collection	20	40	60		80	100	100	100	100	100	100	100	100	100
Duration of Retail Applications					20	40	40	40	40	40	40	100	100	100
Number of Resources for Retail Applications	13	18	26	34	45	50	55	66	76	89	95	100	100	100
Efficiency of Retail Collection				20	80	100	100	100	100	100	100	100	100	100
Degree of automatization of retail processes			6	19	25	31	63	88	100	100	100	100	100	100
Number of Marketing Activities	22	43	70	83	100	100	100	100	100	100	100	100	100	100
Market Rating												67	67	100
Customer Satisfaction Rating						33	33	33	33	33	33	100	100	100
Percentage of offers/deals				5	21	32	32	32	53	79	89	100	100	100
Products per customer				33	100	100	100	100	100	100	100	100	100	100
Product Profitability											18	45	73	100
Treasury Revenue									13	30	50	69	86	100

Table 4.36. Timely development of the planned benefits in relative figures

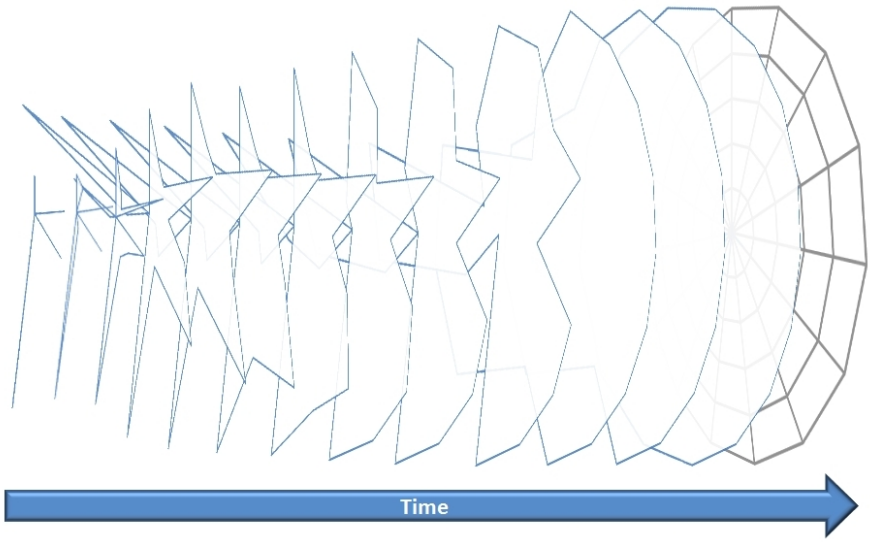


Fig. 4.33. Radar Chart showing the timely development of the planned benefits

Consistency Check

For the consistency check the questions as defined in section 4.5.4 are used:

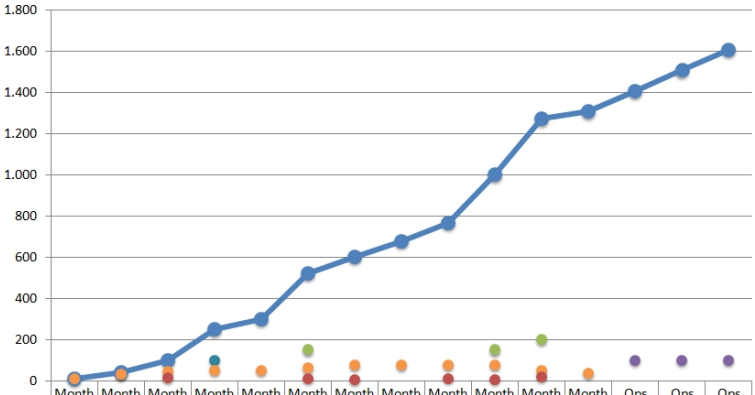
- *Are there any α-figures estimated for a project that correlate negatively with the expected outcomes? (e.g.: the company wants to increase their retail business but reduces training for their employees in this field at the same time)*
  The α-figures in this example correlate in the same way that is expected out of the design of the BSC. The verification is obvious if the figures are compared to the description of the criteria – e.g. if the duration of non-retail applications is considered, the processing time must be improved and the duration thereby decreased. The figure to be expected is, therefore, negative.
- *Are the accumulated adjusted α-figures lower than the ones including the dependencies and the adaptations out of it?*
  They are – the assumption taken in this example is extreme because the effects of the MIS and the APS project were considered to to be fully counted. Therefore the total benefit equals the accumulated figures from the single projects. As explained above, this is unrealistic for a real world project portfolio but can be considered just for the reasons of traceability in this example.
- *Are there any α- or β-figures that differ significantly from the expectations?*
  As the targets for the BSC in this example are virtual ones, this assumption is supported.
- *Are the β-figures of the BSC calculated within the benefit analysis in line with the ones given as targets for the respective points in time?*
  As the targets for the BSC in this example are virtual ones, this assumption is supported.

Estimation of the project cost factors and their requisite adjustments because of risk and inflation

In general the determination of costs of project portfolios is easier to achieve than the benefits for the same portfolio. The two reasons are that first, people are much more used to dealing with costs than with the qualification of benefits. Second, regarding the costs there are usually more facts available, upon which the project manager can base his estimates. He knows the hourly rates of the project participants, can ask for offers for services or investments from vendors and he can take reference projects as a baseline for his calculations. This section discusses the building of a cost baseline, according to the actual standards for Project Management for the sample portfolio. These items will be complemented by special issues defined in the sections 4.5.4 to 4.5.4.

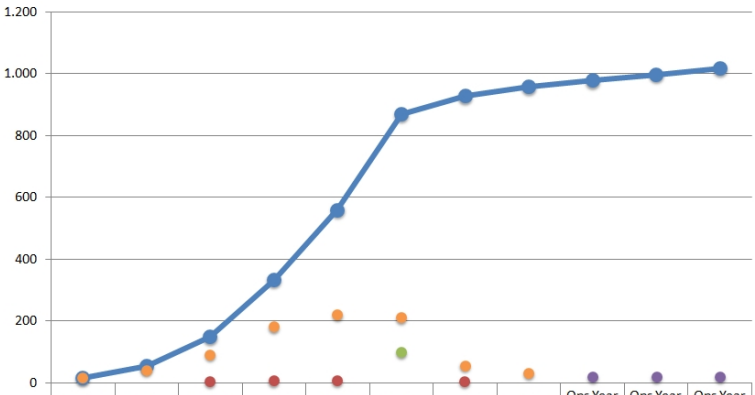
In this example the basic costs including risks are calculated together, because the risk adjustments are easily integrated into the phase planning

approach for the remaining costs. All cost and risk estimates are accumulated bottom-up to get a cost baseline on a monthly basis. The costs considered do not only include the project costs but also take into consideration the operation costs for the project within the first three years of operations. The data for the three projects in the portfolio look as follows:



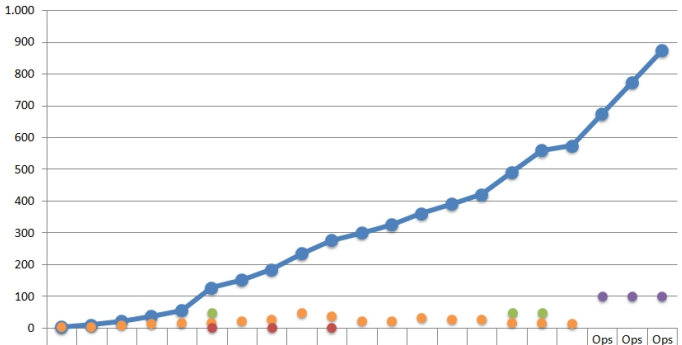
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Ops Year 1	Ops Year 2	Ops Year 3
IT Investments						150				150	200				
Building Investments				100											
Labour Cost	10	30	45	50	50	60	75	75	75	75	50	35			
Running Costs													100	100	100
Risk Cost			15			12	6		14	8	21				
Cumulated Costs	10	40	100	250	300	522	603	678	767	1.000	1.271	1.306	1.406	1.506	1.606

Fig. 4.34. Cost Baseline for the DWH project in thousands



	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Ops Year 1	Ops Year 2	Ops Year 3
IT Investments						100					
Building Investments											
Labour Cost	15	40	90	180	220	210	55	30			
Running Costs									20	20	20
Risk Cost			3	5	6		3				
Cumulated Costs	15	55	148	333	559	869	927	957	977	997	1.017

Fig. 4.35. Cost Baseline for the MIS project in thousands



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	Ops Year 1	Ops Year 2	Ops Year 3
IT Investments						50										50	50				
Building Investments																					
Labour Cost	5	7	12	15	18	20	25	30	50	40	25	25	35	30	30	20	18	15			
Running Costs																			100	100	100
Risk Cost						2		2		1											
Cumulated Costs	5	12	24	39	57	129	154	186	236	277	302	327	362	392	422	492	560	575	675	775	875

Fig. 4.36. Cost Baseline for the APS project in thousands

The project portfolio requires to be recalculated taking inflation into consideration – the assumption is at 3% per year or $\approx 0.25\%$ per month. As already mentioned in section 4.5.4, the inflation has to be calculated only for the costs accrued in the appropriate period. Then they are summarized and present the following picture in the sample portfolio:

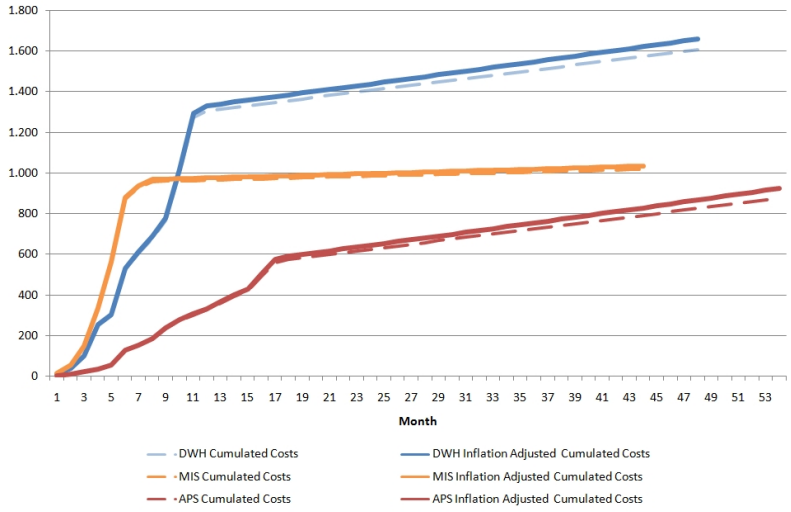


Fig. 4.37. Cost Baseline adjusted by the expected inflation in thousands

The consideration of depreciation

Normally the baseline for depreciation can be determined by the accounting department based on the project's facts. They would consider all cost parts of the project that can be activated (e.g.: investments, parts of the person days and so on). In this example the baseline for depreciation is assumed to be all of the investments plus a third of the person-years, as they are assumed to be generated by external consultants and, therefore, considered to be investments. The period of depreciation is considered to be three years (this period should be the same as the one used for the total cost of ownership). The tax-rate in this example is assumed to be 30%.

Depreciation	Baseline	In total	A year
DWH	810	243	81
MIS	380	114	39
APS	290	87	29

Table 4.37. Depreciation figures in thousands in the example

Figure 4.37 described the change of cumulative costs because of inflation. This view is now extended by the effect of depreciation starting with the end of the project (when the depreciation can start):

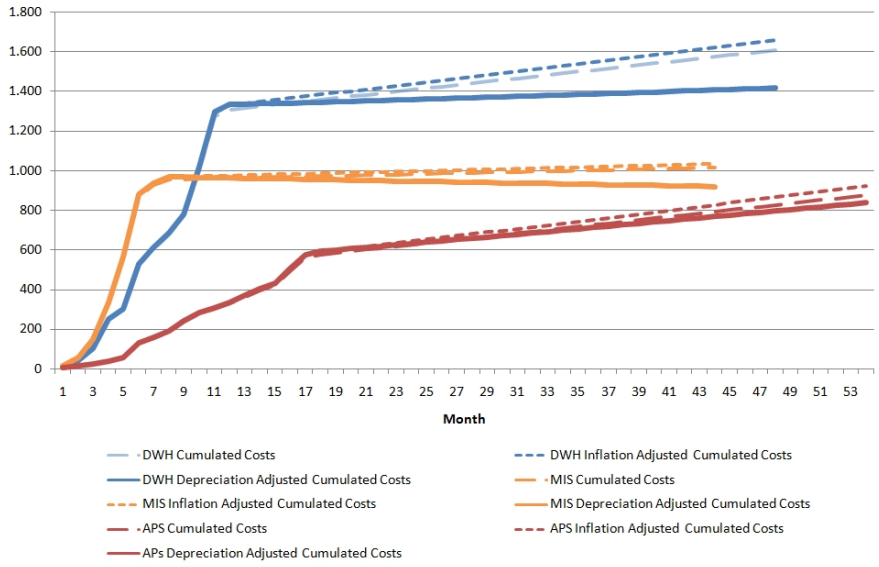


Fig. 4.38. Cost Baseline adjusted by the expected inflation and the depreciation in thousands

Embracing of all cost relevant data in the project portfolio

Finally the different starting points of the projects have to be considered and the data aggregated. This results in a total cost baseline or cost budgeting baseline that shows the demand for the projects in the project portfolio:

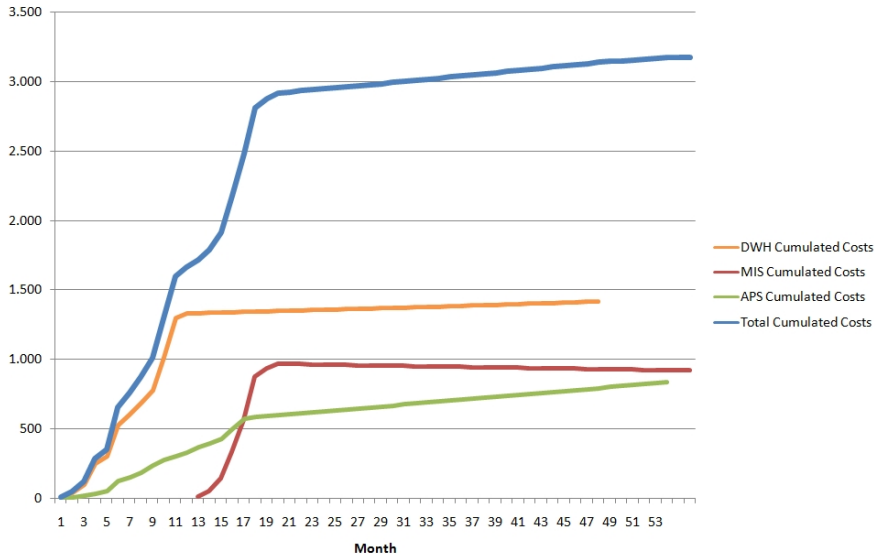


Fig. 4.39. Total Cost Baseline for the project portfolio in thousands

4.5.6 Monitoring portfolio performance and realization of benefits

In the discussion of the status quo in monitoring and controlling of the Project Portfolio Management in section 2.6, a five-step process was introduced to ensure a proper collection of data and interpretation in order to manage the project portfolio effectively. The fundamentals of this process will also be applied in this approach but the process steps have to be adapted to the concepts introduced in the previous sections.

The process as introduced in section 2.6:

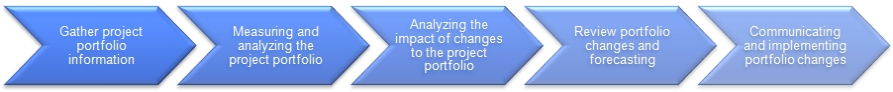


Fig. 4.40. Steps of the Portfolio Monitoring Process visualized after [RMW07], p.116ff

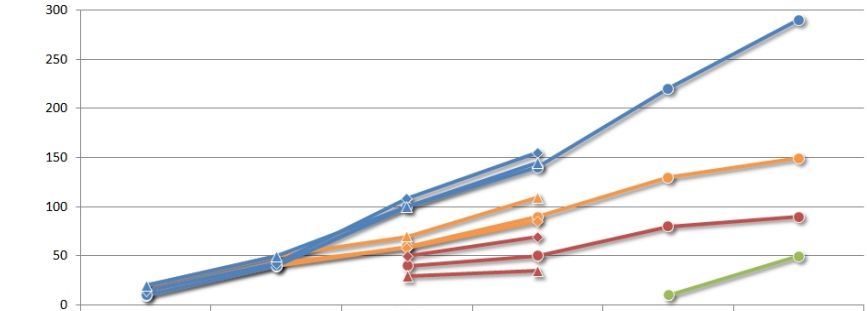
An important distinction to be made is the separation between monitoring and controlling of

- actuals out of currently executed projects and programs (these are the elements taken from the magical triangle: schedule, cost and quality)
- benefits of the finished projects and programs

Gather project portfolio information

The collection of actuals for project-specific measures is executed following the principles of project management. The data for costs, schedule and quality are aggregated across the projects and programs to create an overview of the total figures. In the first step this is done for every single project in a project portfolio to ascertain the development of the figures over the lifetime of this endeavor. The data collected and the indicators that can be derived from it are described in the model in section 4.4.2.

The figure below shows a sample portfolio that shows the Portfolio Planned Value (PPV), the Portfolio Actual Cost (PAC) and the Portfolio Earned Value (PEV) derived from the collected actuals:



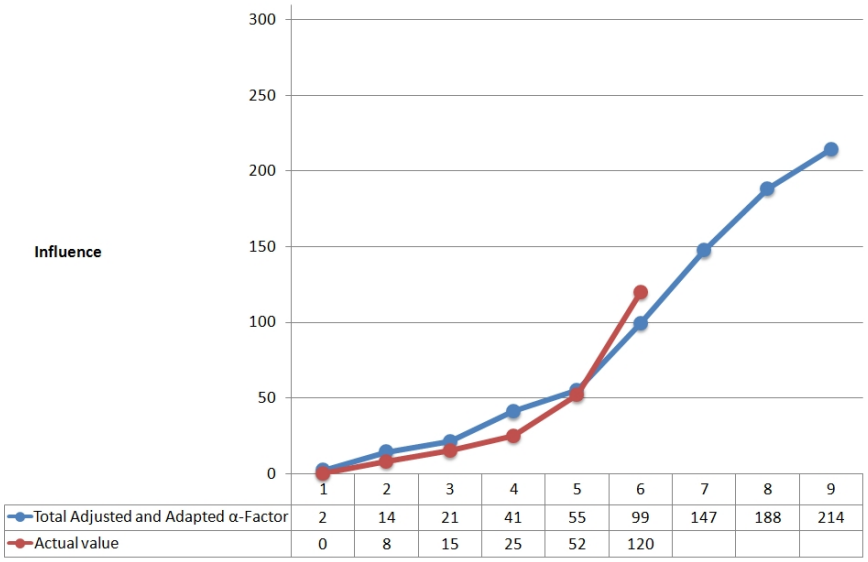
	1	2	3	4	5	6
P1 - PV	10	40	60	90	130	150
P1 - AC	15	42	58	85		
P1 - EV	20	50	70	110		
P2 - PV			40	50	80	90
P2 - AC			50	70		
P2 - EV			30	35		
P3 - PV					10	50
PPV	10	40	100	140	220	290
PAC	15	42	108	155		
PEV	20	50	100	145		

Fig. 4.41. Portfolio Planned Value (PPV), Portfolio Actual Cost (PAC) and Portfolio Earned Value (PEV)

Similarly to the gathering of data in the monitoring and control phase of a project, the planned values and actuals are collected for the expected benefits in a project portfolio. As discussed in previous sections, the measures that are considered during the projects' life-time are extended by correlating indicators from the company's BSC. Consequently, they ought to be included in the monitoring and controlling as well – otherwise the selection and planning would have been done considering them, but nobody would be in the position

to ensure that the perspectives have been achieved. It is important to note that the monitoring and controlling of benefits focuses on the period after the finalization of a project or program in a project portfolio.

This implies that all factors that have been planned according to the discussion in 4.5.4 build the baseline for monitoring and controlling. So the baselines (the adjusted and adapted α-factors over time) for every α-factor as they have been created in section 4.5.4 are taken and the actual values for those α-values are collected. This may give the following picture for a single α-indicator:



	1	2	3	4	5	6	7	8	9
Total Adjusted and Adapted α-Factor	2	14	21	41	55	99	147	188	214
Actual value	0	8	15	25	52	120			

Fig. 4.42. The baseline of an adjusted and adapted α-factor over time compared to its actual values

It is important to realize that this approach does not foresee the collection of the influence of a single project on a single α-factor but only the determination of the change of the α-factor caused by the project portfolio. This is because interdependences of the various projects on a single α-factor can hardly be extracted and the effort for doing so cannot be justified. Working with this assumption implies a disadvantage that has to be kept in mind: the influences on the α-factors that are not caused by the project portfolio but by other influences are not explicitly considered. Consequently, the controllers must take a look at it and possibly apply flat-rates for every α-factor to include this effect.

The collection of data needs to be done consistently for all α-factors over all the periods up to the actual point in time. Naturally this gives a matrix as it was introduced in figure 4.9 and represents an extension to figure 4.8, which showed the project-specific measures.

As soon as this is done for all the α-factors, it is also repeated for all the cost-factors defined in the planning phase of the portfolio. This exercise is easier, since the figures for every single project are normally available. They have to be aggregated to obtain the values for the portfolio. The collection and determination of the figures strictly follows the one defined by the Earned Value Methodology defined in section 3.2. An example for the representation of planned versus actual cost is shown in figure 3.15.

Although it has been already mentioned in the paper, it should be emphasized once again that costs are naturally also considered when talking about α-factors in a BSC – the reason why they are treated separately during the evolution of the paper is because the planning and determination of the figures in this field follows different approaches.

The radar chart introduced in section 4.4.4, can be used in order to provide a comprehensive view of the collected values for the entire project portfolio at the time of collection. In contrast to the definition used in section 4.4.4, the $P\alpha$-value describes the planned α-value for the measured point in time and the $A\alpha$ the actual one. This can be seen below:

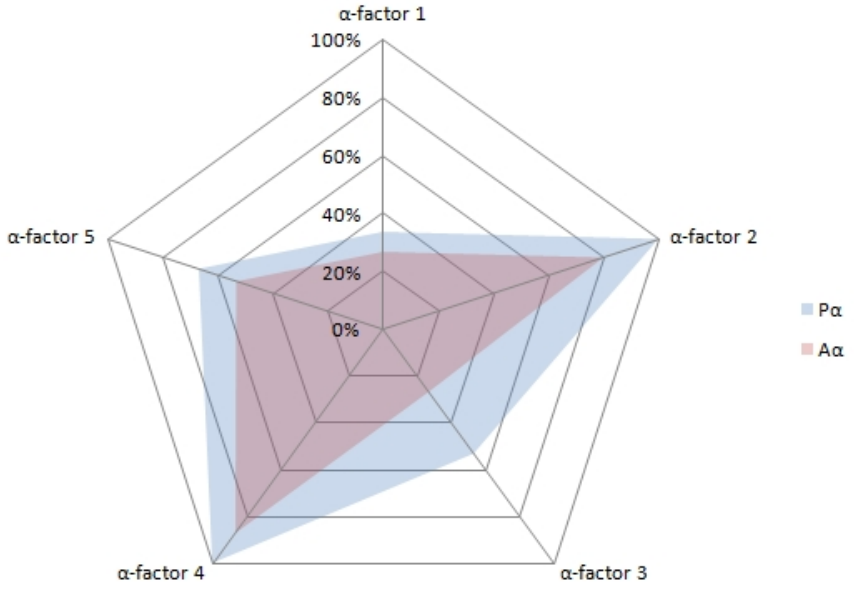
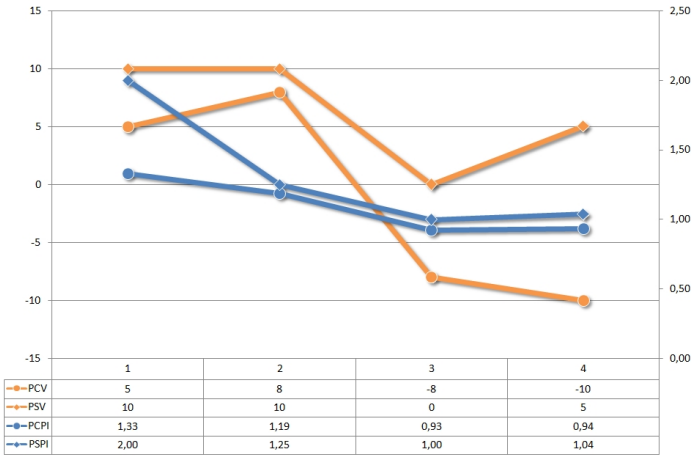


Fig. 4.43. Radar chart for the comparison of planned and actual α-figures for an actual point in time (APIT)

Measuring and analyzing the project portfolio

The formulas for the indicators to measure and analyze the status of the project portfolio based on the derived figures are defined in section 4.4.2. The example below shows the application of the formulas and the interpretation of the results based on the discussion of EVM in section 3.2.2:



	1	2	3	4
PCV	5	8	-8	-10
PSV	10	10	0	5
PCPI	1,33	1,19	0,93	0,94
PSPI	2,00	1,25	1,00	1,04

Fig. 4.44. Portfolio Cost Variance (PCV), Portfolio Schedule Variance (PSV), Portfolio Cost Performance Index (PCPI) and Portfolio Schedule Performance Index (PSPI)

The sample shows a well balanced portfolio that is 6% below budget and, at the same time, 4% ahead of schedule. If one of the indicators of a project differed significantly from the expectations, an investigation would have to be started to find the detailed reasons for the deviance. It is important to identify the root causes and not the symptoms because the removal of the latter would only help the portfolio in the short term.

The facts gathered for the α-figures must also be analyzed and conclusions drawn to locate the actual position on the virtual road map that was created during the planning of the project portfolio. Therefore, two indicators defined in the EVM in table 3.1 are applied in a slightly adapted way as described in section 4.4.2.

The outcome of such an analysis might result in a chart such as the one below:

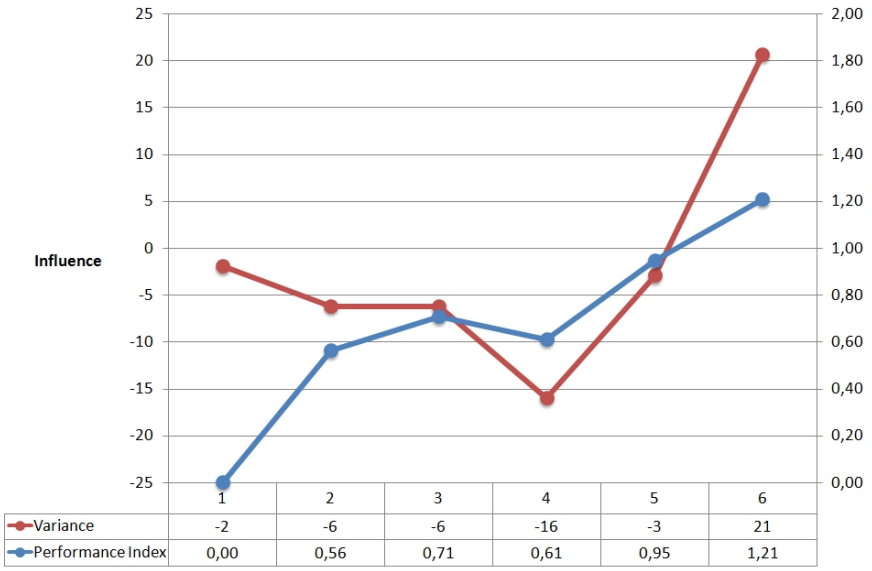


Fig. 4.45. Timely development of the variance and the performance for an α-factor

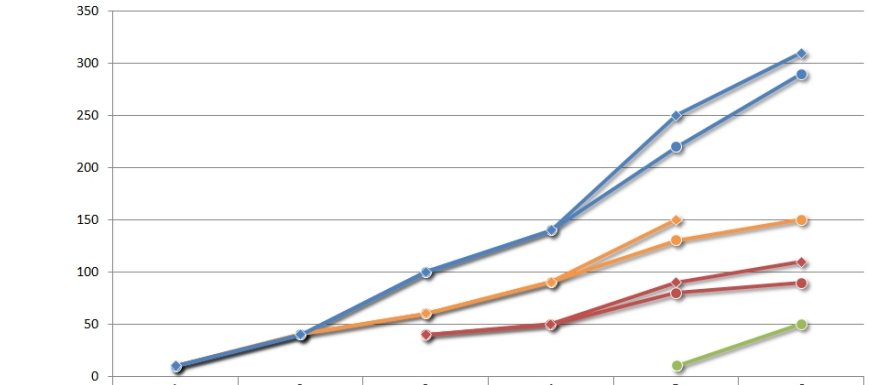
The chart and the figures show that from the beginning of the measurement until period five, the development of the α-factor is behind expectations. This is represented by a negative variance and a performance value being < 1. From the performance index figures a slightly different trend emerges that shows that the expectations could still be met as over time the difference between period one and period five shrinks from 100% to only 5% respectively. In period six the turnaround was achieved by showing a positive variance and a performance of 21% above the original expectations.

The question which this analysis raises is: "Why"? So, why is the development of the α-factor or the cost not according to plan? Naturally, this question is not of importance when the actuals are above expectations and stay within a range that is not conspicuous. As soon as the deviations are too high or the delivered values are significantly below the estimated ones, a drill down has to be performed. At this point a counter-reaction is initiated in line with the general principle defined in section 4.5.6: how have the measured values for α-factors evolved? How to to make sure that it is possible to compare the values from the planning phase (in a detailed manner) with the outcomes? However, this does not revise the general principle, since the effort spent here is target-oriented and far below the one a detailed elaboration for the whole project portfolio would cause.

An important detail in the elaboration is that the dependencies of the "Why" are understood. This is important for the subsequent phases when the project portfolio outlook is deliberated.

Analyzing the impact of changes to the project portfolio

As soon as the root-causes for the issues are identified, the necessary changes can be implemented. Normally this results in a re-planning of the projects in the portfolio and leads to updated EV-indicators, as shown in the following example. An important – although obvious – remark is to only change future planning figures. The past cannot be revised.



	1	2	3	4	5	6
P1 - PV	10	40	60	90	130	150
Upd. P1 - PV	10	40	60	90	150	
P2 - PV			40	50	80	90
Upd. P2 - PV			40	50	90	110
P3 - PV					10	50
PPV	10	40	100	140	220	290
Upd. PPV	10	40	100	140	250	310

Fig. 4.46. Updated Portfolio Plan Value (PPV)

The graph shows that due to the performance and the root causes identified, project 1 will finish earlier. However, project 2 will need additional financial resources and also is delayed significantly. Therefore, the execution is extended with new plan values for one further period. Project 3 is not affected, because it will only start in the next period and it is assumed that the changes to the other projects do not have an impact on this endeavor.

The analysis of the project portfolio normally results in changes to the development of the α-factors and/or cost for the life-time of the portfolio compared to the last analysis and creation of a baseline. Up to now, the influences measured and analyzed originated from the inner aspects of the project portfolio. Effects or requirements for action have not been considered so far. In general the changes to the benefits of a project portfolio can be classified into three major causes:

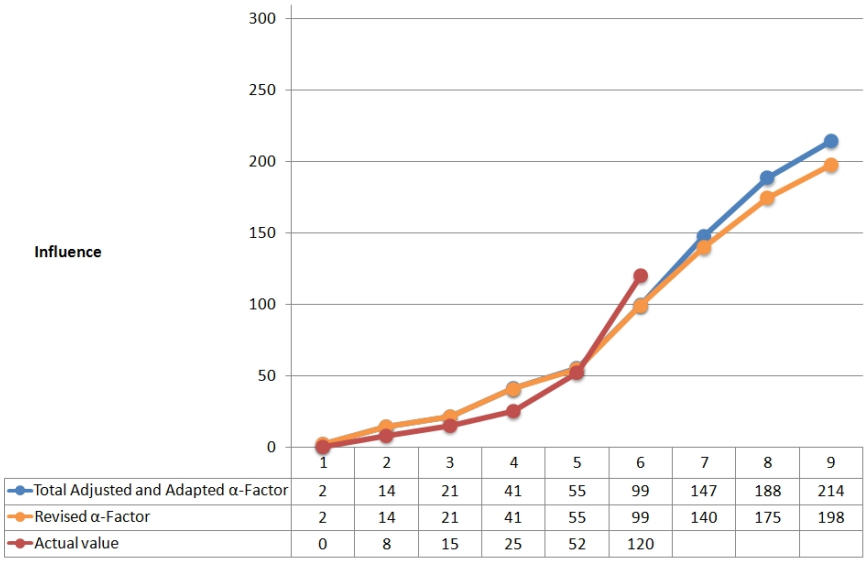
- Out of the daily business of a company (processes, ...)
- Out of the company's environment (regulations, market, competition, ...)
- Out of the project or program (scope, schedule, cost, resources, ...)

The first reason should be a formal one, because it has to be covered already by the BSC itself. This means that the changes in the daily business of a company need to be presented by the evolutionary baseline for the BSC. The α-factors for the project portfolio are built on top of these changes. As to the causation within the environment, the changes resulting from regulations can be further divided into two types:

- Regulations that directly affect the BSC (e.g. obligations for the minimum age peoople are allowed to use financial services, like a current account)
- Regulations that result in the implementation of a mandatory project (e.g. the implementation of the Basel II framework in the financial industry)

The company's target has to be to balance and to align all three factors over the time.

When the actual data and changes are collected, they must be compared to the outside factors and the results of the internal processes in order to adapt the existing project portfolio. This means that the collected factors require to be used as an input for the adjustment of the planning of the α-factors (including the costs). From a process perspective this means the recurrence of all the steps defined in section 4.5.4. Repeating all the planning might sound exaggerated and in the actual execution it is: the Project Portfolio Manager only ought to compare the planning assumptions with the facts provided by the Portfolio Management and go into details on the divergence. As a result, the planning documents described for the planning of the portfolio are revised. The outcome for the adaptation of a single α-factor might look like this:



	1	2	3	4	5	6	7	8	9
Total Adjusted and Adapted α-Factor	2	14	21	41	55	99	147	188	214
Revised α-Factor	2	14	21	41	55	99	140	175	198
Actual value	0	8	15	25	52	120			

Fig. 4.47. Revised development of an α-factor

The updates of the plans and baselines should only be done for periods in the future – otherwise it might look like the portfolio was always developing according to plan. Moreover, the history of baselines must be maintained meticulously, since a later deviation analysis would not deliver proper results for the lessons learned from Project Portfolio Management.

If the majority of changes to the Project Portfolio came from the benefits expected from the projects or programs the performance indices calculated for the α-factors should be considered during the re-working and checking stage of the planning. This means that if the results of a project under-perform in the contribution to some α-figures, the final target for contribution needs to be reevaluated and the contribution curve should be revised.

Finally, the revised plans for all α-factors and costs are aggregated to obtain a view of the current portfolio, considering all necessary changes.

Review portfolio changes and forecasting

The result of the last step is an updated view of the existing project portfolio but is not concerned whether the execution of this portfolio is still acceptable in terms of:

- Capacity issues (under- and over-capacity)
  Because of the re-planning of the projects or programs a higher or lower demand for specific skills may be asked for. In case of under-capacity either additional resources must be utilized which creates the need for an increased budget or the executed projects in the existing project portfolio are shortened. A special case is the necessity for additional skills that have not been demanded before. Solving this issue works the same way as described for under-capacity.
- Financial resources
  The new plans might either describe additional financial resources or free up some. In case of an increased demand for money the company, it must be clear whether this additional investment can be carried out. If so, the project portfolio can be continued, otherwise the list of executed projects or programs must be shortened accordingly. If there is a possibility that financial resources can be freed up, additional activities can be scrutinized – this would lead to another selection as described in section 4.5.2.

Besides the attention that needs to be paid to these factors, an estimate must be provided. The formulas for doing so are provided by the formulas (4.8) and (4.9) in section 4.4.2.

From the benefits perspective, there are two additional shortcomings in additional approaches that require to be considered:

- Shifted targets
  The targets for the figures from the BSC (α- and β-figures) might have been significantly changed by the management. In this case there is also

the need for another selection as described in section 4.5.2 to verify the existing project portfolio against the new targets and to come up with an updated project portfolio.
- New projects in the pipeline promising a higher delivery of value or the delivery of the same value with lower efforts
  This case also describes a complete review of the project portfolio and would then result in a new selection as described in section 4.5.2.

To overcome these shortcomings, effective forecasts need to be in place – a detailed description can be found in section 4.4.2. On the basis of these forecasts it can be established whether the execution of the project portfolio is still considered to be adequate enough to deliver the expected results. If there are major deviations observed, the project portfolio may also need to be re-planned as defined in section 4.5.2.

Communicating and implementing portfolio changes

After the analysis, forecasting, re-planning and a possible new evaluation and selection of the projects for the project portfolio is done, the altered portfolio must be communicated and implemented. Although this sounds quite easy, it is a critical task: not because of its complexity but because of its impact on the work execution. Inadequately communicated changes in the project portfolio lead to differential priorities between teams. This causes an inefficient value creation process. Additional literature on this topic can be found at [PMI04] and [ART01].

4.5.7 Example: Implementation of the monitoring and controlling approach

The data for this example has already been used in sections 4.5.3 and 4.5.5. All assumptions set during the example so far are still valid. The continuation of the example will describe two different points in time for the presented project portfolio:

- Snapshot 1:
  the point in time described is period 12. The DWH project should be completed in this period but has major difficulties in supplying the expected deliverables. The APS project is executed according to plan.
- Snapshot 2:
  the point in time described is period 20. The DWH project and the APS project are finished. The MIS project was started after a delay. The Collection System (CS)-project has to be delayed because neither the vendor for the application nor the integration partner are in a position to start before period 24.

Further details will be provided during the discussion of this example.

Snapshot 1: Gather project portfolio information

Table 4.38 gives an overview of the plan values and actuals for the project portfolio at the end of period 12 based on the definition given in figure 4.8. In addition the formulas given for the CV, SV, CPI, SPI (all defined in table 3.1), PPV(4.1), PAC(4.2), PEV(4.3), PCV_{APIT}(4.4), PSV_{APIT} (4.5), $PCPI_{APIT}$ (4.6) and $PSPI_{APIT}$ (4.7) have been applied as well.

The graphical representation of the figures given in 4.38 is as follows:

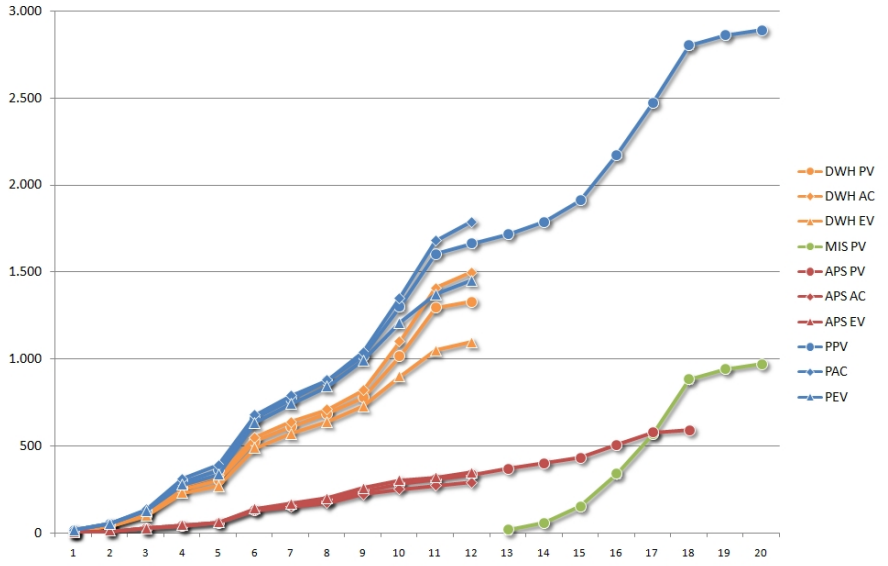


Fig. 4.48. Graphical representation of the collected figures in table 4.38

The benefits from the project portfolio cannot be measured now, because none of the projects in the portfolio is finished, or, at this stage, contribute any value to the benefits.

Snapshot 1: Measuring and analyzing the project portfolio

Interpreting the figures in table 4.38 shows that by the end of period 12 two projects of the portfolio are executed: the DWH and the APS project.

The DWH project showed lack of performance in costs and schedule from the very beginning. There were some signals that this trend could be inverted between period 6 and 9, but starting with period 10 the project's level of performance faltered once again. The reason for the underperforming schedule related data is that the mapping of the relevant data from the core systems to the GDWH showed unexpected difficulties in terms of the availability of data and its quality. Both reasons put additional burden on the business analysts in the project – the existing staff is overloaded with the assigned work. The

		Month																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	PV	10	40	101	252	303	528	610	687	778	1.017	1.295	1.331								
	AC	12	42	110	270	330	550	640	710	820	1.100	1.410	1.500								
	EV	10	38	98	230	270	490	570	640	730	900	1.050	1.100								
DWH	CV	-2	-4	-12	-40	-60	-60	-70	-70	-90	-200	-360	-400								
	SV	0	-2	-3	-22	-33	-38	-40	-47	-48	-117	-245	-231								
	CPI	0,83	0,90	0,89	0,85	0,82	0,89	0,89	0,90	0,89	0,82	0,74	0,73								
	SPI	1,00	0,95	0,97	0,91	0,89	0,93	0,93	0,93	0,94	0,89	0,81	0,83								
	PV													15	55	149	336	565	879	938	969
	AC																				
	EV																				
MIS	CV																				
	SV																				
	CPI																				
	SPI																				
	PV	5	12	24	39	58	131	156	189	240	282	308	333	370	401	432	505	575	591		
	AC	5	12	24	41	60	128	150	170	220	250	270	290								
	EV	6	14	27	45	62	140	170	200	260	305	320	350								
APS	CV	1	2	3	4	2	12	20	30	40	55	50	60								
	SV	1	2	3	6	4	9	14	11	20	23	12	17								
	CPI	1,20	1,17	1,13	1,10	1,03	1,09	1,13	1,18	1,18	1,22	1,19	1,21								
	SPI	1,20	1,16	1,12	1,15	1,08	1,07	1,09	1,06	1,08	1,08	1,04	1,05								
	PPV	15	52	125	291	360	659	766	876	1.018	1.299	1.603	1.665	1.716	1.787	1.912	2.172	2.471	2.802	2.861	2.891
	PAC	17	54	134	311	390	678	790	880	1.040	1.350	1.680	1.790								
	PEV	16	52	125	275	332	630	740	840	990	1.205	1.370	1.450								
	PCV	-1	-2	-9	-36	-58	-48	-50	-40	-50	-145	-310	-340								
	PSV	1	0	0	-16	-28	-29	-26	-36	-28	-94	-233	-215								
	PCPI	0,94	0,96	0,93	0,88	0,85	0,93	0,94	0,95	0,95	0,89	0,82	0,81								
	PSPI	1,06	1,00	1,00	0,94	0,92	0,96	0,97	0,96	0,97	0,93	0,85	0,87								

Table 4.38. Planned Value (PV), Actual Cost (AC), Earned Value (EV), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI) and Schedule Performance Index (SPI) for every project in the project portfolio plus Portfolio Planned Value (PPV), Portfolio Actual Cost (PAC), Portfolio Earned Value (PEV), Portfolio Cost Variance (PCV), Portfolio Schedule Variance (PSV), Portfolio Cost Performance Index (PCPI) and Portfolio Schedule Perfofmance Index (PSPI) for the sample project portfolio

additionally employed resources from external sources to cover this shortage need some time to get to know the company's systems and also to take over some of the work-time from already overloaded business analysts. This implies also the overrun in costs, as there were no additional resources planned to be assigned to this project.

The numeric facts show that there have been 27% higher costs spent on the project that should have been spent for the actual progress and that the project is 17% behind schedule. As the project should have been finished by now, it also means that there is still 17% of the work to be done before the project will be completed. Naturally, the project will be delayed. According to these facts, the project will exceed the initial budget and will be, naturally, delayed.

In contrast the APS project developed very well over its life cycle. Whereas the budget figures were ahead of plan by around 20% close to all of the periods, schedule performance decreased but is still ahead of schedule by 5%. The reason for the reduction of schedule performance in the last two month was the unexpected illness of one of the key-resources. However, the project manager expects an increase of the SPI in period 13 as many deliverables where already finished in the last period but not signed off by the missing key-resource. Therefore they were only partially counted for the EV, and thereby decreased the value for both performance indicators. As the volume of the DWH project is more than twice that of the APS project, the negative effects of the DWH-project cannot be made up by the APS project. Accumulating the figures shows a project portfolio 19% behind cost and 13% behind schedule after 12 periods of execution. This means that the project portfolio loses every month on average 1,6% in terms of cost, and 1,1% in terms of schedule compared to the plan values. As mentioned already in the previous process step, there are no benefits that could be measured, because it is too early in the execution of the project portfolio. However, based on the discussion of the actuals, it emerges that a re-planning might be ecexuted. In this case not only the EVM figures require to be adapted but also the benefits planning needs to be revised.

Snapshot 1: Analyzing the impact of changes to the project portfolio

The actual situation and its root causes (as discussed in the last section) lead to the notion that the project portfolio plan must be adapted to reflect the current situation. The fact that the DWH project cannot be finished during this period suggests a need for extension of the project. The feedback from the responsible project manager is to prolong it by 6 months.

Before moving on with the data given by the project manager, the data should be cross-checked to see if it fits with the expectations that can be derived from the available facts. Using the formula defined in (4.9), this gives the project portfolio manager the possibility to verify this estimate. Filling the

formula for the DWH would mean to take the original duration of 12 months and the latest SPI which is 0,83:

$$DAC \text{ for the DWH-project} = \frac{12}{0,83} = 14,46$$

According to the current schedule performance the forecast for the project completion is another 2,46 months ($= 14,46 - 12,00$). The project manager should then decide whether there are enough reasons to extend the project by twice the original forecast or whether it would just be for the sake of caution. This example assumes that it is the latter reason and that the re-planning assumption will be 3 months. Because the MIS project dependends on the finalization of the DWH project, the start of this project has to be shifted by the same amount of time.

For the complete costs of the DWH-project the totals are revised by the project manager to 1.800 which goes along with the forecast that would have been achieved by using the formula for the BAC as defined in (4.8):

$$BAC \text{ for the DWH-project} = \frac{1.331}{0,73} = 1.823,29$$

Although the evolution of the APS-project is a success, the planning ought to be adapted according to the results of the fact-finding mission. Small deviations are normally not reflected in a revised planning but the cost deviation is about 20% and the project manager has announced that he expects the schedule to show the same deviation as well. The theory in the example is to agree to reduce the duration of the project by one month (which is still a defensive approach as this can be achieved with the latest performance given) and a decrease of the planned value to 490. These figures can be verified in the same way as was done for the DWH-project:

$$DAC \text{ for the APS-project} = \frac{18}{1,05} = 17,14$$

$$BAC \text{ for the APS-project} = \frac{591}{1,21} = 488,43$$

The original and the re-planned figures are displayed in table 4.39. The PV and EV for the two projects that required re-planning are set to the value of the AC. The reason is that occurred cost cannot be revised and ultimately build the baseline for planning the PV. As already mentioned, the figures for the past are not to be changed during the re-planning – the plan-revision starts with the actual reporting period. Here the baseline is renewed, which is represented by the figures marked "Revised" in the table. To be precise, the re-estimation of inflation and depreciation as described in section 4.5.4 and 4.5.4 must also be calculated according the new baseline, but for the sake of convenience is omitted here.

		Month												
		11	12	13	14	15	16	17	18	19	20	21	22	23
DWH	PV	1.295	1.331											
	PV Revised	1.295	1.500	1.600	1.700	1.800								
	AC	1.410	1.500											
	EV	1.050	1.100											
	EV Revised	1.050	1.500											
	PV			15	55	149	336	565	879	938	969			
	PV Revised						15	55	149	336	565	879	938	969
MIS	AC													
	EV													
	EV Revised													
	PV	308	333	370	401	432	505	575	591					
	PV Revised	308	290	330	350	390	460	490						
APS	AC	270	290											
	EV	320	350											
	EV Revised	320	290											
	PPV	1.603	1.665	1.716	1.787	1.912	2.172	2.471	2.802	2.861	2.891			
	PPV Revised	1.603	1.790	1.930	2.050	2.190	2.275	2.345	2.439	2.626	2.855	3.169	3.228	3.259
	PAC	1.680	1.790											
	PEV	1.370	1.450											
	PEV Revised	1.370	1.790											

Table 4.39. Revised planning figures for the sample project portfolio

The table now shows the DWH-project prolongation and the reduction in duration for the APS-project, as well as the agreed financials and their adapted baselines.

The graphical representation of the new baseline compared to the previous one can be seen below:

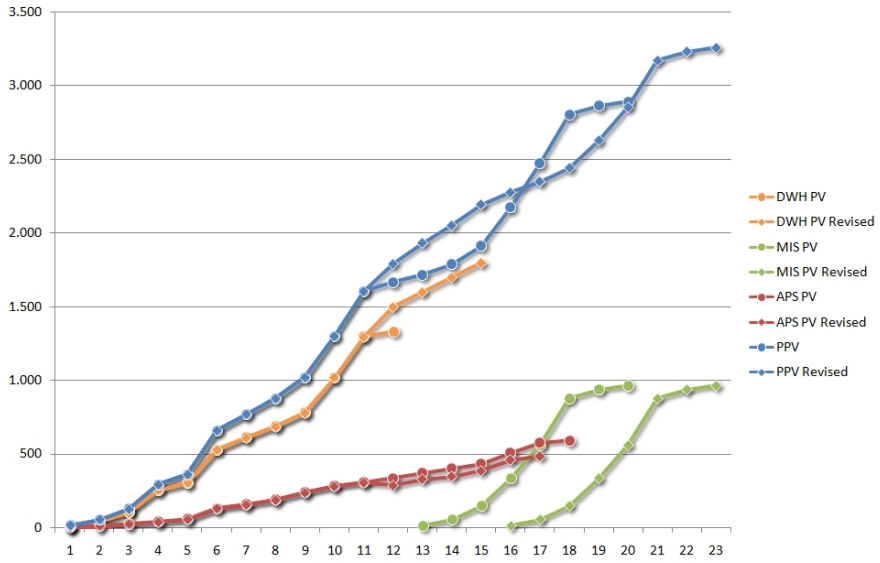


Fig. 4.49. Graphical representation of the revised baseline described in table 4.39

Because of the schedule shift in the planning the implementation of the benefits will shift as well. First of all, the amounts for the different benefits are checked but they still seem to be feasible – just the schedule is to be re-planned. Because the DWH- and the MIS-project (as a direct dependency) are shifted, but the APS-project and its expected benefits stay as they were originally defined, the benefits matrix must not be shifted by the three month delay of the DWH-project. However, it needs to be completely recalculated as was done in section 4.5.4. The results are presented in the table provided in 4.40 and the new representation of the relative figures in table 4.41.

	Month													
	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Training Hours	+113	+230	+375	+788	+1.413	+1.950	+2.138	+2.300	+2.450	+2.475	+2.495	+2.513	+2.530	+2.545
Duration of NR Applications			-1	-1	-2	-5	-7	-8	-8	-8	-8	-8	-8	-8
Number of Resources for NR Applications				-1	-3	-5	-8	-12	-15	-15	-15	-15	-15	-15
Efficiency of NR Collection		+1%	+2%	+3%	+4%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%
Duration of Retail Applications					-1	-2	-2	-2	-5	-5	-5	-5	-5	-5
Number of Resources for Retail Applications	-5	-7	-10	-15	-23	-29	-34	-36	-38	-38	-38	-38	-38	-38
Efficiency of Retail Collection				+1%	+4%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%
Degree of automatization of retail processes			+1%	+8%	+13%	+16%	+16%	+16%	+16%	+16%	+16%	+16%	+16%	+16%
Number of Marketing Activities	+	+10	+16	+19	+23	+23	+23	+23	+23	+23	+23	+23	+23	+23
Market Rating									+2	+2	+2	+2	+2	+3
Customer Satisfaction Rating						+1	+1	+1	+3	+3	+3	+3	+3	+3
Percentage of offers/deals				+1%	+4%	+10%	+15%	+17%	+19%	+19%	+19%	+19%	+19%	+19%
Products per customer				+1	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3
Product Profitability											+2%	+5%	+8%	+11%
Treasury Revenue									+13.8k	+32.5k	+53.8k	+73.8k	+92.5k	+107.5k

Table 4.40. Update of all adjusted α-factors in the project portfolio due to the re-planning in snapshot 1

	Month													
Figures in percent	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Training Hours	4	9	15	31	56	77	84	90	96	97	98	99	99	100
Duration of NR Applications			13	13	25	63	88	100	100	100	100	100	100	100
Number of Resources for NR Applications				7	20	33	53	80	100	100	100	100	100	100
Efficiency of NR Collection		20	40	60	80	100	100	100	100	100	100	100	100	100
Duration of Retail Applications					20	40	40	40	100	100	100	100	100	100
Number of Resources for Retail Applications	13	18	26	39	61	76	89	95	100	100	100	100	100	100
Efficiency of Retail Collection				20	80	100	100	100	100	100	100	100	100	100
Degree of automatization of retail processes				6	50	81	100	100	100	100	100	100	100	100
Number of Marketing Activities	22	43	70	83	100	100	100	100	100	100	100	100	100	100
Market Rating									67	67	67	67	67	100
Customer Satisfaction Rating						33	33	33	100	100	100	100	100	100
Percentage of offers/deals				5	21	53	79	89	100	100	100	100	100	100
Products per customer				33	100	100	100	100	100	100	100	100	100	100
Product Profitability									13	30	50	69	86	100
Treasury Revenue									13	30	50	69	86	100

Table 4.41. Update of timely development of the planned benefits in relative figures in snapshot 1

Snapshot 1: Review portfolio changes and forecasting

The two key criteria defined in section 4.5.6 against which the planning can be checked are capacity issues and financial resources.

The topic of capacity issues has already been addressed, since it was the reason for the shift of the portfolio. However, because the APS-project finishes earlier, there are additional resources available and it would not make sense to shift them to another project at such a late stage.

The assumption for the financial resources in the example is that they can be approved and allocated.

If the formulas defined in (4.9) and (4.8) for estimating the final duration and demand for budget are applied to the whole project portfolio, the following figures can be derived:

$$DAC \text{ for the whole project portfolio} = \frac{20}{0,87} = 22,99$$

$$BAC \text{ for the whole project portfolio} = \frac{2.891}{0,81} = 3.569,14$$

Compared to the actual re-planning results, the duration is exactly estimated, wheres the expected budget shows a deviation of about 10%. In the field of forecasting this deviation is acceptable and still proves that the new plan seems feasible.

As defined in section 4.5.6, there are two indicators for possible issues in the area of benefits to be checked in this phase: shifted targets and new projects. This example assumes that both of them do not apply during snapshot 1.

The forecast for the α-figures is also obsolete at this point in time because there are no benefits from the project portfolio to review.

Snapshot 2: Gather project portfolio information

The actual figures at the end of period 20 are represented in table 4.42 and the graphical representation can be seen in figure 4.50

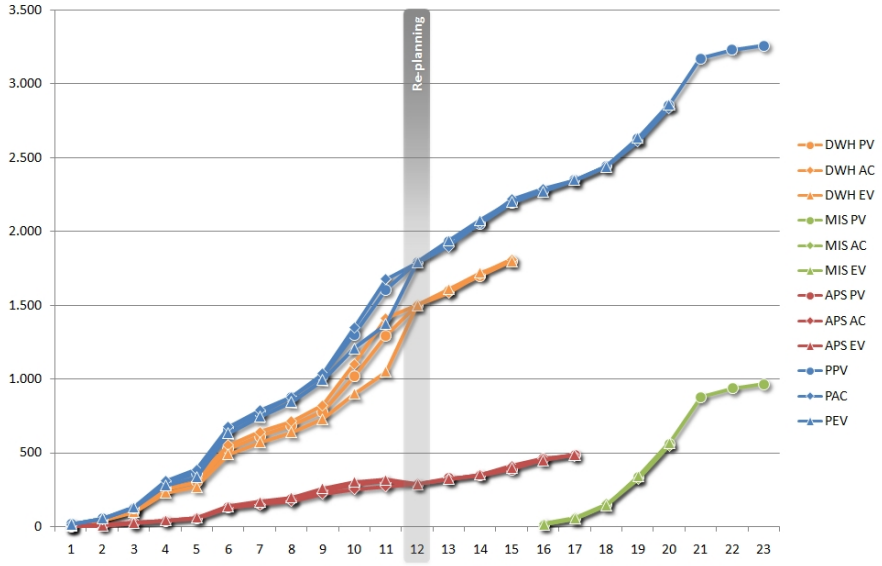


Fig. 4.50. Graphical representation of the updated actual figures for the sample project portfolio in snapshot 2

The figures in table 4.42 show that the numbers for the re-planned projects (DWH and APS) have been fixed in a way that $PV = EV = AC$, and all derived indicators are reset accordingly. The column in the table is marked in bold lettering to demonstrate this fact.

Table 4.43 and 4.44 reflect the development of the benefit-relevant figures up to period 20. The details behind the figures are as follows:

– Training Hours
  the kick-off for the training did not work out as expected as the employees

		Month												
		11	**12**	13	14	15	16	17	18	19	20	21	22	23
	PV	1.295	**1.500**	1.600	1.700	1.800								
	AC	1.410	**1.500**	1.580	1.710	1.810								
	EV	1.050	**1.500**	1.610	1.720	1.800								
DWH	CV	-360	**0**	30	10	-10								
	SV	-245	**0**	10	20	0								
	CPI	0,74	**1,00**	1,02	1,01	0,99								
	SPI	0,81	**1,00**	1,01	1,01	1,00								
	PV						15	55	149	336	565	879	938	969
	AC						20	61	155	320	550			
	EV						18	55	145	340	570			
MIS	CV						-2	-6	-10	20	20			
	SV						3	0	-4	4	5			
	CPI						0,90	0,90	0,94	1,06	1,04			
	SPI						1,20	1,00	0,97	1,01	1,01			
	PV	308	**290**	330	350	390	460	490						
	AC	270	**290**	320	350	410	460	480						
	EV	320	**290**	325	355	400	450	490						
APS	CV	50	**0**	5	5	-10	-10	10						
	SV	12	**0**	-5	5	10	-10	0						
	CPI	1,19	**1,00**	1,02	1,01	0,98	0,98	1,02						
	SPI	1,04	**1,00**	0,98	1,01	1,03	0,98	1,00						
	PPV	1.603	**1.790**	1.930	2.050	2.190	2.275	2.345	2.439	2.626	2.855	3.169	3.228	3.259
	PAC	1.680	**1.790**	1.900	2.060	2.220	2.290	2.351	2.445	2.610	2.840			
	PEV	1.370	**1.790**	1.935	2.075	2.200	2.268	2.345	2.435	2.630	2.860			
	PCV	-310	**0**	35	15	-20	-22	-6	-10	20	20			
	PSV	-233	**0**	5	25	10	-7	0	-4	4	5			
	PCPI	0,82	**1,00**	1,02	1,01	0,99	0,99	1,00	1,00	1,01	1,01			
	PSPI	0,85	**1,00**	1,00	1,01	1,00	1,00	1,00	1,00	1,00	1,00			

Table 4.42. Updated actual figures for the sample project portfolio in snapshot 2

		Month													
		16	17	18	19	20	21	22	23	24	25	26	27	28	29
Training Hours	$P\alpha$	+113	+230	+375	+788	+1.413	+1.950	+2.138	+2.300	+2.450	+2.475	+2.495	+2.513	+2.530	+2.545
	$A\alpha$	+50	+150	+350	+850	+1.600									
Duration of NR	$P\alpha$			-1	-1	-2	-5	-7	-8	-8	-8	-8	-8	-8	-8
Applications	$A\alpha$					-1									
Number of Resources for	$P\alpha$				-1	-3	-5	-8	-12	-15	-15	-15	-15	-15	-15
NR Applications	$A\alpha$					-1									
Efficiency of NR Collection	$P\alpha$		+1%	+2%	+3%	+4%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%
	$A\alpha$				+1%	+2%									
Duration of Retail	$P\alpha$					-1	-2	-2	-2	-5	-5	-5	-5	-5	-5
Applications	$A\alpha$				-1	-2									
Number of Resources for	$P\alpha$	-5	-7	-10	-15	-23	-29	-34	-36	-38	-38	-38	-38	-38	-38
Retail Applications	$A\alpha$	-5	-9	-12	-18	-27									
Efficiency of Retail	$P\alpha$				+1%	+4%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%
Collection	$A\alpha$			+1%	+2%	+5%									
Degree of automatization	$P\alpha$			+1%	+8%	+13%	+16%	+16%	+16%	+16%	+16%	+16%	+16%	+16%	+16%
of retail processes	$A\alpha$			+2%	+10%	+15%									

Table 4.43. Planned adjusted α-factors in the project portfolio plus the actual values in period 20 1/2

		Month													
		16	17	18	19	20	21	22	23	24	25	26	27	28	29
Number of Marketing Activities	$P\alpha$	+5	+10	+16	+19	+23	+23	+23	+23	+23	+23	+23	+23	+23	+23
	$A\alpha$		+3	+9	+15	+20									
Market Rating	$P\alpha$									+2	+2	+2	+2	+2	+3
	$A\alpha$					+1									
Customer Satisfaction Rating	$P\alpha$						+1	+1	+1	+3	+3	+3	+3	+3	+3
	$A\alpha$					+1									
Percentage of offers/deals	$P\alpha$				+1%	+4%	+10%	+15%	+17%	+19%	+19%	+19%	+19%	+19%	+19%
	$A\alpha$			+2%	+4%	+8%									
Products per customer	$P\alpha$				+1	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3
	$A\alpha$					+1									
Product Profitability	$P\alpha$											+2%	+5%	+8%	+11%
	$A\alpha$					+1%									
Treasury Revenue	$P\alpha$									+13.8k	+32.5k	+53.8k	+73.8k	+92.5k	+107.5k
	$A\alpha$														

Table 4.44. Planned adjusted α-factors in the project portfolio plus the actual values in period 20 2/2

could not be freed for them at the very beginning because of daily business. Over time the training efficiency has improved and at the moment there are more people trained than expected. In the last period, the training was extended by the changes resulting from the APS-project which finished on schedule.

- Duration of Non-Retail Applications, Number of Resources for Non-Retail Applications, Effectivity of Non-Retail Applications
  the effects of the DWH-implementation in the field of Non-Retail stay below expectations. Obviously the influences were overestimated – this must be considered as a lessons learned for the next non-retail relevant projects.
- Duration of Retail Applications, Number of Resources for Retail Applications, Effectivity of Retail Applications
  in the field of retail the picture looks different. Some of the benefits of the DWH-project could be collected earlier because the retail-relevant parts of the project finished earlier than expected. In accordance with the punctual finalization of the APS-project the full value-added expected could be achieved. Furthermore some regulatory changes supported the effectivity of the retail collection – this is an environmental effect to the project portfolio and the changed figures are only partially based on the project portfolio execution.
- Marketing Activities
  these are also victims of the DWH-project. The original plan could not be kept because of the lack of data availability. It turned out that a lot of the data assumed to be in the DWH was of such low quality that it could not be used for marketing activities. However, the gap caused by the delay is almost closed, and, meanwhile, the α-figure is on its way to catch up with the expected value soon.
- Market Rating
  due to the positive development of the retail-processes the market rating increased much earlier than expected.
- Customer Satisfaction Rating
  this healthy development is far above expectations and has been achieved earlier than anticipated. The reason can also lie in the healthy growth of the retail processes.
- Percentage offers/deals
  because of the timely implementation of the DWH for the retail business the increase rate is far beyond expectations. The responsible persons expect the final target to be revised to about 25%.
- Products per customer
  the number of products per customer is growing at a lower rate than expected. There are two reasons for this: first, the issue described in Marketing Activities did not allow an aggressive marketing. Second, new products do not create as much demand in the market as expected. Probably the

benefits to be expected were grossly overestimated during the planning phase.

– Product Profitability
  Although the Product Profitability should have been affected by the MIS project, it increased without having this project in the portfolio finished. The reason is the already achieved reduction in required resources for retail applications and the reduced processing time.
– Treasury revenue
  there was no development expected so far. Further development is still expected with the finalization of the MIS project.

A first graphical comparison from the planned α-figures ($P\alpha$) and actual α-figures ($A\alpha$) for period 20 deliver the following picture:

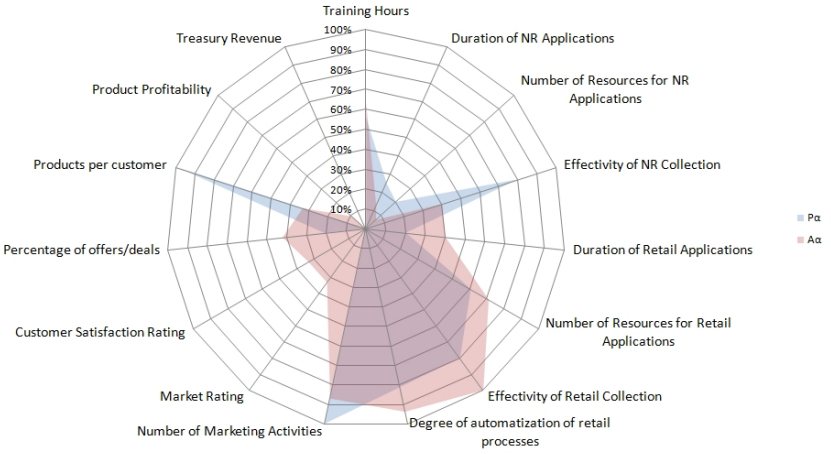


Fig. 4.51. Comparison of planned α-figures ($P\alpha$) and actual α-figures ($A\alpha$) in period 20

Snapshot 2: Measuring and analyzing the project portfolio

The data in the table shows that both the DWH- and the APS-project finished as expected without major deviations from the plan. The kick-off of the MIS-project is very promising and generates the defined deliverables as expected. This is confirmed by the EVM-indicators for each of the projects.

The indicators for the project portfolio status are supplying a promising outlook, because the schedule seems to be perfectly on time and the costs are even 1% below budget.

Originally the Collection System (CS)-project should have been started immediately after the finalization of the APS-project but it was delayed to period 24 because of the inability of the vendor and the integration partner to deliver. The effects would probably be negotiated between the companies but is not a topic covered by this paper.

From the analytical point of view, there are neither corrective actions nor a re-planning necessary for this project portfolio.

Applying the formulas for BSC-related measures given in (4.10) and (4.11) on the data delivers the quantified differences between the planned α-figures ($P\alpha$) and the actual α-figures ($A\alpha$):

		Month				
		16	17	18	19	20
Training Hours	αV	-63	-80	-25	+62	+187
	αPI	0,44	0,65	0,93	1,08	1,13
Duration of NR Applications	αV			+1	+1	+1
	αPI			0,00	0,00	0,50
Number of Resources for NR Applications	αV				+1	+2
	αPI				0,00	0,33
Efficiency of NR Collection	αV		-1%	-2%	-2%	-2%
	αPI		0,00	0,00	0,33	0,50
Duration of Retail Applications	αV				-1	-1
	αPI					2,00
Number of Resources for Retail Applications	αV		-2	-2	-3	-4
	αPI	1,00	1,29	1,20	1,20	1,17
Efficiency of Retail Collection	αV			+1%	+1%	+1%
	αPI				2,00	1,25
Degree of automatization of retail processes	αV			+1%	+2%	+2%
	αPI			2,00	1,25	1,15
Number of Marketing Activities	αV	-5	-7	-7	-4	-3
	αPI	0,00	0,30	0,56	0,79	0,87
Market Rating	αV					+1
	αPI					

		Month				
		16	17	18	19	20
Customer Satisfaction Rating	αV					+1
	αPI					
Percentage of offers/deals	αV			+2%	+3%	+4%
	αPI				4,00	2,00
Products per customer	αV				-1	-2
	αPI				0,00	0,33
Product Profitability	αV					+1%
	αPI					
Treasury Revenue	αV					
	αPI					

Table 4.45. Development of the α-factor variances and α-factor performance indicators over time

During the data analysis the focus must be on the α-factor performance indicators (αPI), since the digits after the comma demonstrate the deviation to the planned figure in percentages. The retail relevant figures show that the positive trend can be comprehended – special focus must be applied to the non-retail relevant figures (-50% to -67% compared to the planned value!) and to the products per customer (-67% compared to the planned value!). These are the fields where the detailed "Why?" analysis must be started, since the explanations are not detailed enough to deduct specific activities for the project portfolio.

The extensive analysis in this example shows that the implications on the non-retail parts of the DWH implementation were highly overestimated:

- Business managers expected to reduce the duration of non-retail applications by the use of the DWH because they thought that comparable cases in the past could be easily found and already developed products could be used. Practice has shown that non-retail products are more specialized than expected and the search for already developed non-retail products does not help that much.
- The data quality for the historical products and their applications is very low and often parts of the data is missing – this implies that some of the information cannot be reused but needs to be re-developed.
- The resources in the non-retail area are so highly specialized that they cannot be easily released without having a significant impact on the quality of the process. It seems that the final reduction will be lower than assumed.
- The efficiency of the collection in the non-retail field could also not be increased as expected, because the data-mining capabilities with the data available in the DWH is below expectation. The achievement of the final target seems to be questionable.

In the field of the products per customer the bank product developers seem to be below expectation because of the poor data quality in the DWH – so they share their destiny with the people responsible for the non-retail credit applications and their collection. Also their targets seem to be far from being reached.

Snapshot 2: Analyzing the impact of changes on the project portfolio

Because there are no changes to the plans of the projects in this portfolio, there is basically nothing to be done. In the fields of planning the benefits within this portfolio, the picture looks different.

The Performance Indicators for the α-factors in the non-retail area and the Products per Customer are dramatically below expectation; the possibility of

the target values being achieved must be reviewed. Therefore the target values can be re-estimated using the original target value and the actual performance such as defined in formula 4.12:

$$\text{Expected Duration of Non-Retail Applications} = -8 \times 0,50 = -4$$

$$\text{Expected Number of Resources for Non-Retail Applications} = -15 \times 0,33 \approx -5$$

$$\text{Expected Effectivity of Non-Retail Collection} = 5\% \times 0,50 = 2,5\%$$

$$\text{Expected Products per customer} = 3 \times 0,33 \approx 1$$

Naturally, these figures must not be taken over one-by-one without discussing them with the business partners, especially since the collected benefits in this example have a very short history. However, they give a first indication as to what looks feasible. After the negotiation with the responsible persons regarding the breakdown of the figures for every single project, a revised benefits planning is established for this portfolio (in this example the numbers stay unchanged and could be broken down accordingly to the projects in the portfolio). This can be seen in table 4.46, and the new relative distribution in table 4.47.

	Month													
	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Training Hours	+113	+230	+375	+788	+1.413	+1.950	+2.138	+2.300	+2.450	+2.475	+2.495	+2.513	+2.530	+2.545
Duration of NR Applications			-1	-1	-1	-2	-2	-3	-3	-4	-4	-4	-4	-4
Number of Resources for NR Applications				-1	-1	-2	-2	-3	-3	-4	-4	-5	-5	-5
Efficiency of NR Collection		+1%	+2%	+3%	+2%	+2%	+2,5%	+2,5%	+2,5%	+2,5%	+2,5%	+2,5%	+2,5%	+2,5%
Duration of Retail Applications					-1	-2	-2	-2	-5	-5	-5	-5	-5	-5
Number of Resources for Retail Applications	-5	-7	-10	-15	-23	-29	-34	-36	-38	-38	-38	-38	-38	-38
Efficiency of Retail Collection				+1%	+4%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%	+5%
Degree of automatization of retail processes			+1%	+8%	+13%	+16%	+16%	+16%	+16%	+16%	+16%	+16%	+16%	+16%
Number of Marketing Activities	+	+10	+16	+19	+23	+23	+23	+23	+23	+23	+23	+23	+23	+23
Market Rating									+2	+2	+2	+2	+2	+3
Customer Satisfaction Rating						+1	+1	+1	+3	+3	+3	+3	+3	+3
Percentage of offers/deals				+1%	+4%	+10%	+15%	+17%	+19%	+19%	+19%	+19%	+19%	+19%
Products per customer				+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Product Profitability											+2%	+5%	+8%	+11%
Treasury Revenue									+13.8k	+32.5k	+53.8k	+73.8k	+92.5k	+107.5k

Table 4.46. Update of all adjusted α-factors in the project portfolio due to the re-planning in snapshot 2

	Month													
Figures in percent	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Training Hours	4	9	15	31	56	77	84	90	96	97	98	99	99	100
Duration of NR Applications			13	13	13	50	50	75	75	100	100	100	100	100
Number of Resources for NR Applications				7	7	40	40	60	60	80	80	100	100	100
Efficiency of NR Collection		20	40	60	60	80	100	100	100	100	100	100	100	100
Duration of Retail Applications					20	40	40	40	100	100	100	100	100	100
Number of Resources for Retail Applications	13	18	26	39	61	76	89	95	100	100	100	100	100	100
Efficiency of Retail Collection				20	80	100	100	100	100	100	100	100	100	100
Degree of automatization of retail processes			6	50	81	100	100	100	100	100	100	100	100	100
Number of Marketing Activities	22	43	70	83	100	100	100	100	100	100	100	100	100	100
Market Rating									67	67	67	67	67	100
Customer Satisfaction Rating						33	33	33	100	100	100	100	100	100
Percentage of offers/deals				5	21	53	79	89	100	100	100	100	100	100
Products per customer				33	100	100	100	100	100	100	100	100	100	100
Product Profitability									13	30	50	69	86	100
Treasury Revenue									13	30	50	69	86	100

Table 4.47. Update of timely development of the planned benefits in relative figures in snapshot 2

Snapshot 2: Review portfolio changes and forecasting

For the Project Portfolio Actuals there was no update required during this snapshot, and for the Project Portfolio Benefits the forecast was already done to verify the planning baseline. Therefore, there are no additional actions to be taken during this step in this portfolio.

4.6 The tool-support

4.6.1 Software architecture and development environment

The developed solution is based on a three tier application architecture shown below:

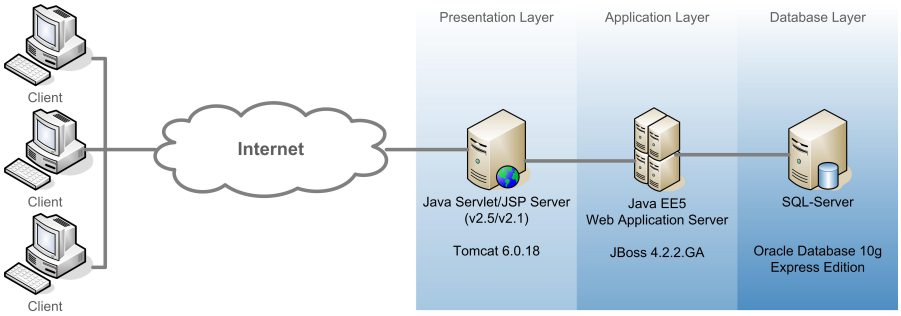


Fig. 4.52. Three tier architecture used in the proof of concept

The client connects over the internet to a Java Servlet/Java Server Pages (JSP) Server which represents the presentation layer of the architecture. It renders the pages based on the templates and the data coming from the application server. The servlets and JSP pages used are based on v2.5 [CDJ07] of the servlet and on v2.1 [CDJ06] of the JSP specification – therefore Tomcat 6.0.18 was used as it implements the latest specifications already. Since the frontend is Web 2.0 compatible, it uses the functionality of Java Server Faces (JSF), RichFaces (http://www.jboss.org/jbossrichfaces) and Ajax4Jsf to steer the communication with the application server and to carry out the graphical representation.

The application server implements the logic of the application by processing the requests from the presentation layer. It posts the requests to the database layer, does the calculations, and provides the relevant results back to the Servlet/JSP Server. The product used in the POC is a JBoss 4.2.2.GA application server. In addition, the Seam Framework (http://www.seamframework.org) is used to ease the implementation of the business process and to optimize the co-operation between the application server and the Java Persistency Application Interface (JPA) which is used for communicating with the database layer.

The database layer in the POC is represented by the Oracle Database 10g Express Edition. The communication is carried out over the JDBC driver provided by Oracle and the JPA.

The development environment used is Eclipse(http://www.eclipse.org) enhanced by the Web Tools Platform(WTP - http://www.eclipse.org/webtools) and the JBoss Tools Project(http://www.jboss.org/tools).

4.6.2 Application architecture and application details

The application architecture is derived from the PPM-model shown in section 4.4.5:

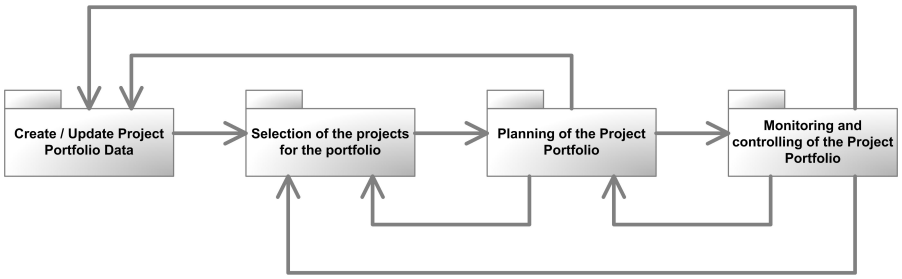


Fig. 4.53. High level application architecture

At the beginning, all available portfolio and project data are entered into the system. Based on the facts given, the selection is executed according to the guidelines presented in section 4.5.2. After choosing the portfolio with the highest option value, the planning on a more detailed level is carried out. This planning results in loops that make possible the gathering of initial data. It also leads to the selection step, as well as to the monitoring and controlling of the projects in the portfolio as soon as these are executed. During the monitoring and control the step back to all of the other processes is possible – as it is required from the situation of the portfolio.

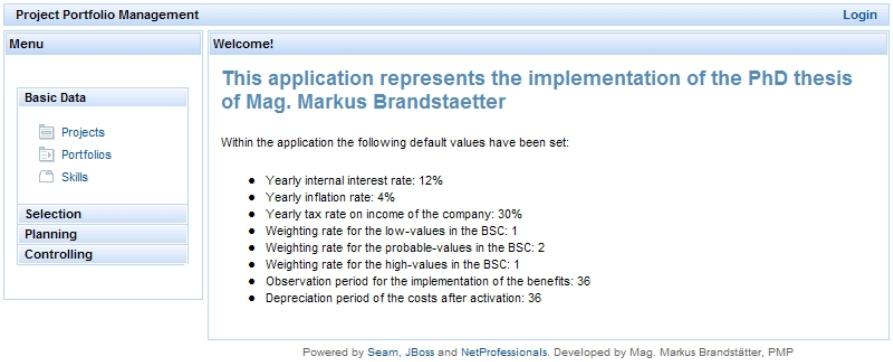


Fig. 4.54. Welcome screen of the application

The application's welcome screen shows the parameters that are intended for calculation. These can also be altered in the configuration file. The left hand side shows the menu which is organized the same way this thesis is: it is divided into the collection of the base parameters, the selection of the projects in the portfolio, the detailed planning of the portfolio and the controlling of the portfolio:

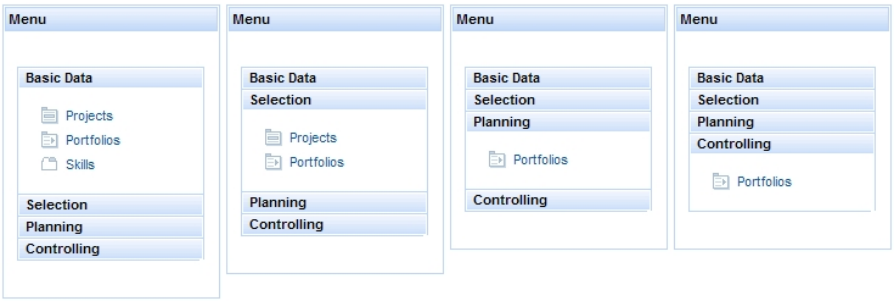


Fig. 4.55. Menu structure of the application

The Basic Data section lets the user simply collect the baseline data for the portfolio's name, the projects that should be considered in the portfolio and the skills available including their hourly rates. The table below shows the overview of the projects in the portfolio with the baseline information captured for the projects:

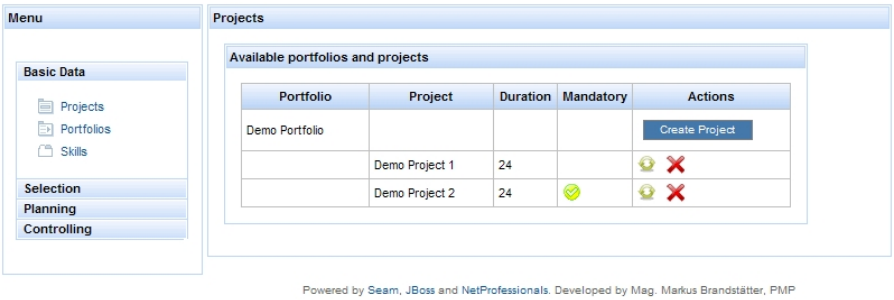


Fig. 4.56. Project Portfolio Overview

As described in section 4.4.4, the distribution of project portfolios is discrete. To determine the number of possibilities within the portfolios, the dependencies get specified in the software:

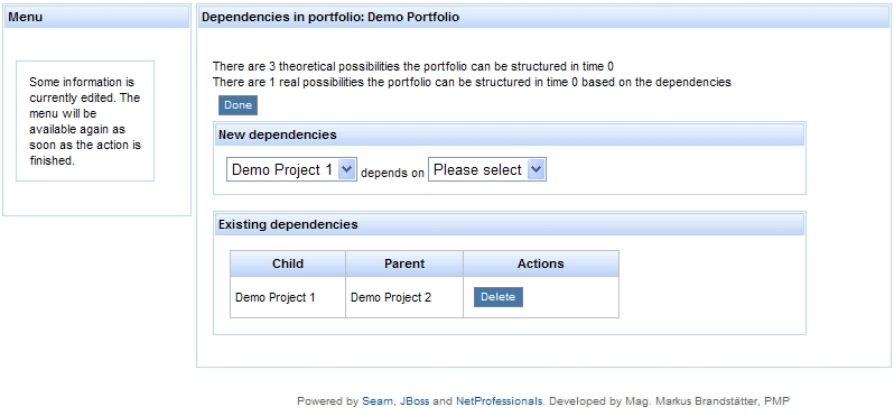


Fig. 4.57. Sample dependency definition within the software

The entry shows a dependency of "Demo Project 1" (called DP_1) to "Demo Project 2" (called DP_2), which leaves only one (DP_2) possibility out of the three theoretical possibilities to build the project portfolio in t_0 ($DP_1 + DP_2$, DP_1, DP_2).

To calculate the option value described in section 4.4.4 based on the measures taken from a Balanced Scorecard (BSC) and from Project Management figures as described in section 4.5.4 the figures are captured within the application and presented the following way:

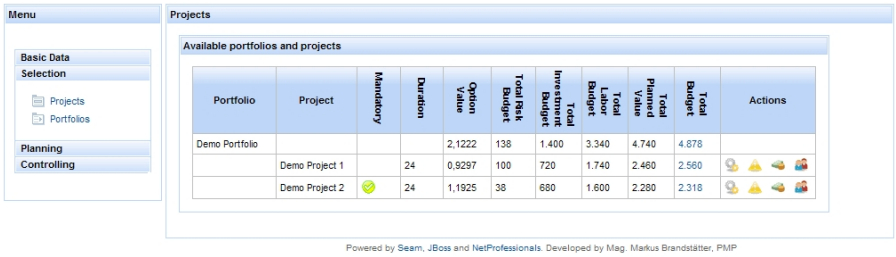


Fig. 4.58. Presentation of the option value and the aggregated BSC and project management figures

The application allows the capturing of project financials such as investments, labor and risks. In addition, it allows the collection of the benefit relevant information based on the scorecard presented in figure 4.21. The collection of the contribution of a single project to the company's BSC is as shown in figure 4.59.

The compilation of the constraints works the same way, including, perhaps an improvement: it is possible to collect every constraint with the information - whether it is a minimum or a maximum value. The same is naturally possible for the project management related parts as well.

As soon as all the information is collected, the software allows the calculation of the option values for all different project portfolio possibilities. It sorts the possibilities in a descending way, based on the option value.

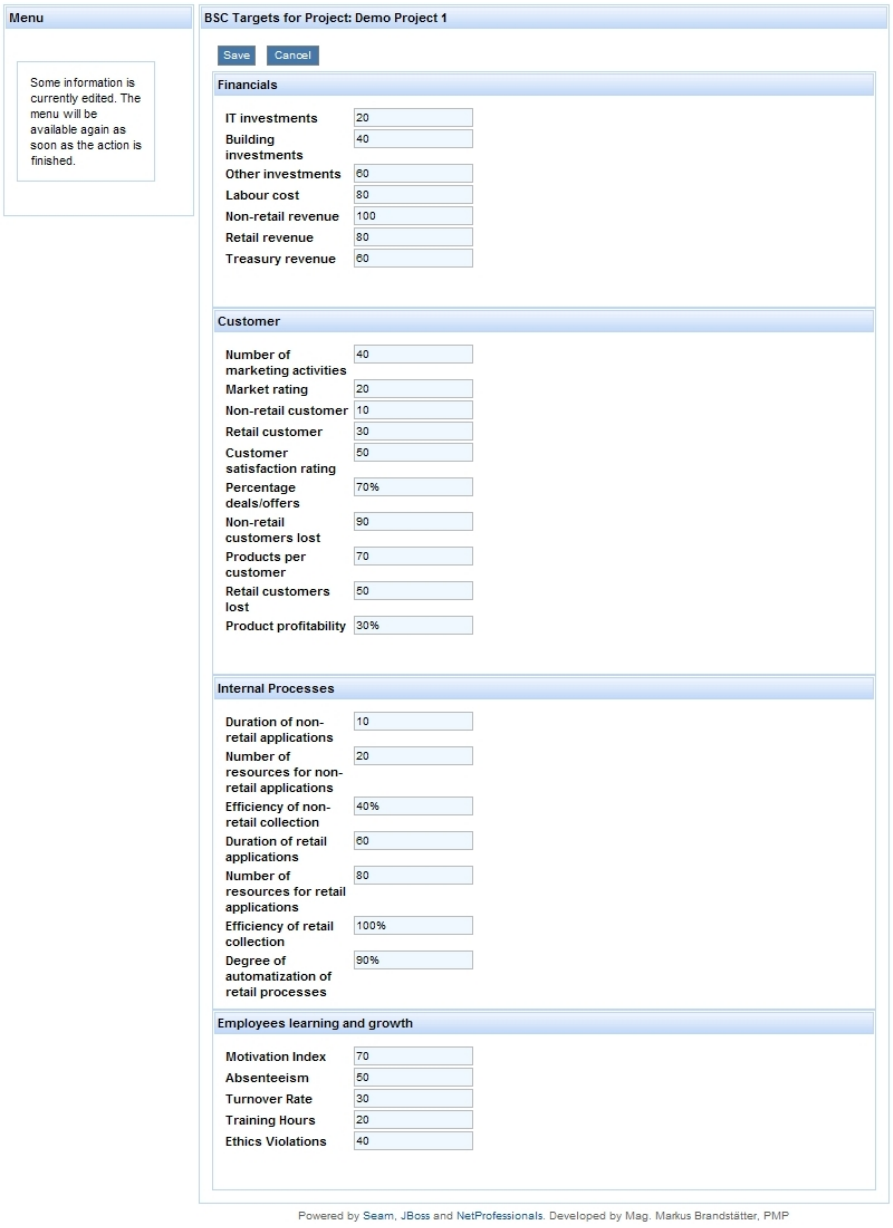


Fig. 4.59. The collection of project contribution figures in the application

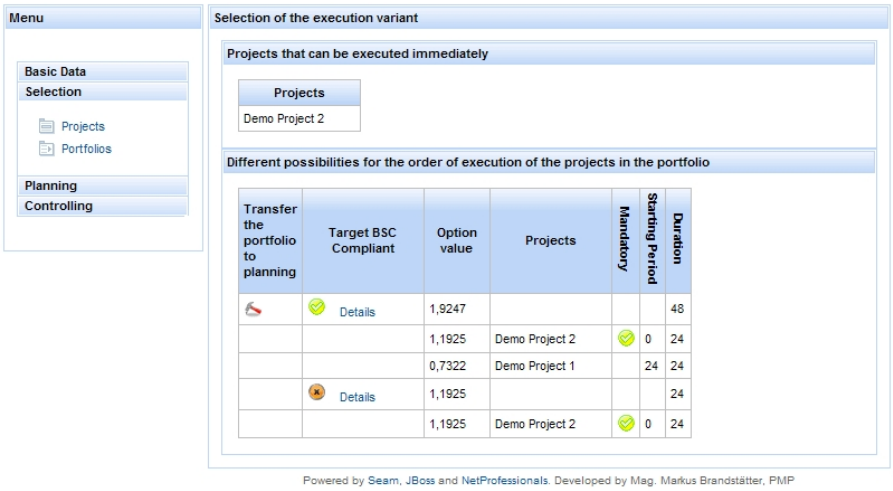
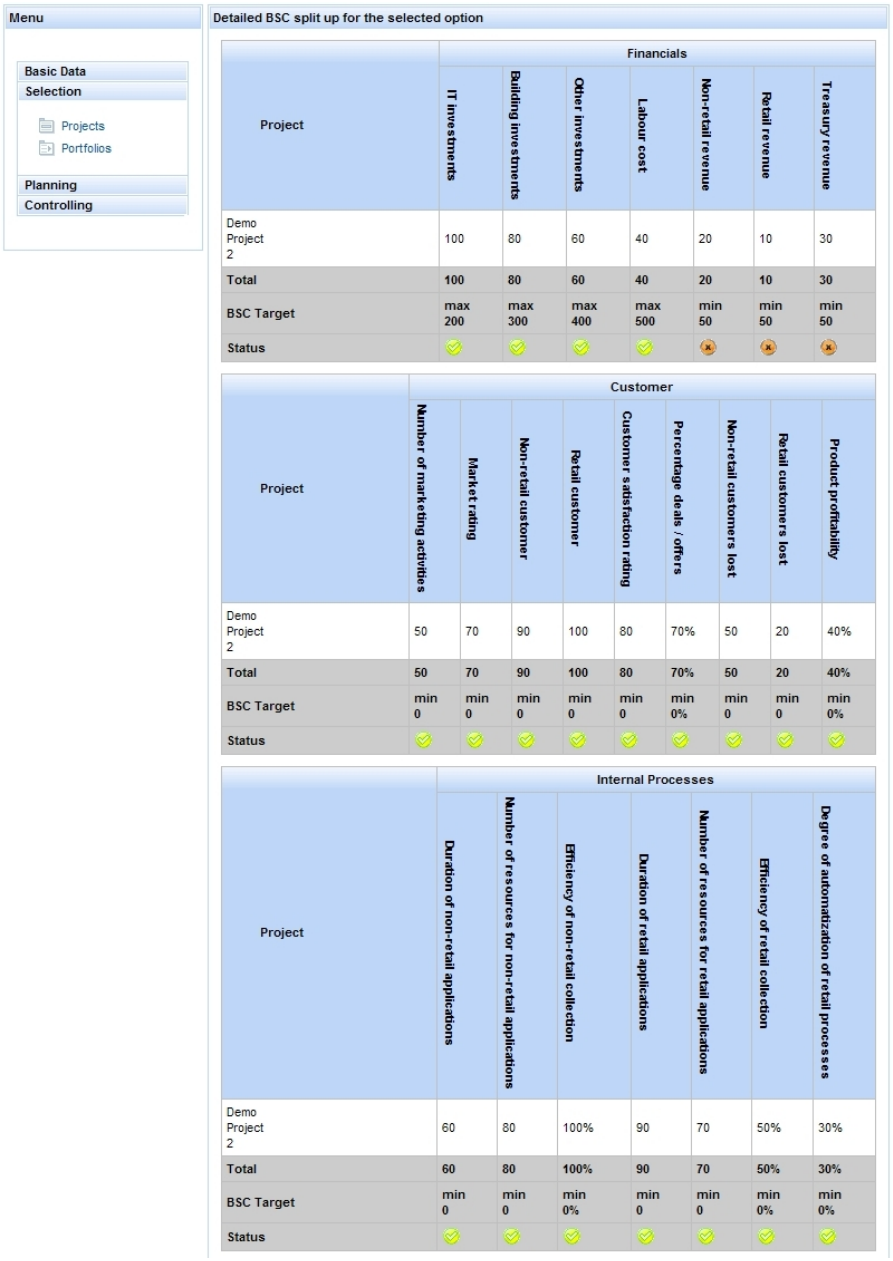


Fig. 4.60. Project portfolio possibilities sorted by the option value

Each of the possibilities can be checked in detail as to how much the contribution on every single value is, and if there are violations of the possibility in general and in case there are, the detailed view in which of the constraints the violation occurs (option two is shown in figure 4.61 and 4.62).

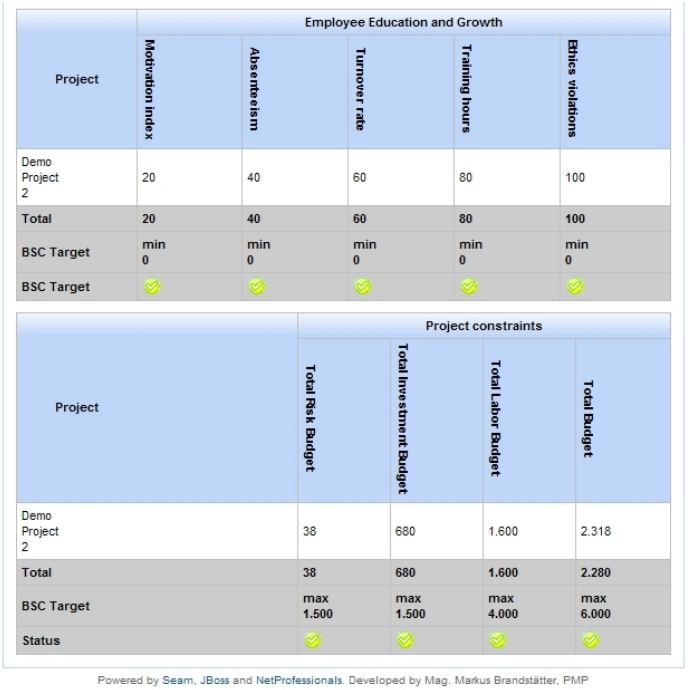


Project	Financials						
	IT investments	Building investments	Other investments	Labour cost	Non-retail revenue	Retail revenue	Treasury revenue
Demo Project 2	100	80	60	40	20	10	30
Total	**100**	**80**	**60**	**40**	**20**	**10**	**30**
BSC Target	max 200	max 300	max 400	max 500	min 50	min 50	min 50
Status							

Project	Customer								
	Number of marketing activities	Market rating	Non-retail customer	Retail customer	Customer satisfaction rating	Percentage deals / offers	Non-retail customers lost	Retail customers lost	Product profitability
Demo Project 2	50	70	90	100	80	70%	50	20	40%
Total	**50**	**70**	**90**	**100**	**80**	**70%**	**50**	**20**	**40%**
BSC Target	min 0	min 0	min 0	min 0	min 0	min 0%	min 0	min 0	min 0%
Status									

Project	Internal Processes						
	Duration of non-retail applications	Number of resources for non-retail applications	Efficiency of non-retail collection	Duration of retail applications	Number of resources for retail applications	Efficiency of retail collection	Degree of automatization of retail processes
Demo Project 2	60	80	100%	90	70	50%	30%
Total	**60**	**80**	**100%**	**90**	**70**	**50%**	**30%**
BSC Target	min 0	min 0	min 0%	min 0	min 0	min 0%	min 0%
Status							

Fig. 4.61. Comparison of the projects in a portfolio and the constraints of a portfolio 1/2



Project	Employee Education and Growth				
	Motivation Index	Absenteeism	Turnover rate	Training hours	Ethics violations
Demo Project 2	20	40	60	80	100
Total	**20**	**40**	**60**	**80**	**100**
BSC Target	**min 0**	**min 0**	**min 0**	**min 0**	**min 0**
BSC Target					

Project	Project constraints			
	Total Risk Budget	Total Investment Budget	Total Labor Budget	Total Budget
Demo Project 2	38	680	1.600	2.318
Total	**38**	**680**	**1.600**	**2.280**
BSC Target	**max 1.500**	**max 1.500**	**max 4.000**	**max 6.000**
Status				

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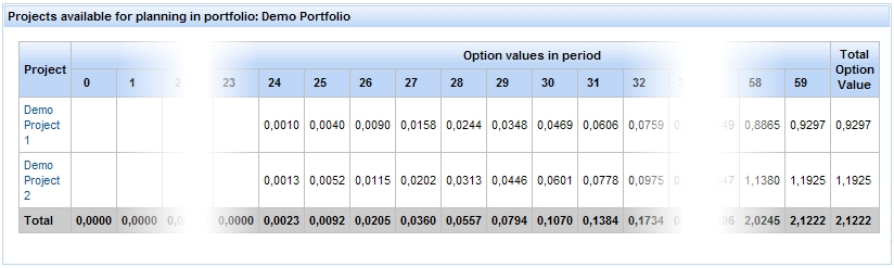
Fig. 4.62. Comparison of the projects in a portfolio and the constraints of a portfolio 2/2

The option that should be selected is then transfered to the planning stage. This means that the software obtains the values for benefits and cost from the selection phase together with the planned duration, the observation period for the benefit values and the duration planned for the depreciation of cost to provide a first plan by simply linearly distributing the figures.



Projects available for planning in portfolio: Demo Portfolio

Project	Option values in period														Total Option Value
	0	1	2	23	24	25	26	27	28	29	30	31	32	58	59	
Demo Project 1					0,0010	0,0040	0,0090	0,0158	0,0244	0,0348	0,0469	0,0606	0,0759	0,8865	0,9297	0,9297
Demo Project 2					0,0013	0,0052	0,0115	0,0202	0,0313	0,0446	0,0601	0,0778	0,0975	1,1380	1,1925	1,1925
Total	**0,0000**	**0,0000**		**0,0000**	**0,0023**	**0,0092**	**0,0205**	**0,0360**	**0,0557**	**0,0794**	**0,1070**	**0,1384**	**0,1734**	**2,0245**	**2,1222**	**2,1222**

Fig. 4.63. Planning overview for the development of the option values of the portfolio

Projects available for planning in portfolio: Demo Portfolio

Project	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	2	59	Total Cost
Demo Project 1	107	107	107	107	107	107	107	107	107	107	107	140	35	107	107	107	107	107	107	107	107	107	107	107				2.522
Demo Project 2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97				2.318
Total	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**237**	**132**	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**203**	**203**				**4.840**

Fig. 4.64. Overview of the cost per period within the portfolio

The detailed planning for the benefit values as described in section 4.5.4 to adapt the figures from the suggested linear distribution to the real estimated values per period can be carried out, too. Here the application calculates the probable benefit values based on the estimates for the lowest, most probable, and highest value and the weights provided from the application's parametrization.

The cost planning is also done the same way as described in section 4.5.4. The inflation and tax reductions due to the depreciation of the activated projects within the portfolio are taken into consideration.

In the controlling period of the portfolio the progress is reported. During the life cycle of project execution, the costs are in focus of the controlling. As soon as a project is finished, the focus shifts to the development of the benefit factors expected from the project. Based on the development of costs and benefits the application calculates the performance indices described in section 4.5.6.

4.6.3 Data Model

The data model describes the entities used within the application together with the relations they have to each other. For the developed application see below:

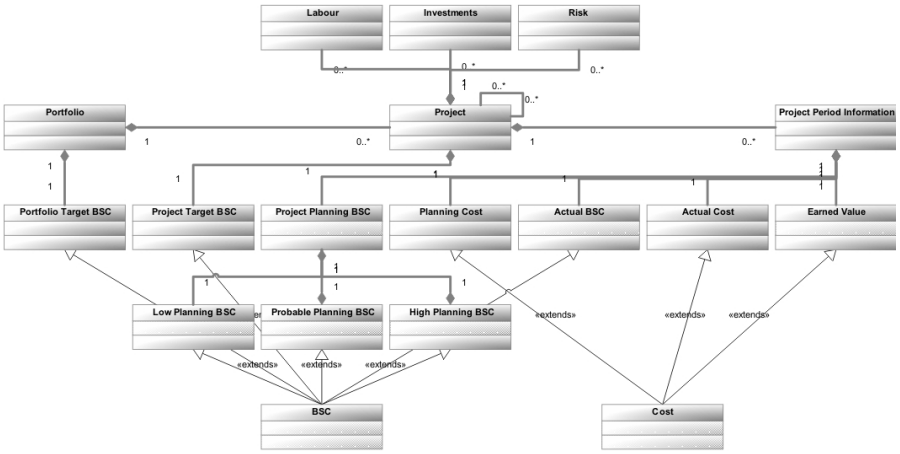


Fig. 4.65. Data model of the application

The main entities are the *Portfolio*, the *Project* and the *Project Period Information*(PPI). Every portfolio may have zero or more projects connected to it. Any of the projects has just as many PPIs, as periods are needed to describe the execution of the project, its observation period for gaining the benefits and the depreciation period for the activated costs. In principle every project has labor, investment and risk costs associated with it.

For the selection of the projects in a portfolio, the *Portfolio Target BSC* describes the constraints that are associated with the portfolio. Like all BSC relevant entities, it is derived from the abstract entity *BSC*, which describes all factors from the BSC. The *Project Target BSC* describes the contribution of the project to the portfolio targets.

As soon as a portfolio moves to the planning status, the more detailed planning is covered by the entities *Low Planning BSC*, *Probable Planning BSC* and *High Planning BSC* which fill the *Project Planning BSC* based on the weights provided. It should to be mentioned here that *Project Planning BSC* is not a persistent entity, but the figures are calculated at execution. The costs are covered by *Planning Cost* which are derived from the abstract entity *Cost*.

During the project's execution the actual values for cost are collected in the entity *Actual Cost* and the progress in the entity *Earned Value*. Because the progress in the Earned Value Methodology (EVM) is captured in relation to costs, the entity used is also derived from the entity cost. After the project's execution - during the observation period of the project - the development of the BSC contribution of every single project is captured in the entity *Actual BSC*.

5

The Proof of Concept (POC) prototype

The proof of concept for this thesis will focus on two aspects:

- Simulation of several points in time with the software solution based on the data of an international active bank
- Comparison of decisions taken in real-life situation with those suggested by the software solutions as well as this thesis

The real life content based test of the application is executed using data from an IT project portfolio of an internationally active banking group. The data is completely anonymized, so that no conclusions from the proof of concept can be applied either to the type, or the project's subject or to the business strategy executed by the banking group. Because not all data required for the algorithms presented in this paper and used by the application have been collected in real life yet, the author complemented the missing data accordingly, based on the experience of personnel in charge for the real life projects.

The Balanced Scorecard (BSC) used in the proof of concept has been developed by the author but has not been applied in the banking group the data is taken from. Therefore, all BSC relevant information used is based on assumptions made in the context of the financial industry.

The focus of this section is on comparing the results and their conclusions from the application with the decisions taken in real life. Further, the possible optimization potential and the suggestions stemming from the results presented, will be discussed.

5.1 Portfolio 1

5.1.1 Collection of the basic data

To begin with, this project portfolio is a rather simple one. It contains two projects – Project 1 (P_1) and Project 2 (P_2). The duration of P_1 is 12 and the one of P_2 24 months, whereas project P_2 is an obligatory project:

Fig. 5.1. Projects with their duration and necessity in project portfolio 1

Following this thesis section 4.4.4, the first step is to define the dependencies within the portfolio. In this case P_2 depends on the finalization of P_1. The method of defining such a dependency in the application was demonstrated in figure 4.57. The dependency chart for this portfolio is very simple:

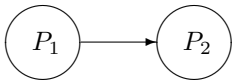


Fig. 5.2. Dependency graph in project portfolio 1

The second step is to determine the option value of a portfolio as defined in section 4.4.4. To do so, the value set developed from the description in section 4.4.1 was defined in the Balanced Scorecard already used in this thesis, and presented in the figures 4.20 and 4.21. The contribution values used for the projects in this project portfolio are:

	P_1	P_2
Financials		
IT Investments	50	
Building Investments		
Other Investments		
Labor Cost	100	
Non-Retail Revenue	200	100
Retail Revenue	50	100
Treasury Revenue	100	
Customer		
Number of Marketing Activities	2	
Market Rating	2	5
Non-Retail Customer	50	
Retail Customer	30.000	
Customer Satisfaction Rating	1	
Percentage of offers/deals		
Non-Retail customers lost		
Products per customer		
Retail Customers lost		
Product Profitability		
Processes		
Duration of NR Applications	3	5
Number of Resources for NR Applications	2	
Effectivity of NR Collection		10%
Duration of Retail Applications	5	5
Number of Resources for Retail Applications	20	
Effectivity of Retail Collection		10%
Degree of automatization of retail processes	10%	10%
Employees education and growth		
Motivation Index		
Absenteeism		
Turnover Rate		
Training Hours	400	1.200
Ethics Violations		

Table 5.1. Project contribution of P_1 and P_2 in project portfolio 1

Together with the option value derived from these figures, the efforts in P_1 and P_2 for investment cost, labor and risk are collected. The graphical representation of the option value for this portfolio looks as follows:

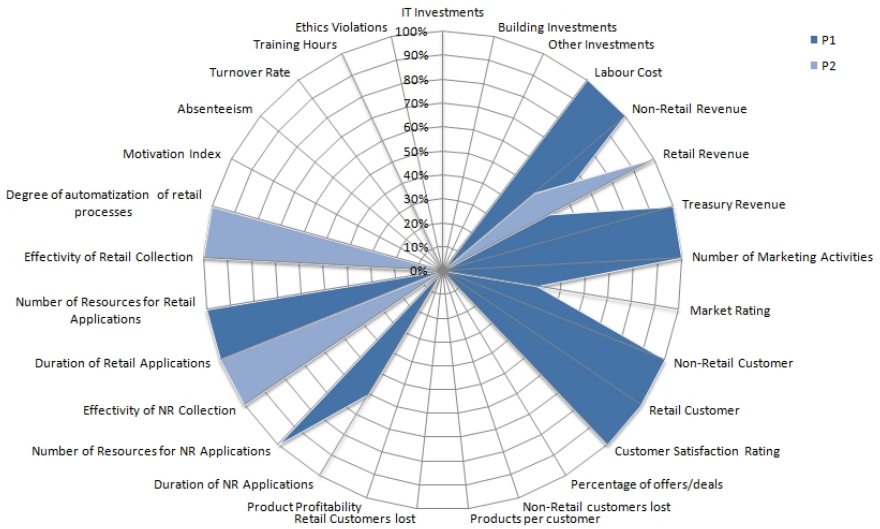


Fig. 5.3. Graphical representation of the option value in portfolio 1

Before the projects for the project portfolio can be prioritized, the constraints the project portfolio needs to comply with have to be defined. For this portfolio the constraints are shown in the graph that compares the constraints with the aggregate values obtained from the projects (figure 5.5 and 5.6).

5.1.2 The Selection process

In the selection process itself, all possible combinations for the project portfolio are calculated based on the dependencies and the projects having obligatory status. The results sorted in descending order and based on their option value are calculated and provide the following picture:

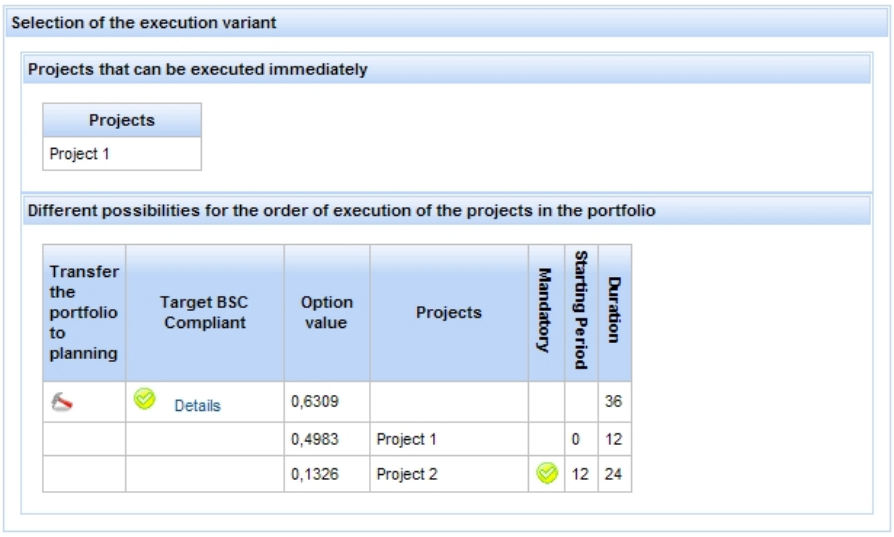


Fig. 5.4. Possibilities for the selection of the projects in portfolio 1

The selection result shows that there is only one way to structure the project portfolio by starting with P_1 followed by P_2. The green check indicates that the portfolio is compliant with the constraints set for it. The details for this portfolio are shown in figure (5.5) and (5.6).

5.1.3 The Planning process

In the planning process the indicated values for the BSC and the financials for the project are broken down into periods within the portfolio. The development of the option value for the portfolio is assumed as shown in the tables 5.2 to 5.5. As the duration of P_1 is planned to be 12 periods (from period 0 to period 11), the observation period for the benefits starts in period 12. In this context it is important to note that the option value does not change any more after the observation period is finished. This is so in order to achieve comparability between the option values. For P_1 the option value is "frozen" starting from period 47. Because P_2 depends on P_1, the observation period starts with period 36 and finishes with period 71.

Going into details the tables 5.6 to 5.9 show the planning of every α-parameter of the BSC in P_1. The same planning for P_2 is shown in the tables 5.10 and 5.11. For both projects in this project portfolio a linear development of the α-figures over the time is assumed and the dependencies between the α-figures of both projects are considered.

The detailed costs per period estimates for both projects expected in the planning period are described in the tables 5.12 to 5.14. Further the graphical representation of the development of the BSC contribution values is shown in figure 5.7 – for the matter of clarity the development is shown with five selected periods.

Project	Period														
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
P_1	0,0005	0,0022	0,0048	0,0085	0,0131	0,0187	0,0251	0,0325	0,0407	0,0498	0,0597	0,0703	0,0817	0,0938	0,1066
P_2															
Total	0,0005	0,0022	0,0048	0,0085	0,0131	0,0187	0,0251	0,0325	0,0407	0,0498	0,0597	0,0703	0,0817	0,0938	0,1066

Table 5.2. Development of the option value in project portfolio 1 1/4

Project	Period														
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
P_1	0,1201	0,1342	0,149	0,1644	0,1803	0,1968	0,2139	0,2315	0,2495	0,2681	0,2871	0,3065	0,3264	0,3467	0,3673
P_2										0,0001	0,0006	0,0013	0,0023	0,0035	0,0050
Total	0,1201	0,1342	0,149	0,1644	0,1803	0,1968	0,2139	0,2315	0,2495	0,2682	0,2877	0,3078	0,3287	0,3502	0,3723

Table 5.3. Development of the option value in project portfolio 1 2/4

Project	Period														
	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
P_1	0,3883	0,4097	0,4314	0,4534	0,4757	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983
P_2	0,0067	0,0087	0,0108	0,0133	0,0159	0,0187	0,0217	0,025	0,0284	0,032	0,0357	0,0396	0,0437	0,0480	0,0524
Total	0,3950	0,4184	0,4422	0,4667	0,4916	0,5170	0,5200	0,5233	0,5267	0,5303	0,5340	0,5379	0,5420	0,5463	0,5507

Table 5.4. Development of the option value in project portfolio 1 3/4

Project	Period														
	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
P_1	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983	0,4983
P_2	0,0569	0,0616	0,0664	0,0713	0,0764	0,0816	0,0868	0,0922	0,0977	0,1033	0,1090	0,1148	0,1206	0,1266	0,1326
Total	0,5552	0,5599	0,5647	0,5696	0,5747	0,5799	0,5851	0,5905	0,5960	0,6016	0,6073	0,6131	0,6189	0,6249	0,6309

Table 5.5. Development of the option value in project portfolio 1 4/4

BSC Value		Period																	
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
IT investments	low	1	2	4	5	6	7	8	9	11	12	13	14	15	17	18	19	20	21
	probable	1	3	4	6	7	8	10	11	12	14	15	16	18	19	21	22	23	25
	high	2	3	4	6	8	9	10	12	14	15	16	18	20	21	22	24	26	27
	adjusted	1	3	4	6	7	8	10	11	12	14	15	17	18	19	21	22	24	25
Labor cost	low	2	5	7	9	12	14	17	19	21	24	26	28	31	33	35	38	40	42
	probable	3	6	8	11	14	16	19	22	25	27	30	33	36	38	41	44	47	50
	high	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
	adjusted	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50
Non-retail revenue	low	5	9	14	19	24	28	33	38	42	47	52	57	61	66	71	76	80	85
	probable	6	11	16	22	27	33	38	44	50	55	60	66	71	77	82	88	94	99
	high	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108
	adjusted	6	11	17	22	28	33	39	44	50	56	61	67	72	78	83	89	94	100
Retail revenue	low	1	2	4	5	6	7	8	9	11	12	13	14	15	17	18	19	20	21
	probable	1	3	4	6	7	8	10	11	12	14	15	16	18	19	21	22	23	25
	high	2	3	4	6	8	9	10	12	14	15	16	18	20	21	22	24	26	27
	adjusted	1	3	4	6	7	8	10	11	12	14	15	17	18	19	21	22	24	25
Treasury revenue	low	2	5	7	9	12	14	17	19	21	24	26	28	31	33	35	38	40	42
	probable	3	6	8	11	14	16	19	22	25	27	30	33	36	38	41	44	47	50
	high	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
	adjusted	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50
Number of marketing activities	low	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	probable	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
	high	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	adjusted	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
Market rating	low	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	probable	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
	high	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	adjusted	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
Non-retail customer	low	1	2	4	5	6	7	8	9	11	12	13	14	15	17	18	19	20	21
	probable	1	3	4	6	7	8	10	11	12	14	15	16	18	19	21	22	23	25
	high	2	3	4	6	8	9	10	12	14	15	16	18	20	21	22	24	26	27
	adjusted	1	3	4	6	7	8	10	11	12	14	15	17	18	19	21	22	24	25

Table 5.6. Development of the BSC values in P_1 in portfolio 1 1/4

BSC Value		Period																	
		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
IT investments	low	22	24	25	26	27	28	30	31	32	33	34	35	37	38	39	40	41	50
	probable	26	27	29	30	32	33	34	36	37	38	40	41	43	44	45	47	48	50
	high	29	30	32	33	34	36	38	39	40	42	44	45	47	48	50	51	52	50
	adjusted	26	28	29	31	32	33	35	36	38	39	40	42	43	44	46	47	49	50
Labor cost	low	45	47	50	52	54	57	59	61	64	66	68	71	73	76	78	80	83	100
	probable	52	55	58	60	63	66	69	71	74	77	80	82	85	88	91	94	96	100
	high	57	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	100
	adjusted	53	56	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100
Non-retail revenue	low	90	94	99	104	109	113	118	123	128	132	137	142	146	151	156	161	165	200
	probable	104	110	116	121	126	132	138	143	148	154	159	165	170	176	182	187	192	200
	high	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210	200
	adjusted	106	111	117	122	128	133	139	144	150	156	161	167	172	178	183	189	194	200
Retail revenue	low	22	24	25	26	27	28	30	31	32	33	34	35	37	38	39	40	41	50
	probable	26	27	29	30	32	33	34	36	37	38	40	41	43	44	45	47	48	50
	high	29	30	32	33	34	36	38	39	40	42	44	45	47	48	50	51	52	50
	adjusted	26	28	29	31	32	33	35	36	38	39	40	42	43	44	46	47	49	50
Treasury revenue	low	45	47	50	52	54	57	59	61	64	66	68	71	73	76	78	80	83	100
	probable	52	55	58	60	63	66	69	71	74	77	80	82	85	88	91	94	96	100
	high	57	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	100
	adjusted	53	56	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100
Number of marketing activities	low	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	probable	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
	high	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
	adjusted	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
Market rating	low	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	probable	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
	high	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
	adjusted	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
Non-retail customer	low	22	24	25	26	27	28	30	31	32	33	34	35	37	38	39	40	41	50
	probable	26	27	29	30	32	33	34	36	37	38	40	41	43	44	45	47	48	50
	high	29	30	32	33	34	36	38	39	40	42	44	45	47	48	50	51	52	50
	adjusted	26	28	29	31	32	33	35	36	38	39	40	42	43	44	46	47	49	50

Table 5.7. Development of the BSC values in P_1 in portfolio 1 2/4

BSC Value		Period																	
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Retail customer	low	708	1.417	2.125	2.833	3.542	4.250	4.958	5.667	6.375	7.083	7.792	8.500	9.208	9.917	10.625	11.333	12.042	12.750
	probable	825	1.650	2.475	3.300	4.125	4.950	5.775	6.600	7.425	8.250	9.075	9.900	10.725	11.550	12.375	13.200	14.025	14.850
	high	900	1.800	2.700	3.600	4.500	5.400	6.300	7.200	8.100	9.000	9.900	10.800	11.700	12.600	13.500	14.400	15.300	16.200
	adjusted	833	1.667	2.500	3.333	4.167	5.000	5.833	6.667	7.500	8.333	9.167	10.000	10.833	11.667	12.500	13.333	14.167	15.000
Customer satisfaction rating	low	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	probable	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	high	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	adjusted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Duration of non-retail applications	low	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	probable	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	high	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2
	adjusted	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2
Number of resources for non-retail applications	low	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	probable	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
	high	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	adjusted	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
Duration of retail applications	low	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	probable	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	high	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
	adjusted	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Number of resources for retail applications	low	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	8
	probable	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10
	high	1	1	2	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11
	adjusted	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10
Degree of automatization of retail processes	low	0%	0%	1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%
	probable	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%
	high	0%	0%	1%	1%	1%	1%	2%	2%	2%	4%	3%	3%	3%	5%	4%	4%	4%	6%
	adjusted	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%
Training hours	low	9	19	28	38	47	57	66	76	85	94	104	113	123	132	142	151	161	170
	probable	11	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198
	high	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216
	adjusted	11	22	33	44	56	67	78	89	100	111	122	133	144	156	167	178	189	200

Table 5.8. Development of the BSC values in P_1 in portfolio 1 3/4

BSC Value		Period																	
		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Retail customer	low	13.458	14.167	14.875	15.583	16.292	17.000	17.708	18.417	19.125	19.833	20.542	21.250	21.958	22.667	23.375	24.083	24.792	30.000
	probable	15.675	16.500	17.325	18.150	18.975	19.800	20.625	21.450	22.275	23.100	23.925	24.750	25.575	26.400	27.225	28.050	28.875	30.000
	high	17.100	18.000	18.900	19.800	20.700	21.600	22.500	23.400	24.300	25.200	26.100	27.000	27.900	28.800	29.700	30.600	31.500	30.000
	adjusted	15.833	16.667	17.500	18.333	19.167	20.000	20.833	21.667	22.500	23.333	24.167	25.000	25.833	26.667	27.500	28.333	29.167	30.000
Customer satisfaction rating	low	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	probable	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	high	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	adjusted	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Duration of non-retail applications	low	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
	probable	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3
	high	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
	adjusted	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3
Number of resources for non-retail applications	low	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	probable	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
	high	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
	adjusted	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
Duration of retail applications	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Number of resources for retail applications	low	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	20
	probable	10	11	12	12	13	13	14	14	15	15	16	16	17	18	18	19	19	20
	high	11	12	13	13	14	14	15	16	16	17	17	18	19	19	20	20	21	20
	adjusted	11	11	12	12	13	13	14	14	15	16	16	17	17	18	18	19	19	20
Degree of automatization of retail processes	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%
	high	6%	5%	7%	7%	7%	6%	8%	8%	8%	9%	9%	9%	9%	10%	10%	10%	10%	10%
	adjusted	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%
Training hours	low	179	189	198	208	217	227	236	246	255	264	274	283	293	302	312	321	331	400
	probable	209	220	231	242	253	264	275	286	297	308	319	330	341	352	363	374	385	400
	high	228	240	252	264	276	288	300	312	324	336	348	360	372	384	396	408	420	400
	adjusted	211	222	233	244	256	267	278	289	300	311	322	333	344	356	367	378	389	400

Table 5.9. Development of the BSC values in P_1 in portfolio 1 4/4

BSC Value		Period																	
		36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
Non-retail revenue	low	2	5	7	9	12	14	17	19	21	24	26	28	31	33	35	38	40	42
	probable	3	6	8	11	14	16	19	22	25	27	30	33	36	38	41	44	47	50
	high	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
	adjusted	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50
Retail revenue	low	2	5	7	9	12	14	17	19	21	24	26	28	31	33	35	38	40	42
	probable	3	6	8	11	14	16	19	22	25	27	30	33	36	38	41	44	47	50
	high	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
	adjusted	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50
Market rating	low	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	probable	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	high	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
	adjusted	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Duration of non-retail applications	low	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	probable	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	high	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
	adjusted	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Efficiency of non-retail collection	low	0%	0%	1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%
	probable	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%
	high	0%	0%	1%	1%	1%	1%	2%	2%	2%	4%	3%	3%	3%	5%	4%	4%	4%	6%
	adjusted	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%
Duration of retail applications	low	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	probable	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	high	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
	adjusted	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Efficiency of retail collection	low	0%	0%	1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%
	probable	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%
	high	0%	0%	1%	1%	1%	1%	2%	2%	2%	4%	3%	3%	3%	4%	4%	4%	4%	6%
	adjusted	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%
Degree of automatization of retail processes	low	0%	0%	1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%
	probable	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%
	high	0%	0%	1%	1%	1%	1%	2%	2%	2%	4%	3%	3%	3%	5%	4%	4%	4%	6%
	adjusted	0%	0%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%
Training hours	low	28	57	85	113	142	170	198	227	255	283	312	340	368	397	425	453	482	510
	probable	33	66	99	132	165	198	231	264	297	330	363	396	429	462	495	528	561	594
	high	36	72	108	144	180	216	252	288	324	360	396	432	468	504	540	576	612	648
	adjusted	33	67	100	133	167	200	233	267	300	333	367	400	433	467	500	533	567	600

Table 5.10. Development of the BSC values in P_2 in portfolio 1 1/2

BSC Value		Period																	
		54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Non-retail revenue	low	45	47	50	52	54	57	59	61	64	66	68	71	73	76	78	80	83	100
	probable	52	55	58	60	63	66	69	71	74	77	80	82	85	88	91	94	96	100
	high	57	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	100
	adjusted	53	56	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100
Retail revenue	low	45	47	50	52	54	57	59	61	64	66	68	71	73	76	78	80	83	100
	probable	52	55	58	60	63	66	69	71	74	77	80	82	85	88	91	94	96	100
	high	57	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	100
	adjusted	53	56	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100
Market rating	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Duration of non-retail applications	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Efficiency of non-retail collection	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%
	high	6%	5%	7%	7%	7%	6%	8%	8%	8%	9%	9%	9%	9%	10%	10%	10%	10%	10%
	adjusted	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%
Duration of retail applications	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Efficiency of retail collection	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%
	high	6%	5%	7%	7%	7%	6%	8%	8%	8%	9%	9%	9%	9%	10%	10%	10%	10%	10%
	adjusted	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%
Degree of automatization of retail processes	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%
	high	6%	5%	7%	7%	7%	6%	8%	8%	8%	9%	9%	9%	9%	10%	10%	10%	10%	10%
	adjusted	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%
Training hours	low	538	567	595	623	652	680	708	737	765	793	822	850	878	907	935	963	992	1.200
	probable	627	660	693	726	759	792	825	858	891	924	957	990	1.023	1.056	1.089	1.122	1.155	1.200
	high	684	720	756	792	828	864	900	936	972	1.008	1.044	1.080	1.116	1.152	1.188	1.224	1.260	1.200
	adjusted	633	667	700	733	767	800	833	867	900	933	967	1.000	1.033	1.067	1.100	1.133	1.167	1.200

Table 5.11. Development of the BSC values in P_2 in portfolio 1 2/2

Detailed BSC split up for the selected option

Project	Financials						
	IT investments	Building investments	Other investments	Labour cost	Non-retail revenue	Retail revenue	Treasury revenue
Project 1	50	0	0	100	200	50	100
Project 2	0	0	0	0	100	100	0
Total	**50**	**0**	**0**	**100**	**300**	**150**	**100**
BSC Target	**min 40**	**max 20**	**min 0**	**min 80**	**min 220**	**min 120**	**min 80**
Status							

Project	Customer								
	Number of marketing activities	Market rating	Non-retail customer	Retail customer	Customer satisfaction rating	Percentage deals / offers	Non-retail customers lost	Retail customers lost	Product profitability
Project 1	2	2	50	30.000	1	0%	0	0	0%
Project 2	0	5	0	0	0	0%	0	0	0%
Total	**2**	**7**	**50**	**30.000**	**1**	**0%**	**0**	**0**	**0%**
BSC Target	**max 5**	**min 5**	**min 40**	**min 20.000**	**min 1**	**min 0%**	**min 0**	**min 0**	**min 0%**
Status									

Fig. 5.5. Constraints and contribution of the projects in project portfolio 1 1/2

	0	1	2	3	4	5	6	7	8	9	10	11	Total
Investments	5	18	15	9	8	19	8	10	8	12	11	7	130
Labor	90	73	62	96	104	105	96	80	17	40	15	4	782
Risks	2	2	1	3	1	1	2	2	4	2	2	2	24
Total	97	93	78	108	113	125	106	92	29	54	28	13	936

Table 5.12. Costs per period for P_1 in project portfolio 1

Project	Internal Processes						
	Duration of non-retail applications	Number of resources for non-retail applications	Efficiency of non-retail collection	Duration of retail applications	Number of resources for retail applications	Efficiency of retail collection	Degree of automatization of retail processes
Project 1	3	2	0%	5	20	0%	10%
Project 2	5	0	10%	5	0	10%	10%
Total	**8**	**2**	**10%**	**10**	**20**	**10%**	**20%**
BSC Target	**min 5**	**min 2**	**min 5%**	**min 10**	**min 15**	**min 10%**	**min 15%**
Status							

Project	Employee Education and Growth				
	Motivation index	Absenteeism	Turnover rate	Training hours	Ethics violations
Project 1	0	0	0	400	0
Project 2	0	0	0	1.200	0
Total	**0**	**0**	**0**	**1.600**	**0**
BSC Target					

Project	Project constraints			
	Total Risk Budget	Total Investment Budget	Total Labor Budget	Total Budget
Project 1	24	130	782	936
Project 2	1.297	2.652	4.748	8.697
Total	**1.321**	**2.782**	**5.530**	**8.312**
BSC Target	**min 0**	**min 0**	**min 0**	**max 10.000**
Status				

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Fig. 5.6. Constraints and contribution of the projects in project portfolio 1 2/2

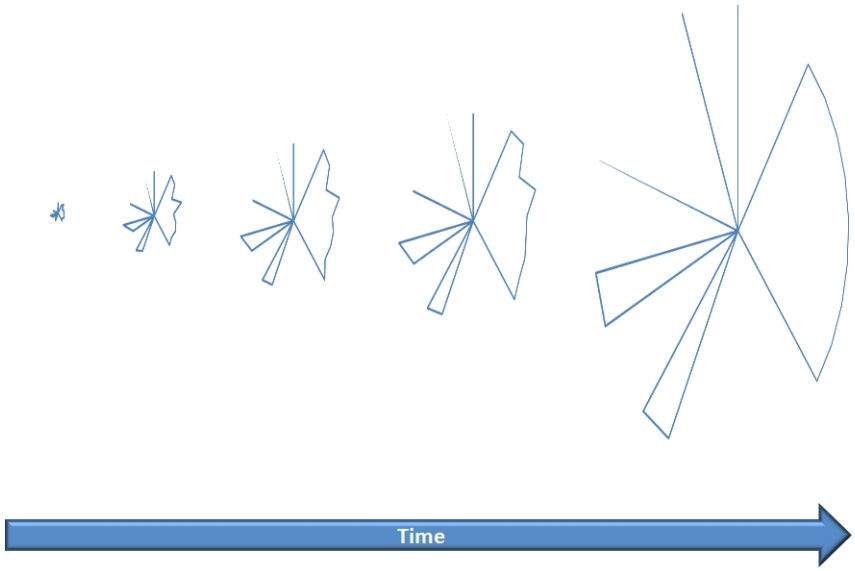


Fig. 5.7. Graphical representation of the development of the BSC contribution values in portfolio 1

	12	13	14	15	16	17	18	19	20	21	22	23	24
Investments	199	173	52	181	28	117	135	158	184	41	3	167	191
Labor	74	13	143	26	15	121	146	182	256	155	195	414	852
Risks	27	45	59	21	50	53	55	48	47	89	19	40	13
Total	300	231	254	228	93	291	336	388	487	285	217	621	1.056

Table 5.13. Costs per period for P_2 in project portfolio 1 1/2

	25	26	27	28	29	30	31	32	33	34	35	Total
Investments	29	119	148	116	17	139	88	84	73	130	82	2.652
Labor	12	325	26	71	80	186	163	100	97	692	403	4.748
Risks	67	84	38	81	37	59	87	80	75	52	71	1.297
Total	108	528	212	269	133	384	338	264	245	874	556	8.697

Table 5.14. Costs per period for P_2 in project portfolio 1 2/2

At this point in time all activities are finished: the selection of the projects for the portfolio is over (in this case there is only one option to go for) and the detailed planning of BSC-values and costs have been carried out based on the procedures described in the thesis in sections 4.5.2 and 4.5.4. The missing

overview of costs taking into consideration inflation and tax reductions out of depreciation is shown in the tables 5.15 to 5.18. It shows that from the original expected costs of 9.634 (=936 + 8.698) only 7.692 remains.

The next step is to kick-off the portfolio and start the monitoring and controlling of the targets defined in the plans.

5.1.4 Snapshot 1

The point in time for snapshot one is period seven. P_1 has been started as planned but the execution did not make the progress expected in the planning phase:

Costs for project: Project 1

Portfolio Overview

Cost type		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	69	70	71	Total Cost
Investments	PV	5	18	15	9	8	19	8	10	8	12	11	7															130
	AC	3	20	13	11	12	16	6	11	0	0	0	0															92
Labour	PV	90	73	62	96	104	105	96	80	17	40	15	4															782
	AC	102	72	70	101	106	118	132	102	0	0	0	0															803
Risks	PV	2	2	1	3	1	1	2	2	4	2	2	2															24
	AC	2	3	0	3	1	1	2	2	0	0	0	0															14
Total	PV	97	93	78	108	113	125	106	92	29	54	28	13															936
	AC	107	95	83	115	119	135	140	115																			909
	EV	9%	19%	25%	38%	47%	57%	64%	75%																			75%
	SV	-13	-12	-34	-20	-49	-80	-121	-110																			
	CV	-23	-24	-51	-44	-79	-120	-195	-207																			
	SPI	0,87	0,94	0,87	0,95	0,90	0,87	0,83	0,86																			
	CPI	0,79	0,88	0,82	0,89	0,85	0,82	0,75	0,77																			

Fig. 5.8. Snaphshot 1 taken in portfolio 1

Considering the project without taking into account EV indicators, the portfolio looks great: the progress is reported with a completion of 75% by having 2/3 of the time spent. Going into details, the picture changes completely: compared to the progress planned and achieved, figure 5.8 shows that the project is already 14% behind schedule (1-0,86) and 23% behind budget (1-0,77). Based on these indicators, the forecast for this project would be to achieve a duration of about 14 months (12/0,86) with a required budget of about 1.215 (936/0,77).

In reality, neither the management nor the project manager were greatly concerned with this project, because the forecast for the schedule looked very good (as described above) and they expected a marginal cost overrun which was calculated as follows:

Project		Period 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Project 1	Costs	97	190	268	376	489	614	720	812	841	895	923	936	936	936	936	936	936	936
	+ Inflation	0	1	2	4	6	10	14	19	22	27	30	34	34	34	34	34	34	34
	- Tax Reduction due to depreciation	0	0	0	0	0	0	0	0	0	0	0	0	8	16	23	31	39	47
	= Subtotal	97	191	270	380	495	624	734	831	863	922	953	970	962	954	947	939	931	923
Project 2	Costs	0	0	0	0	0	0	0	0	0	0	0	0	300	531	785	1.013	1.106	1.397
	+ Inflation	0	0	0	0	0	0	0	0	0	0	0	0	11	20	31	44	49	66
	- Tax Reduction due to depreciation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	= Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	311	551	816	1.057	1.155	1.463
Total		97	191	270	380	495	624	734	831	863	922	953	970	1.273	1.506	1.763	1.996	2.086	2.387

Table 5.15. Cost including inflation and tax reduction out of depreciation for portfolio 1 1/4

Project		Period 18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Project 1	Costs	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936
	+ Inflation	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
	- Tax Reduction due to depreciation	55	62	70	78	86	94	101	109	117	125	133	140	148	156	164	172	179	187
	= Subtotal	915	908	900	892	884	876	869	861	853	845	837	830	822	814	806	798	791	783
Project 2	Costs	1.733	2.121	2.608	2.893	3.110	3.731	4.787	4.895	5.423	5.635	5.903	6.037	6.421	6.759	7.023	7.268	8.142	8.698
	+ Inflation	88	115	152	174	197	253	351	370	425	459	495	523	576	624	666	707	828	914
	- Tax Reduction due to depreciation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	= Subtotal	1.821	2.236	2.760	3.067	3.307	3.984	5.138	5.265	5.848	6.094	6.398	6.560	6.997	7.383	7.689	7.975	8.970	9.612
Total		2.736	3.144	3.659	3.959	4.191	4.860	6.007	6.126	6.701	6.939	7.235	7.390	7.819	8.197	8.495	8.774	9.761	10.395

Table 5.16. Cost including inflation and tax reduction out of depreciation for portfolio 1 2/4

Project		Period 36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
Project 1	Costs	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936
	+ Inflation	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
	- Tax Reduction due to depreciation	195	203	211	218	226	234	242	250	257	265	273	281	281	281	281	281	281	281
	= Subtotal	775	767	759	752	744	736	728	720	713	705	697	689	689	689	689	689	689	689
Project 2	Costs	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698
	+ Inflation	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914
	- Tax Reduction due to depreciation	72	145	217	290	362	435	507	580	652	725	797	870	942	1.015	1.087	1.160	1.232	1.305
	= Subtotal	9.540	9.467	9.395	9.322	9.250	9.177	9.105	9.032	8.960	8.887	8.815	8.742	8.670	8.597	8.525	8.452	8.380	8.308
Total		10.315	10.234	10.154	10.074	9.994	9.913	9.833	9.753	9.672	9.592	9.512	9.432	9.359	9.287	9.214	9.142	9.069	8.997

Table 5.17. Cost including inflation and tax reduction out of depreciation for portfolio 1 3/4

Project		Period 54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	Total Cost
Project 1	Costs	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936
	+ Inflation	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
	- Tax Reduction due to depreciation	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281
	= Subtotal	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689
Project 2	Costs	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698	8.698
	+ Inflation	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914	914
	- Tax Reduction due to depreciation	1.377	1.450	1.522	1.595	1.667	1.740	1.812	1.885	1.957	2.030	2.102	2.174	2.247	2.319	2.392	2.464	2.537	2.609	2.609
	= Subtotal	8.235	8.163	8.090	8.018	7.945	7.873	7.800	7.728	7.655	7.583	7.510	7.438	7.365	7.293	7.220	7.148	7.075	7.003	7.003
Total		8.924	8.852	8.779	8.707	8.634	8.562	8.489	8.417	8.344	8.272	8.199	8.127	8.054	7.982	7.909	7.837	7.765	7.692	7.692

Table 5.18. Cost including inflation and tax reduction out of depreciation for portfolio 1 4/4

Estimate to complete (ETC)	124
+ Actual total cost	909
= Total budget required	1.033
- Budget planned	936
= Budget overrun	97

Table 5.19. Budget overrun calculation done in project 1 of portfolio 1

Naturally, this estimate leaves out the fact that costs have been underestimated over the whole life time of the project. Alterations in this environment are required only if such a change is greater than 10%. No alterations have been carried out in this case, (although the change was about 10.36%), since the project was very close to its completion.

5.1.5 Snapshot 2

P_1 execution continued, and it is now in period eleven. The figures delivered from the project look as follows:

Costs for project: Project 1

Portfolio Overview

Cost type		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	69	70	71	Total Cost
Investments	PV	5	18	15	9	8	19	8	10	8	12	11	7															130
	AC	3	20	13	11	12	16	6	11	15	20	21	0															148
Labour	PV	90	73	62	96	104	105	96	80	17	40	15	4															782
	AC	102	72	70	101	106	118	132	102	25	50	30	0															908
Risks	PV	2	2	1	3	1	1	2	2	4	2	2	2															24
	AC	2	3	0	3	1	1	2	2	3	1	3	0															21
Total	PV	97	93	78	108	113	125	106	92	29	54	28	13															936
	AC	107	95	83	115	119	135	140	115	43	71	54																1.077
	EV	9%	19%	25%	38%	47%	57%	64%	75%	80%	83%	88%																88%
	SV	-13	-12	-34	-20	-49	-80	-121	-110	-92	-118	-99																
	CV	-23	-24	-51	-44	-79	-120	-195	-207	-203	-246	-253																
	SPI	0,87	0,94	0,87	0,95	0,90	0,87	0,83	0,86	0,89	0,87	0,89																
	CPI	0,79	0,88	0,82	0,89	0,85	0,82	0,75	0,77	0,79	0,76	0,76																

Fig. 5.9. Snaphshot 2 taken in portfolio 1

The EV indicators are about the same as in period seven: P_1 is about 11% behind schedule and about 24% behind budget; the project's duration should be about 13,5 months (12/0,89), and the expected total budget is about 1.215 (936/0,76).

In reality, the project manager was asked whether he could manage to finish the project on time. He answered that the project was slightly behind schedule: 12% of the work remained to be done, with 8,33% of the time left.

The schedule would be overdrawn by one period – at most. The cost issue was discussed as well: the cost overrun of 44 (1.077 - 1.033) would only increase by no more than the amount of thirteen – the planned amount for the last period. This means finishing with a total budget of 1.090, i.e. as required.

As a matter of fact P_1 was continued with the expectation of finishing soon with a small budget overrun and to be in the position to start P_2 soon. The official planning for the project was not revised but stayed with the original baseline.

5.1.6 Snapshot 3

Snapshot 3 takes place in period 33. P_1 actually ended up with a delay of two months and total costs of 1.345, which represents a cost overrun of 43% ($[(1.345/936) - 1] \times 100$) – figure 5.10 shows the details of the development.

Costs for project: Project 1

Portfolio Overview

Cost type		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	70	71	72	73	Total Cost
Investments	PV	5	18	15	9	8	19	8	10	8	12	11	7	0	0										130
	AC	3	20	13	11	12	16	6	11	15	20	21	18	18	14										198
Labour	PV	90	73	62	96	104	105	96	80	17	40	15	4	0	0										782
	AC	102	72	70	101	106	118	132	102	25	50	30	89	62	62										1.121
Risks	PV	2	2	1	3	1	1	2	2	4	2	2	2	0	0										24
	AC	2	3	0	3	1	1	2	2	3	1	3	2	2	1										26
Total	PV	97	93	78	108	113	125	106	92	29	54	28	13	0	0										936
	AC	107	95	83	115	119	135	140	115	43	71	54	109	82	77										1.345
	EV	9%	19%	25%	38%	47%	57%	64%	75%	80%	83%	88%	91%	95%	100%										100%
	SV	-13	-12	-34	-20	-49	-80	-121	-110	-92	-118	-99	-84	-47	-0										
	CV	-23	-24	-51	-44	-79	-120	-195	-207	-203	-246	-253	-334	-379	-409										
	SPI	0,87	0,94	0,87	0,95	0,90	0,87	0,83	0,86	0,89	0,87	0,89	0,91	0,95	1,00										
	CPI	0,79	0,88	0,82	0,89	0,85	0,82	0,75	0,77	0,79	0,76	0,76	0,72	0,70	0,70										

Fig. 5.10. Snaphshot 3 of P_1 taken in portfolio 1

As the project P_1 is finished, the observation period for the benefits expected out of P_1 started in period 14. This development is shown in table 5.20 and 5.21.

The figures show that the results from P_1 remain behind the expectations, set when the project was selected and planned. Because it is an obligatory predecessor for P_2, it was not a failure to select it, but the business effects have been overestimated.

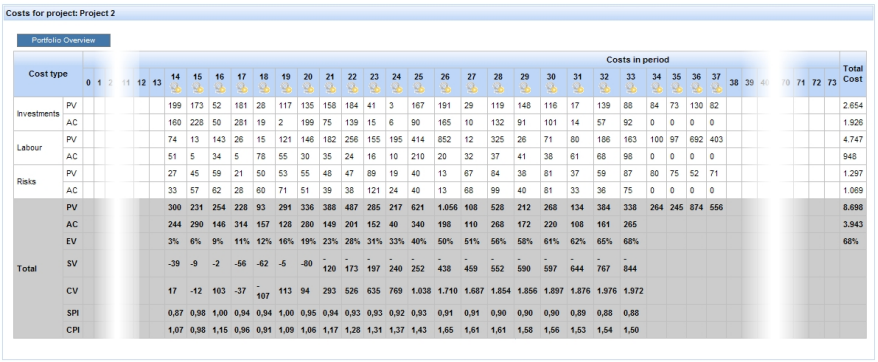
Immediately after P_1 was finished, P_2 was kicked off. The development of the cost figures are is shown below:

BSC Value		Period 14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
IT investments	PV	1	3	4	6	7	8	10	11	12	14	15	17	18	19	21	22	24	25	26	28
	EV	2	2	3	4	5	7	7	8	10	10	12	13	13	15	15	17	18	18	19	20
	Var	1	-1	-1	-2	-2	-1	-3	-3	-2	-4	-3	-4	-5	-4	-6	-5	-6	-7	-7	-8
	PI	1,44	0,72	0,72	0,72	0,72	0,84	0,72	0,72	0,80	0,72	0,79	0,78	0,72	0,77	0,72	0,76	0,76	0,72	0,72	0,72
Labor cost	PV	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50	53	56
	EV	2	4	4	8	11	14	18	20	23	26	28	31	34	35	38	41	43	44	45	47
	Var	-1	-2	-4	-3	-3	-3	-1	-2	-2	-2	-3	-2	-2	-4	-4	-3	-4	-6	-8	-9
	PI	0,72	0,72	0,48	0,72	0,79	0,84	0,93	0,90	0,92	0,94	0,92	0,93	0,94	0,90	0,91	0,92	0,91	0,88	0,85	0,85
Non-retail revenue	PV	6	11	17	22	28	33	39	44	50	56	61	67	72	78	83	89	94	100	106	111
	EV	7	12	12	23	26	32	35	38	44	51	54	60	63	68	74	78	83	89	92	97
	Var	1	1	-5	1	-2	-1	-4	-6	-6	-5	-7	-7	-9	-10	-9	-11	-11	-11	-14	-14
	PI	1,26	1,08	0,72	1,04	0,94	0,96	0,90	0,86	0,88	0,92	0,88	0,90	0,87	0,87	0,89	0,88	0,88	0,89	0,87	0,87
Retail revenue	PV	1	3	4	6	7	8	10	11	12	14	15	17	18	19	21	22	24	25	26	28
	EV	1	2	2	4	5	5	6	7	8	9	10	11	13	13	15	15	17	17	18	19
	Var	0	-1	-2	-2	-2	-3	-4	-4	-4	-5	-5	-6	-5	-6	-6	-7	-7	-8	-8	-9
	PI	0,72	0,72	0,48	0,72	0,72	0,60	0,62	0,63	0,64	0,65	0,65	0,66	0,72	0,67	0,72	0,68	0,72	0,68	0,68	0,68
Treasury revenue	PV	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50	53	56
	EV	2	5	5	10	13	15	19	22	23	26	27	29	32	33	37	40	42	43	46	48
	Var	-1	-1	-3	-1	-1	-2	0	0	-2	-2	-4	-4	-4	-6	-5	-4	-5	-7	-7	-8
	PI	0,72	0,90	0,60	0,90	0,94	0,90	0,98	0,99	0,92	0,94	0,88	0,87	0,89	0,85	0,89	0,90	0,89	0,86	0,87	0,86
Number of marketing activities	PV	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	EV	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Var	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	0	0	0	0	0	0
	PI	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,38	1,29	1,20	1,12	1,06	1,00	0,95	0,90
Market rating	PV	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	EV	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Var	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	0	0	0	0	0	0
	PI	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,38	1,29	1,20	1,12	1,06	1,00	0,95	0,90
Non-retail customer	PV	1	3	4	6	7	8	10	11	12	14	15	17	18	19	21	22	24	25	26	28
	EV	1	3	4	4	5	6	8	8	9	10	12	13	14	15	16	16	18	19	20	21
	Var	0	0	0	-2	-2	-2	-2	-3	-4	-4	-3	-4	-4	-4	-5	-6	-6	-6	-6	-7
	PI	0,72	1,08	0,96	0,72	0,72	0,72	0,82	0,72	0,72	0,72	0,79	0,78	0,78	0,77	0,77	0,72	0,76	0,76	0,76	0,76

Table 5.20. Actuals for the BSC values in P_1 in portfolio 1 1/2

BSC Value		Period 14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Retail customer	PV	833	1.667	2.500	3.333	4.167	5.000	5.833	6.667	7.500	8.333	9.167	10.000	10.833	11.667	12.500	13.333	14.167	15.000	15.833	16.667
	EV	968	1.228	1.928	2.168	3.026	3.366	4.410	4.907	5.131	6.110	7.164	7.576	8.128	8.797	9.028	9.441	9.884	10.694	10.886	11.877
	Var	135	-439	-572	-1.165	-1.141	-1.634	-1.423	-1.760	-2.369	-2.223	-2.003	-2.424	-2.705	-2.870	-3.472	-3.892	-4.283	-4.306	-4.947	-4.790
	PI	1,16	0,74	0,77	0,65	0,73	0,67	0,76	0,74	0,68	0,73	0,78	0,76	0,75	0,75	0,72	0,71	0,70	0,71	0,69	0,71
Duration of non-retail applications	PV	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2
	EV	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Var	0	0	0	0	0	0	-1	-1	0	0	0	0	0	0	0	0	0	0	-1	-1
	PI	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,33	1,20	1,09	1,00	0,92	0,86	0,80	0,75	0,71	0,67	0,63	0,60
Number of resources for non-retail applications	PV	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	EV	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Var	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0
	PI	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,64	1,50	1,38	1,29	1,20	1,12	1,06	1,00	0,95	0,90
Duration of retail applications	PV	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3
	EV	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	Var	0	0	0	-1	0	0	0	0	0	0	-1	-1	-1	-1	0	0	0	0	-1	-1
	PI	0,00	0,00	0,00	0,00	1,44	1,20	1,03	0,90	0,80	0,72	0,65	0,60	0,55	0,51	0,96	0,90	0,85	0,80	0,76	0,72
Number of resources for retail applications	PV	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	11	11
	EV	1	1	2	2	3	4	4	5	5	5	6	6	7	7	8	8	9	9	9	10
	Var	0	0	0	0	0	1	0	1	0	-1	0	-1	0	-1	0	-1	0	-1	-2	-1
	PI	1,80	0,90	1,20	0,90	1,08	1,20	1,03	1,12	1,00	0,90	0,98	0,90	0,97	0,90	0,96	0,90	0,95	0,90	0,85	0,90
Efficiency of retail collection	PV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Var	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PI	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Degree of automatization of retail processes	PV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Var	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PI	0,00	0,00	0,00	0,90	0,72	0,60	0,51	0,90	0,80	0,72	0,65	0,60	0,83	0,77	0,72	0,67	0,64	0,60	0,76	0,72
Training hours	PV	11	22	33	44	56	67	78	89	100	111	122	133	144	156	167	178	189	200	211	222
	EV	4	11	25	37	44	48	52	62	70	76	87	93	105	115	124	129	141	146	160	168
	Var	-7	-11	-8	-7	-12	-19	-26	-27	-30	-35	-35	-40	-39	-41	-43	-49	-48	-54	-51	-54
	PI	0,36	0,50	0,75	0,83	0,79	0,72	0,67	0,70	0,70	0,68	0,71	0,70	0,73	0,74	0,74	0,73	0,75	0,73	0,76	0,76

Table 5.21. Actuals for the BSC values in P_1 in portfolio 1 2/2



Costs for project: Project 2

Portfolio Overview

| Cost type | | Costs in period | | |

the famous saying about project management is very true: "plan the work – then work the plan." The cognition from this portfolio should be that not only the project figures themselves need to be planned, but so do the figures of the benefits which have a great impact on dependent projects.

5.2 Portfolio 2

Portfolio 2 is more complicated than portfolio 1, because it should provide an overview of the situation with more dependencies and implications. The project portfolio consists of five projects with the following basic setup:

Project	Duration	Mandatory
P_1	12	
P_2	6	
P_3	12	
P_4	24	yes
P_5	12	

Table 5.22. Projects in project portfolio 2

The dependencies in this portfolio are slightly more complex than the ones in portfolio 1. They can be described as follows:

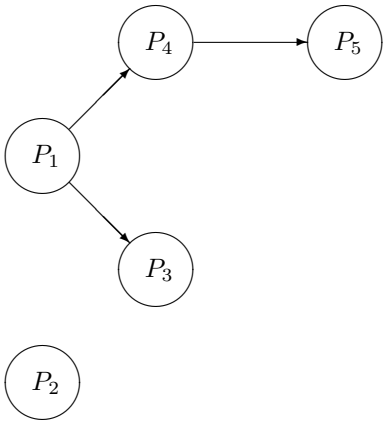


Fig. 5.12. Dependency graph in project portfolio 2

P_1 sets the basis for the projects P_3 and P_4, which directly build on its results. P_2 is a project for business development and its main focus is to increase the number of customers in the retail field (this is also shown in table 5.23 which shows the expected benefits of the project). P_3 supports the long term development of the customer base from P_1 by providing the technical

resources for it. However, as this dependency was not realized in the real project portfolio, the dependency is also not considered in here to allow for the effects' analysis. P_5 builds on the results of P_2 but has no special attributes to be discussed. , The contribution values of this portfolio are already much larger than the ones from portfolio 1. They are summarized below:

	P_1	P_2	P_3	P_4	P_5
Financials					
IT Investments	100				
Building Investments					
Other Investments					
Labor Cost	600				
Non-Retail Revenue	100		400	200	
Retail Revenue	600	3.000	600	200	400
Treasury Revenue	1.200				
Customer					
Number of Marketing Activities					
Market Rating		5		5	
Non-Retail Customer	100				
Retail Customer	5.000	68.000			
Customer Satisfaction Rating	2	5			
Percentage of offers/deals		10%			
Non-Retail customers lost					
Products per customer		3			
Retail Customers lost		20			
Product Profitability		10			
Processes					
Duration of NR Applications	6			5	
Number of Resources for NR Applications	4				
Effectivity of NR Collection			20%	10%	
Duration of Retail Applications	10	20		5	
Number of Resources for Retail Applications	40	60			
Effectivity of Retail Collection		10%	40%	10%	
Degree of automatization of retail processes	20%			10%	15%
Employees education and growth					
Motivation Index		5			
Absenteeism					
Turnover Rate		5			5
Training Hours	15.000	30.000	500	8.000	2.000
Ethics Violations		5			

Table 5.23. Project contribution of the projects in project portfolio 2

The graphical representation of the option value in portfolio that is directly derived from it looks as follows:

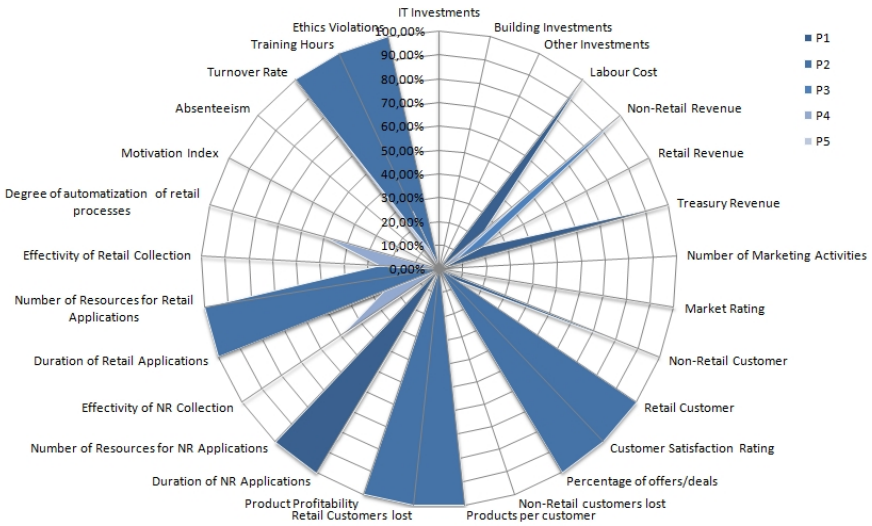


Fig. 5.13. Graphical representation of the option value in portfolio 2

The constraints for this project portfolio are defined as shown in the table below:

	Type	Value
Financials		
IT Investments	min	100
Building Investments	min	0
Other Investments	min	0
Labor Cost	max	1.000
Non-Retail Revenue	min	300
Retail Revenue	min	4.000
Treasury Revenue	min	1.000
Customer		
Number of Marketing Activities	min	0
Market Rating	min	10
Non-Retail Customer	min	100
Retail Customer	min	60.000
Customer Satisfaction Rating	min	5
Percentage of offers/deals	min	8%
Non-Retail customers lost	min	0
Products per customer	min	3
Retail Customers lost	min	20
Product Profitability	min	10

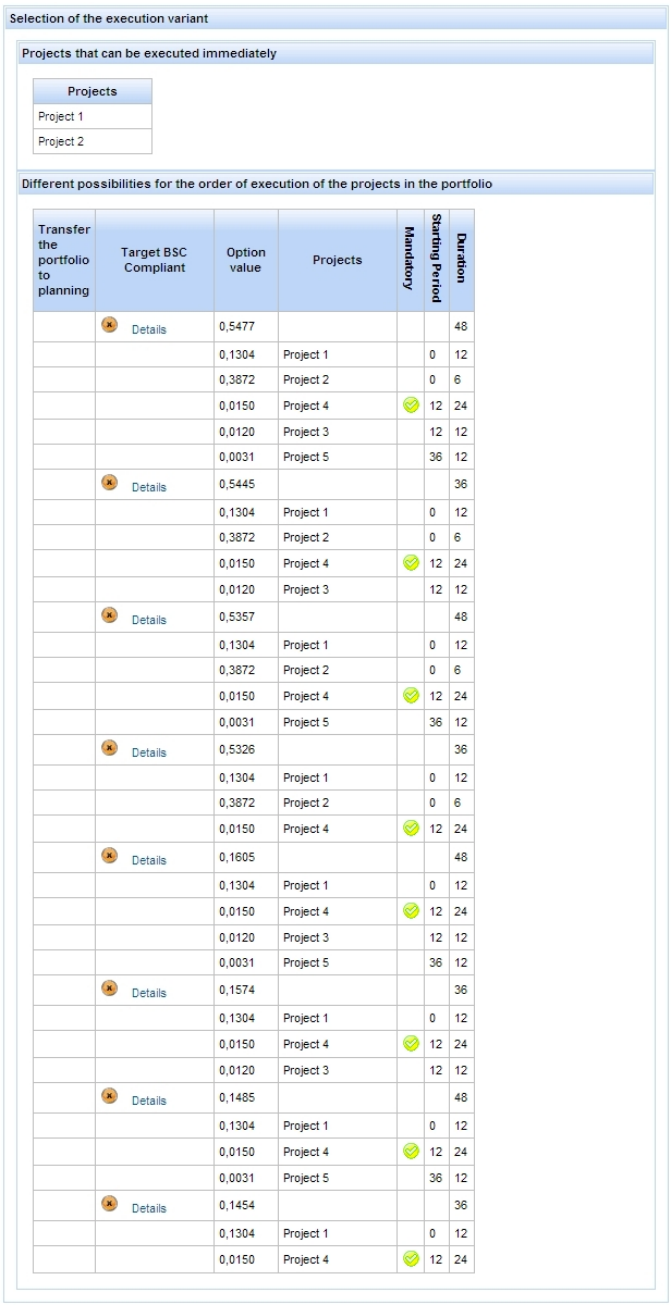
	Type	Value
Processes		
Duration of NR Applications	min	5
Number of Resources for NR Applications	min	4
Effectivity of NR Collection	min	10%
Duration of Retail Applications	min	10
Number of Resources for Retail Applications	min	100
Effectivity of Retail Collection	min	15%
Degree of automatization of retail processes	min	10%
Employees education and growth		
Motivation Index	min	5
Absenteeism	min	0
Turnover Rate	min	5
Training Hours	max	60.000
Ethics Violations	min	5
Project cost constraints		
Total Risk Budget	min	0
Total Investment Budget	min	0
Total Labor Budget	min	0
Total Budget	max	12.000

Table 5.24. Constraints in project portfolio 2

5.2.1 The Selection process

As described in the sections 4.5.2 to 4.5.2, the option value for all possibilities of structuring this project portfolio gets calculated. The result for this portfolio is calculated by the application shown in figure 5.14.

It is clear that the application cannot provide any feasible combination for planning the portfolio. The reason is that one or several constraints are harmed. Looking at the portfolio, the possibility with the highest option value shows that there is only one constraint that cannot be fulfilled. This is the total cost of the project portfolio (shown in figure 5.15).



Selection of the execution variant

Projects that can be executed immediately

Projects
Project 1
Project 2

Different possibilities for the order of execution of the projects in the portfolio

Transfer the portfolio to planning	Target BSC Compliant	Option value	Projects	Mandatory	Starting Period	Duration
	Details	0,5477				48
		0,1304	Project 1		0	12
		0,3872	Project 2		0	6
		0,0150	Project 4	✓	12	24
		0,0120	Project 3		12	12
		0,0031	Project 5		36	12
	Details	0,5445				36
		0,1304	Project 1		0	12
		0,3872	Project 2		0	6
		0,0150	Project 4	✓	12	24
		0,0120	Project 3		12	12
	Details	0,5357				48
		0,1304	Project 1		0	12
		0,3872	Project 2		0	6
		0,0150	Project 4	✓	12	24
		0,0031	Project 5		36	12
	Details	0,5326				36
		0,1304	Project 1		0	12
		0,3872	Project 2		0	6
		0,0150	Project 4	✓	12	24
	Details	0,1605				48
		0,1304	Project 1		0	12
		0,0150	Project 4	✓	12	24
		0,0120	Project 3		12	12
		0,0031	Project 5		36	12
	Details	0,1574				36
		0,1304	Project 1		0	12
		0,0150	Project 4	✓	12	24
		0,0120	Project 3		12	12
	Details	0,1485				48
		0,1304	Project 1		0	12
		0,0150	Project 4	✓	12	24
		0,0031	Project 5		36	12
	Details	0,1454				36
		0,1304	Project 1		0	12
		0,0150	Project 4	✓	12	24

Fig. 5.14. Possibilities for the selection of the projects in portfolio 2

Project	Project constraints			
	Total Risk Budget	Total Investment Budget	Total Labor Budget	Total Budget
Project 1	32	163	1.270	1.465
Project 2	37	17	375	429
Project 4	798	3.811	5.493	10.102
Project 3	36	49	1.154	1.239
Project 5	33	56	1.636	1.725
Total	**936**	**4.096**	**9.928**	**14.024**
BSC Target	**min 0**	**min 0**	**min 0**	**max 12.000**
Status				

Fig. 5.15. Constraint being not fulfilled in portfolio 2

In reality this issue was experienced and brought to the decision makers' attention. They then decided that the budget constraint could be relieved up to the level required, and therefore the first option showed in figure 5.14 was chosen for planning the portfolio.

5.2.2 The Planning process

The planning process follows identical steps already outlined in section 5.1.3 for portfolio 2. Therefore, the detailed description is not repeated, but the information regarding the planning is shown here:

- the development of the option value of this portfolio is shown in the tables 5.25 to 5.30
- the planned development of the BSC-values in P_1 is shown in the tables 5.31 to 5.34
- the planned development of the BSC-values in P_2 is shown in the tables 5.35 and 5.36
- the planned development of the BSC-values in P_3 is shown in the tables 5.37 and 5.38
- the planned development of the BSC-values in P_4 is shown in the tables 5.39 and 5.40
- the planned development of the BSC-values in P_5 is shown in the tables 5.41 and 5.42
- the planned costs for P_1 to P_5 are represented in the tables 5.43 through 5.48
- the cost including inflation and tax reduction from depreciation for portfolio 2 is shown in the tables 5.49 to 5.53

Project	Period												
	6	7	8	9	10	11	12	13	14	15	16	17	18
P1							0,0001	0,0006	0,0013	0,0022	0,0034	0,0049	0,0066
P2	0,0005	0,0018	0,0040	0,0071	0,0110	0,0156	0,0211	0,0272	0,0341	0,0417	0,0500	0,0589	0,0685
P3													
P4													
P5													
Total	0,0005	0,0018	0,0040	0,0071	0,0110	0,0156	0,0212	0,0278	0,0354	0,0439	0,0534	0,0638	0,0750

Table 5.25. Development of the option value in project portfolio 2 1/6

Project	Period												
	19	20	21	22	23	24	25	26	27	28	29	30	31
P1	0,0085	0,0107	0,0130	0,0156	0,0184	0,0214	0,0245	0,0279	0,0314	0,0351	0,0390	0,0430	0,0472
P2	0,0786	0,0893	0,1006	0,1125	0,1249	0,1377	0,1511	0,1650	0,1792	0,1940	0,2091	0,2247	0,2406
P3							0,0001	0,0001	0,0002	0,0003	0,0004	0,0006	0,0008
P4													
P5													
Total	0,0871	0,1000	0,1137	0,1281	0,1433	0,1591	0,1757	0,1930	0,2109	0,2294	0,2485	0,2683	0,2885

Table 5.26. Development of the option value in project portfolio 2 2/6

Project	Period												
	32	33	34	35	36	37	38	39	40	41	42	43	44
P1	0,0515	0,0560	0,0606	0,0653	0,0701	0,0751	0,0802	0,0854	0,0907	0,0961	0,1016	0,1072	0,1129
P2	0,2569	0,2735	0,2905	0,3078	0,3254	0,3433	0,3615	0,3799	0,3986	0,3872	0,3872	0,3872	0,3872
P3	0,0010	0,0012	0,0014	0,0017	0,0020	0,0022	0,0026	0,0029	0,0032	0,0036	0,0039	0,0043	0,0047
P4						0,0001	0,0001	0,0003	0,0004	0,0006	0,0008	0,0010	0,0012
P5													
Total	0,3094	0,3307	0,3525	0,3748	0,3975	0,4207	0,4444	0,4685	0,4929	0,4874	0,4935	0,4997	0,5060

Table 5.27. Development of the option value in project portfolio 2 3/6

Project	Period												
	45	46	47	48	49	50	51	52	53	54	55	56	57
P1	0,1186	0,1245	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304
P2	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872
P3	0,0051	0,0056	0,0060	0,0064	0,0069	0,0074	0,0078	0,0083	0,0088	0,0093	0,0098	0,0103	0,0109
P4	0,0015	0,0018	0,0021	0,0025	0,0028	0,0032	0,0036	0,0040	0,0045	0,0050	0,0054	0,0059	0,0065
P5							0,0001	0,0001	0,0001	0,0002	0,0002	0,0003	0,0003
Total	0,5124	0,5190	0,5257	0,5264	0,5273	0,5282	0,5291	0,5300	0,5310	0,5320	0,5330	0,5341	0,5352

Table 5.28. Development of the option value in project portfolio 2 4/6

Project	Period												
	58	59	60	61	62	63	64	65	66	67	68	69	70
P1	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304
P2	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872
P3	0,0114	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120
P4	0,0070	0,0075	0,0081	0,0087	0,0092	0,0098	0,0105	0,0111	0,0117	0,0124	0,0130	0,0137	0,0143
P5	0,0004	0,0004	0,0005	0,0006	0,0007	0,0008	0,0008	0,0009	0,0010	0,0011	0,0012	0,0013	0,0015
Total	0,5363	0,5375	0,5381	0,5388	0,5394	0,5401	0,5408	0,5415	0,5422	0,5430	0,5438	0,5445	0,5453

Table 5.29. Development of the option value in project portfolio 2 5/6

Project	Period												
	71	72	73	74	75	76	77	78	79	80	81	82	83
P1	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304	0,1304
P2	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872	0,3872
P3	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120	0,0120
P4	0,0150	0,0150	0,0150	0,0150	0,0150	0,0150	0,0150	0,0150	0,0150	0,0150	0,0150	0,0150	0,0150
P5	0,0016	0,0017	0,0018	0,0019	0,0021	0,0022	0,0023	0,0024	0,0026	0,0027	0,0029	0,0030	0,0031
Total	0,5461	0,5462	0,5463	0,5465	0,5466	0,5467	0,5468	0,5470	0,5471	0,5472	0,5474	0,5475	0,5477

Table 5.30. Development of the option value in project portfolio 2 6/6

BSC Value		Period																	
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
IT investments	low	2	5	7	9	12	14	17	19	21	24	26	28	31	33	35	38	40	42
	probable	3	6	8	11	14	16	19	22	25	27	30	33	36	38	41	44	47	50
	high	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
	adjusted	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50
Labor cost	low	14	28	42	57	71	85	99	113	128	142	156	170	184	198	213	227	241	255
	probable	16	33	50	66	82	99	115	132	148	165	181	198	214	231	248	264	280	297
	high	18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324
	adjusted	17	33	50	67	83	100	117	133	150	167	183	200	217	233	250	267	283	300
Non-retail revenue	low	2	5	7	9	12	14	17	19	21	24	26	28	31	33	35	38	40	42
	probable	3	6	8	11	14	16	19	22	25	27	30	33	36	38	41	44	47	50
	high	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
	adjusted	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50
Retail revenue	low	14	28	42	57	71	85	99	113	128	142	156	170	184	198	213	227	241	255
	probable	16	33	50	66	82	99	115	132	148	165	181	198	214	231	248	264	280	297
	high	18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324
	adjusted	17	33	50	67	83	100	117	133	150	167	183	200	217	233	250	267	283	300
Treasury revenue	low	28	57	85	113	142	170	198	227	255	283	312	340	368	397	425	453	482	510
	probable	33	66	99	132	165	198	231	264	297	330	363	396	429	462	495	528	561	594
	high	36	72	108	144	180	216	252	288	324	360	396	432	468	504	540	576	612	648
	adjusted	33	67	100	133	167	200	233	267	300	333	367	400	433	467	500	533	567	600
Non-retail customer	low	2	5	7	9	12	14	17	19	21	24	26	28	31	33	35	38	40	42
	probable	3	6	8	11	14	16	19	22	25	27	30	33	36	38	41	44	47	50
	high	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
	adjusted	3	6	8	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50
Retail customer	low	118	236	354	472	590	708	826	944	1.062	1.181	1.299	1.417	1.535	1.653	1.771	1.889	2.007	2.125
	probable	138	275	412	550	687	825	962	1.100	1.238	1.375	1.512	1.650	1.788	1.925	2.062	2.200	2.337	2.475
	high	150	300	450	600	750	900	1.050	1.200	1.350	1.500	1.650	1.800	1.950	2.100	2.250	2.400	2.550	2.700
	adjusted	139	278	417	556	694	833	972	1.111	1.250	1.389	1.528	1.667	1.806	1.944	2.083	2.222	2.361	2.500

Table 5.31. Development of the BSC values in P_1 in portfolio 2 1/4

BSC Value		Period																	
		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
IT investments	low	45	47	50	52	54	57	59	61	64	66	68	71	73	76	78	80	83	100
	probable	52	55	58	60	63	66	69	71	74	77	80	82	85	88	91	94	96	100
	high	57	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	100
	adjusted	53	56	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100
Labor cost	low	269	283	298	312	326	340	354	368	383	397	411	425	439	453	468	482	496	600
	probable	313	330	346	363	379	396	412	429	446	462	478	495	512	528	544	561	577	600
	high	342	360	378	396	414	432	450	468	486	504	522	540	558	576	594	612	630	600
	adjusted	317	333	350	367	383	400	417	433	450	467	483	500	517	533	550	567	583	600
Non-retail revenue	low	45	47	50	52	54	57	59	61	64	66	68	71	73	76	78	80	83	100
	probable	52	55	58	60	63	66	69	71	74	77	80	82	85	88	91	94	96	100
	high	57	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	100
	adjusted	53	56	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100
Retail revenue	low	269	283	298	312	326	340	354	368	383	397	411	425	439	453	468	482	496	600
	probable	313	330	346	363	379	396	412	429	446	462	478	495	512	528	544	561	577	600
	high	342	360	378	396	414	432	450	468	486	504	522	540	558	576	594	612	630	600
	adjusted	317	333	350	367	383	400	417	433	450	467	483	500	517	533	550	567	583	600
Treasury revenue	low	538	567	595	623	652	680	708	737	765	793	822	850	878	907	935	963	992	1.200
	probable	627	660	693	726	759	792	825	858	891	924	957	990	1.023	1.056	1.089	1.122	1.155	1.200
	high	684	720	756	792	828	864	900	936	972	1.008	1.044	1.080	1.116	1.152	1.188	1.224	1.260	1.200
	adjusted	633	667	700	733	767	800	833	867	900	933	967	1.000	1.033	1.067	1.100	1.133	1.167	1.200
Non-retail customer	low	45	47	50	52	54	57	59	61	64	66	68	71	73	76	78	80	83	100
	probable	52	55	58	60	63	66	69	71	74	77	80	82	85	88	91	94	96	100
	high	57	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	100
	adjusted	53	56	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100
Retail customer	low	2.243	2.361	2.479	2.597	2.715	2.833	2.951	3.069	3.188	3.306	3.424	3.542	3.660	3.778	3.896	4.014	4.132	5.000
	probable	2.612	2.750	2.888	3.025	3.162	3.300	3.438	3.575	3.712	3.850	3.988	4.125	4.262	4.400	4.538	4.675	4.812	5.000
	high	2.850	3.000	3.150	3.300	3.450	3.600	3.750	3.900	4.050	4.200	4.350	4.500	4.650	4.800	4.950	5.100	5.250	5.000
	adjusted	2.639	2.778	2.917	3.056	3.194	3.333	3.472	3.611	3.750	3.889	4.028	4.167	4.306	4.444	4.583	4.722	4.861	5.000

Table 5.32. Development of the BSC values in P_1 in portfolio 2 2/4

BSC Value		Period																	
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Customer satisfaction rating	low											1	1	1	1	1	1	1	1
	probable										1	1	1	1	1	1	1	1	1
	high									1	1	1	1	1	1	1	1	1	1
	adjusted										1	1	1	1	1	1	1	1	1
Duration of non-retail applications	low				1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
	probable				1	1	1	1	1	1	2	2	2	2	2	2	3	3	3
	high			1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
	adjusted				1	1	1	1	1	2	2	2	2	2	2	2	3	3	3
Number of resources for non-retail applications	low						1	1	1	1	1	1	1	1	1	1	2	2	2
	probable					1	1	1	1	1	1	1	1	1	2	2	2	2	2
	high					1	1	1	1	1	1	1	1	2	2	2	2	2	2
	adjusted					1	1	1	1	1	1	1	1	1	2	2	2	2	2
Duration of retail applications	low			1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4
	probable		1	1	1	1	2	2	2	2	3	3	3	4	4	4	4	5	5
	high		1	1	1	2	2	2	2	3	3	3	4	4	4	5	5	5	5
	adjusted		1	1	1	1	2	2	2	2	3	3	3	4	4	4	4	5	5
Number of resources for retail applications	low	1	2	3	4	5	6	7	8	8	9	10	11	12	13	14	15	16	17
	probable	1	2	3	4	6	7	8	9	10	11	12	13	14	15	16	18	19	20
	high	1	2	4	5	6	7	8	10	11	12	13	14	16	17	18	19	20	22
	adjusted	1	2	3	4	6	7	8	9	10	11	12	13	14	16	17	18	19	20
Degree of automatization of retail processes	low		1%	1%	2%	2%	3%	3%	4%	4%	5%	5%	6%	6%	7%	7%	8%	8%	8%
	probable		1%	1%	2%	2%	3%	3%	4%	5%	5%	6%	6%	7%	7%	8%	9%	9%	10%
	high			1%	1%	3%	3%	4%	4%	5%	5%	6%	7%	8%	8%	9%	9%	10%	11%
	adjusted		1%	1%	2%	2%	3%	3%	4%	5%	5%	6%	6%	7%	7%	8%	9%	9%	10%
Training hours	low	354	708	1.062	1.417	1.771	2.125	2.479	2.833	3.188	3.542	3.896	4.250	4.604	4.958	5.312	5.667	6.021	6.375
	probable	412	825	1.238	1.650	2.062	2.475	2.887	3.300	3.712	4.125	4.538	4.950	5.362	5.775	6.188	6.600	7.012	7.425
	high	450	900	1.350	1.800	2.250	2.700	3.150	3.600	4.050	4.500	4.950	5.400	5.850	6.300	6.750	7.200	7.650	8.100
	adjusted	417	833	1.250	1.667	2.083	2.500	2.917	3.333	3.750	4.167	4.583	5.000	5.417	5.833	6.250	6.667	7.083	7.500

Table 5.33. Development of the BSC values in P_1 in portfolio 2 3/4

BSC Value		Period																	
		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Customer satisfaction rating	low	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	probable	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
	high	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
	adjusted	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
Duration of non-retail applications	low	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5	6
	probable	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	6	6	6
	high	3	4	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6	6
	adjusted	3	3	4	4	4	4	4	4	4	5	5	5	5	5	6	6	6	6
Number of resources for non-retail applications	low	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	4
	probable	2	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4	4
	high	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4
	adjusted	2	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4	4
Duration of retail applications	low	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	10
	probable	5	6	6	6	6	7	7	7	7	8	8	8	9	9	9	9	10	10
	high	6	6	6	7	7	7	8	8	8	8	9	9	9	10	10	10	11	10
	adjusted	5	6	6	6	6	7	7	7	8	8	8	8	9	9	9	9	10	10
Number of resources for retail applications	low	18	19	20	21	22	23	24	25	26	26	27	28	29	30	31	32	33	40
	probable	21	22	23	24	25	26	27	29	30	31	32	33	34	35	36	37	38	40
	high	23	24	25	26	28	29	30	31	32	34	35	36	37	38	40	41	42	40
	adjusted	21	22	23	24	26	27	28	29	30	31	32	33	34	36	37	38	39	40
Degree of automatization of retail processes	low	9%	9%	10%	10%	11%	11%	12%	12%	13%	13%	14%	14%	15%	15%	16%	16%	17%	20%
	probable	10%	11%	11%	12%	13%	13%	14%	14%	15%	15%	16%	17%	17%	18%	18%	19%	19%	20%
	high	12%	13%	13%	14%	14%	15%	15%	17%	17%	18%	18%	19%	19%	20%	21%	22%	22%	20%
	adjusted	10%	11%	11%	12%	13%	13%	14%	14%	15%	15%	16%	17%	17%	18%	18%	19%	19%	20%
Training hours	low	6.729	7.083	7.438	7.792	8.146	8.500	8.854	9.208	9.562	9.917	10.271	10.625	10.979	11.333	11.688	12.042	12.396	15.000
	probable	7.838	8.250	8.662	9.075	9.487	9.900	10.312	10.725	11.138	11.550	11.962	12.375	12.787	13.200	13.612	14.025	14.437	15.000
	high	8.550	9.000	9.450	9.900	10.350	10.800	11.250	11.700	12.150	12.600	13.050	13.500	13.950	14.400	14.850	15.300	15.750	15.000
	adjusted	7.917	8.333	8.750	9.167	9.583	10.000	10.417	10.833	11.250	11.667	12.083	12.500	12.917	13.333	13.750	14.167	14.583	15.000

Table 5.34. Development of the BSC values in P_1 in portfolio 2 4/4

BSC Value		Period																	
		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Retail revenue	low	71	142	212	283	354	425	496	567	638	708	779	850	921	992	1.062	1.133	1.204	1.275
	probable	165	248	330	412	495	577	660	742	825	908	990	1.072	1.155	1.238	1.320	1.402	1.485	
	high	180	270	360	450	540	630	720	810	900	990	1.080	1.170	1.260	1.350	1.440	1.530	1.620	
	adjusted	167	250	333	417	500	583	667	750	833	917	1.000	1.083	1.167	1.250	1.333	1.417	1.500	
Market rating	low				1	1	1	1	1	1	1	1	2	2	2	2	2	2	
	probable			1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	
	high			1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	
	adjusted			1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	
Retail customer	low	3.211	4.817	6.422	8.028	9.633	11.239	12.844	14.450	16.056	17.661	19.267	20.872	22.478	24.083	25.689	27.294	28.900	
	probable	3.740	5.610	7.480	9.350	11.220	13.090	14.960	16.830	18.700	20.570	22.440	24.310	26.180	28.050	29.920	31.790	33.660	
	high	4.080	6.120	8.160	10.200	12.240	14.280	16.320	18.360	20.400	22.440	24.480	26.520	28.560	30.600	32.640	34.680	36.720	
	adjusted	3.778	5.667	7.556	9.444	11.333	13.222	15.111	17.000	18.889	20.778	22.667	24.556	26.444	28.333	30.222	32.111	34.000	
Customer satisfaction rating	low				1	1	1	1	1	1	1	1	2	2	2	2	2	2	
	probable			1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	
	high			1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	
	adjusted			1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	
Percentage deals/offers	low		1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	
	probable	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%	
	high	1%	1%	1%	2%	2%	2%	2%	3%	4%	3%	4%	4%	5%	4%	5%	5%	6%	
	adjusted	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%	
Products per customer	low								1	1	1	1	1	1	1	1	1	1	1
	probable			1	1	1	1	1		1	1	1	1	1	1	2	2	2	2
	high						1	1	1	1	1	1	1	1	1	1	1	1	2
	adjusted						1	1	1	1	1	1	1	1	1	1	1	1	2
Retail customers lost	low	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	8	
	probable	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	
	high	1	2	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	
	adjusted	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	
Product profitability	low		1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	
	probable	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%	
	high	1%	1%	1%	2%	2%	2%	2%	3%	4%	3%	4%	4%	5%	4%	5%	5%	6%	
	adjusted	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%	

Table 5.35. Development of the BSC values in P_2 in portfolio 2 1/2

BSC Value		Period																	
		24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Retail revenue	low	1.346	1.417	1.488	1.558	1.629	1.700	1.771	1.842	1.912	1.983	2.054	2.125	2.196	2.267	2.338	2.408	2.479	3.000
	probable	1.568	1.650	1.732	1.815	1.898	1.980	2.062	2.145	2.228	2.310	2.392	2.475	2.557	2.640	2.722	2.805	2.888	3.000
	high	1.710	1.800	1.890	1.980	2.070	2.160	2.250	2.340	2.430	2.520	2.610	2.700	2.790	2.880	2.970	3.060	3.150	3.000
	adjusted	1.583	1.667	1.750	1.833	1.917	2.000	2.083	2.167	2.250	2.333	2.417	2.500	2.583	2.667	2.750	2.833	2.917	3.000
Market rating	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Retail customer	low	30.506	32.111	33.717	35.322	36.928	38.533	40.139	41.744	43.350	44.956	46.561	48.167	49.772	51.378	52.983	54.589	56.194	68.000
	probable	35.530	37.400	39.270	41.140	43.010	44.880	46.750	48.620	50.490	52.360	54.230	56.100	57.970	59.840	61.710	63.580	65.450	68.000
	high	38.760	40.800	42.840	44.880	46.920	48.960	51.000	53.040	55.080	57.120	59.160	61.200	63.240	65.280	67.320	69.360	71.400	68.000
	adjusted	35.889	37.778	39.667	41.556	43.444	45.333	47.222	49.111	51.000	52.889	54.778	56.667	58.556	60.444	62.333	64.222	66.111	68.000
Customer satisfaction rating	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Percentage deals/offers	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
	high	7%	6%	7%	7%	8%	7%	8%	8%	9%	9%	9%	10%	10%	10%	10%	11%	11%	10%
	adjusted	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
Products per customer	low	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
	probable	2	2	3	2	2	2	2	2	3	3	3	3	3	3	4	4	4	3
	high	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	adjusted	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
Retail customers lost	low	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	20
	probable	10	11	12	12	13	13	14	14	15	15	16	16	17	18	18	19	19	20
	high	11	12	13	13	14	14	15	16	16	17	17	18	19	19	20	20	21	20
	adjusted	11	11	12	12	13	13	14	14	15	16	16	17	17	18	18	19	19	20
Product profitability	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
	high	7%	6%	7%	7%	8%	7%	8%	8%	9%	9%	9%	10%	10%	10%	10%	11%	11%	10%
	adjusted	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%

Table 5.36. Development of the BSC values in P_2 in portfolio 2 2/2

BSC Value		Period																	
		24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Non-retail revenue	low	9	19	28	38	47	57	66	76	85	94	104	113	123	132	142	151	161	170
	probable	11	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198
	high	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216
	adjusted	11	22	33	44	56	67	78	89	100	111	122	133	144	156	167	178	189	200
Retail revenue	low	14	28	42	57	71	85	99	113	128	142	156	170	184	198	213	227	241	255
	probable	16	33	50	66	82	99	115	132	148	165	181	198	214	231	248	264	280	297
	high	18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324
	adjusted	17	33	50	67	83	100	117	133	150	167	183	200	217	233	250	267	283	300
Efficiency of non-retail collection	low		1%	1%	2%	2%	3%	3%	4%	4%	5%	5%	6%	6%	7%	7%	8%	8%	8%
	probable	1%	1%	2%	2%	3%	3%	4%	4%	5%	6%	6%	7%	7%	8%	8%	9%	9%	10%
	high	1%	1%	2%	2%	4%	4%	5%	5%	6%	6%	7%	7%	8%	9%	10%	10%	11%	12%
	adjusted	1%	1%	2%	2%	3%	3%	4%	4%	5%	6%	6%	7%	7%	8%	8%	9%	9%	10%
Efficiency of retail collection	low	1%	2%	3%	4%	5%	6%	7%	8%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%
	probable	1%	2%	3%	4%	6%	7%	8%	9%	10%	11%	12%	13%	14%	16%	17%	18%	19%	20%
	high	1%	2%	4%	5%	6%	7%	9%	10%	12%	13%	14%	16%	17%	18%	19%	21%	22%	23%
	adjusted	1%	2%	3%	4%	6%	7%	8%	9%	10%	11%	12%	13%	14%	16%	17%	18%	19%	20%
Training hours	low	12	24	35	47	59	71	83	94	106	118	130	142	153	165	177	189	201	212
	probable	14	27	41	55	69	82	96	110	124	138	151	165	179	192	206	220	234	248
	high	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270
	adjusted	14	28	42	56	69	83	97	111	125	139	153	167	181	194	208	222	236	250

Table 5.37. Development of the BSC values in P_3 in portfolio 2 1/2

BSC Value		Period																	
		42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Non-retail revenue	low	179	189	198	208	217	227	236	246	255	264	274	283	293	302	312	321	331	400
	probable	209	220	231	242	253	264	275	286	297	308	319	330	341	352	363	374	385	400
	high	228	240	252	264	276	288	300	312	324	336	348	360	372	384	396	408	420	400
	adjusted	211	222	233	244	256	267	278	289	300	311	322	333	344	356	367	378	389	400
Retail revenue	low	269	283	298	312	326	340	354	368	383	397	411	425	439	453	468	482	496	600
	probable	313	330	346	363	379	396	412	429	446	462	478	495	512	528	544	561	577	600
	high	342	360	378	396	414	432	450	468	486	504	522	540	558	576	594	612	630	600
	adjusted	317	333	350	367	383	400	417	433	450	467	483	500	517	533	550	567	583	600
Efficiency of non-retail collection	low	9%	9%	10%	10%	11%	11%	12%	12%	13%	13%	14%	14%	15%	15%	16%	16%	17%	20%
	probable	11%	11%	12%	12%	13%	13%	14%	14%	15%	16%	16%	17%	17%	18%	18%	19%	19%	20%
	high	12%	13%	13%	14%	15%	16%	16%	17%	17%	18%	18%	19%	19%	21%	21%	22%	22%	20%
	adjusted	11%	11%	12%	12%	13%	13%	14%	14%	15%	16%	16%	17%	17%	18%	18%	19%	19%	20%
Efficiency of retail collection	low	18%	19%	20%	21%	22%	23%	24%	25%	26%	26%	27%	28%	29%	30%	31%	32%	33%	40%
	probable	21%	22%	23%	24%	26%	27%	28%	29%	30%	31%	32%	33%	34%	36%	37%	38%	39%	40%
	high	24%	25%	27%	28%	29%	30%	32%	33%	34%	36%	37%	39%	40%	41%	42%	44%	45%	40%
	adjusted	21%	22%	23%	24%	26%	27%	28%	29%	30%	31%	32%	33%	34%	36%	37%	38%	39%	40%
Training hours	low	224	236	248	260	272	283	295	307	319	331	342	354	366	378	390	401	413	500
	probable	261	275	289	302	316	330	344	357	371	385	399	412	426	440	454	467	481	500
	high	285	300	315	330	345	360	375	390	405	420	435	450	465	480	495	510	525	500
	adjusted	264	278	292	306	319	333	347	361	375	389	403	417	431	444	458	472	486	500

Table 5.38. Development of the BSC values in P_3 in portfolio 2 2/2

BSC Value		Period																	
		36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
Non-retail revenue	low	5	9	14	19	24	28	33	38	42	47	52	57	61	66	71	76	80	85
	probable	6	11	16	22	27	33	38	44	50	55	60	66	71	77	82	88	94	99
	high	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108
	adjusted	6	11	17	22	28	33	39	44	50	56	61	67	72	78	83	89	94	100
Retail revenue	low	5	9	14	19	24	28	33	38	42	47	52	57	61	66	71	76	80	85
	probable	6	11	16	22	27	33	38	44	50	55	60	66	71	77	82	88	94	99
	high	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108
	adjusted	6	11	17	22	28	33	39	44	50	56	61	67	72	78	83	89	94	100
Market rating	low					1	1	1	1	1	1	1	1	2	2	2	2	2	2
	probable				1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	high				1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
	adjusted				1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Duration of non-retail applications	low					1	1	1	1	1	1	1	1	2	2	2	2	2	2
	probable				1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	high				1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
	adjusted				1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Efficiency of non-retail collection	low			1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%
	probable		1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%
	high	1%	1%	1%	1%	2%	2%	2%	2%	3%	4%	3%	4%	4%	5%	4%	5%	5%	6%
	adjusted		1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%
Duration of retail applications	low					1	1	1	1	1	1	1	1	2	2	2	2	2	2
	probable				1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	high				1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
	adjusted				1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Efficiency of retail collection	low			1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%
	probable		1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%
	high	1%	1%	1%	1%	2%	2%	2%	2%	3%	4%	3%	4%	4%	5%	4%	5%	5%	6%
	adjusted		1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%
Degree of automatization of retail processes	low			1%	1%	1%	1%	2%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%
	probable		1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%
	high	1%	1%	1%	1%	2%	2%	2%	2%	3%	4%	3%	4%	4%	5%	4%	5%	5%	6%
	adjusted		1%	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	4%	4%	4%	4%	5%	5%
Training hours	low	189	378	567	756	944	1.133	1.322	1.511	1.700	1.889	2.078	2.267	2.456	2.644	2.833	3.022	3.211	3.400
	probable	220	440	660	880	1.100	1.320	1.540	1.760	1.980	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.960
	high	240	480	720	960	1.200	1.440	1.680	1.920	2.160	2.400	2.640	2.880	3.120	3.360	3.600	3.840	4.080	4.320
	adjusted	222	444	667	889	1.111	1.333	1.556	1.778	2.000	2.222	2.444	2.667	2.889	3.111	3.333	3.556	3.778	4.000

Table 5.39. Development of the BSC values in P_4 in portfolio 2 1/2

BSC Value		Period																	
		54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Non-retail revenue	low	90	94	99	104	109	113	118	123	128	132	137	142	146	151	156	161	165	200
	probable	104	110	116	121	126	132	138	143	148	154	159	165	170	176	182	187	192	200
	high	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210	200
	adjusted	106	111	117	122	128	133	139	144	150	156	161	167	172	178	183	189	194	200
Retail revenue	low	90	94	99	104	109	113	118	123	128	132	137	142	146	151	156	161	165	200
	probable	104	110	116	121	126	132	138	143	148	154	159	165	170	176	182	187	192	200
	high	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210	200
	adjusted	106	111	117	122	128	133	139	144	150	156	161	167	172	178	183	189	194	200
Market rating	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Duration of non-retail applications	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Efficiency of non-retail collection	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
	high	7%	6%	7%	7%	8%	7%	8%	8%	9%	9%	9%	10%	10%	10%	10%	11%	11%	10%
	adjusted	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
Duration of retail applications	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Efficiency of retail collection	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
	high	7%	6%	7%	7%	8%	7%	8%	8%	9%	9%	9%	10%	10%	10%	10%	11%	11%	10%
	adjusted	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
Degree of automatization of retail processes	low	4%	5%	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	8%	10%
	probable	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
	high	7%	6%	7%	7%	8%	7%	8%	8%	9%	9%	9%	10%	10%	10%	10%	11%	11%	10%
	adjusted	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	9%	10%	10%
Training hours	low	3.589	3.778	3.967	4.156	4.344	4.533	4.722	4.911	5.100	5.289	5.478	5.667	5.856	6.044	6.233	6.422	6.611	8.000
	probable	4.180	4.400	4.620	4.840	5.060	5.280	5.500	5.720	5.940	6.160	6.380	6.600	6.820	7.040	7.260	7.480	7.700	8.000
	high	4.560	4.800	5.040	5.280	5.520	5.760	6.000	6.240	6.480	6.720	6.960	7.200	7.440	7.680	7.920	8.160	8.400	8.000
	adjusted	4.222	4.444	4.667	4.889	5.111	5.333	5.556	5.778	6.000	6.222	6.444	6.667	6.889	7.111	7.333	7.556	7.778	8.000

Table 5.40. Development of the BSC values in P_4 in portfolio 2 2/2

BSC Value		Period 48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
Retail revenue	low	9	19	28	38	47	57	66	76	85	94	104	113	123	132	142	151	161	170
	probable	11	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198
	high	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216
	adjusted	11	22	33	44	56	67	78	89	100	111	122	133	144	156	167	178	189	200
Degree of automatization of retail processes	low		1%	1%	1%	2%	2%	2%	3%	3%	4%	4%	4%	5%	5%	5%	6%	6%	6%
	probable		1%	1%	2%	2%	3%	3%	3%	4%	4%	5%	5%	5%	6%	6%	7%	7%	8%
	high	1%	1%	2%	2%	2%	3%	4%	4%	5%	4%	5%	6%	6%	7%	8%	7%	8%	9%
	adjusted		1%	1%	2%	2%	3%	3%	3%	4%	4%	5%	5%	5%	6%	6%	7%	7%	8%
Turnover rate	low					1	1	1	1	1	1	1	1	2	2	2	2	2	2
	probable				1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	high				1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
	adjusted				1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Training hours	low	47	94	142	189	236	283	331	378	425	472	519	567	614	661	708	756	803	850
	probable	55	110	165	220	275	330	385	440	495	550	605	660	715	770	825	880	935	990
	high	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900	960	1.020	1.080
	adjusted	56	111	167	222	278	333	389	444	500	556	611	667	722	778	833	889	944	1.000

Table 5.41. Development of the BSC values in P_5 in portfolio 2 1/2

BSC Value		Period 66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
Retail revenue	low	179	189	198	208	217	227	236	246	255	264	274	283	293	302	312	321	331	400
	probable	209	220	231	242	253	264	275	286	297	308	319	330	341	352	363	374	385	400
	high	228	240	252	264	276	288	300	312	324	336	348	360	372	384	396	408	420	400
	adjusted	211	222	233	244	256	267	278	289	300	311	322	333	344	356	367	378	389	400
Degree of automatization of retail processes	low	7%	7%	7%	8%	8%	8%	9%	9%	10%	10%	10%	11%	11%	11%	12%	12%	12%	15%
	probable	8%	8%	9%	9%	10%	10%	10%	11%	11%	12%	12%	13%	13%	13%	14%	14%	15%	15%
	high	9%	10%	11%	10%	11%	12%	12%	13%	13%	13%	14%	14%	15%	16%	16%	16%	17%	15%
	adjusted	8%	8%	9%	9%	10%	10%	10%	11%	11%	12%	12%	13%	13%	13%	14%	14%	15%	15%
Turnover rate	low	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5
	probable	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
	high	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5
	adjusted	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Training hours	low	897	944	992	1.039	1.086	1.133	1.181	1.228	1.275	1.322	1.369	1.417	1.464	1.511	1.558	1.606	1.653	2.000
	probable	1.045	1.100	1.155	1.210	1.265	1.320	1.375	1.430	1.485	1.540	1.595	1.650	1.705	1.760	1.815	1.870	1.925	2.000
	high	1.140	1.200	1.260	1.320	1.380	1.440	1.500	1.560	1.620	1.680	1.740	1.800	1.860	1.920	1.980	2.040	2.100	2.000
	adjusted	1.056	1.111	1.167	1.222	1.278	1.333	1.389	1.444	1.500	1.556	1.611	1.667	1.722	1.778	1.833	1.889	1.944	2.000

Table 5.42. Development of the BSC values in P_5 in portfolio 2 2/2

	0	1	2	3	4	5	6	7	8	9	10	11	Total
Investments	23	1	8	11	18	7	24	25	14	7	15	11	164
Labor	1	134	54	144	127	184	196	53	119	75	135	49	1.271
Risks	2	2	4	2	1	2	3	3	3	4	3	4	33
Total	26	137	66	157	146	193	223	81	136	86	153	64	1.468

Table 5.43. Costs per period for P_1 in project portfolio 2

	0	1	2	3	4	5	Total
Investments	5	2	3	2	2	4	18
Labor	55	55	45	101	16	103	375
Risks	7	8	7	2	5	7	36
Total	67	65	55	105	23	114	429

Table 5.44. Costs per period for P_2 in project portfolio 2

	12	13	14	15	16	17	18	19	20	21	22	23	Total
Investments	0	9	5	1	0	3	7	4	5	8	3	4	49
Labor	145	113	159	105	30	126	105	1	115	39	79	138	1.155
Risks	3	4	3	5	2	2	1	4	3	4	2	4	37
Total	148	126	167	111	32	131	113	9	123	51	84	146	1.241

Table 5.45. Costs per period for P_3 in project portfolio 2

	12	13	14	15	16	17	18	19	20	21	22	23
Investments	244	154	9	35	267	32	118	47	185	129	74	252
Labor	130	955	92	228	457	90	70	33	546	147	353	204
Risks	4	32	28	22	50	14	46	24	11	71	0	14
Total	378	1.141	129	285	774	136	234	104	742	347	427	470

Table 5.46. Costs per period for P_4 in project portfolio 2 1/2

	24	25	26	27	28	29	30	31	32	33	34	35	Total
Investments	92	249	126	111	61	284	163	282	258	139	224	275	3.810
Labor	287	32	40	465	122	38	183	334	43	120	227	299	5.495
Risks	25	44	69	74	43	12	20	47	28	34	75	10	797
Total	404	325	235	650	226	334	366	663	329	293	526	584	10.102

Table 5.47. Costs per period for P_4 in project portfolio 2 2/2

	36	37	38	39	40	41	42	43	44	45	46	47	Total
Investments	2	2	5	3	5	4	8	1	6	4	6	9	55
Labor	204	198	242	88	149	163	177	24	225	131	9	26	1.636
Risks	1	1	5	0	2	3	4	5	2	3	4	4	34
Total	207	201	252	91	156	170	189	30	233	138	19	39	1.725

Table 5.48. Costs per period for P_5 in project portfolio 2

The graphical representation of the development of the BSC contribution values is shown in figure 5.16 – for the matter of clarity the development is shown with five selected periods.

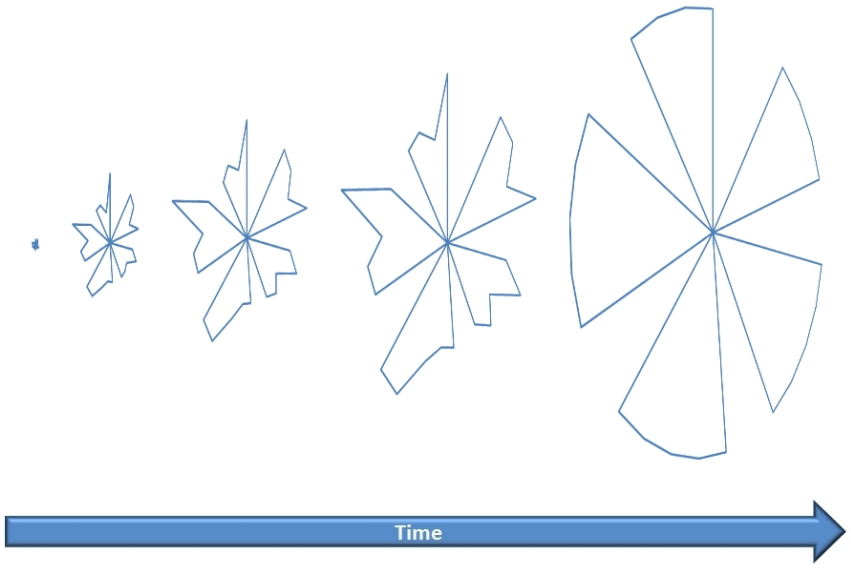


Fig. 5.16. Graphical representation of the development of the BSC contribution values in portfolio 2

5.2.3 Snapshot 1

The first snapshot of project portfolio 2 is obtained in period 16. P_1 has finished 16,5% over budget (actuals of 1.709 instead of 1.468 planned) and with a delay of two months which delayed the start of the projects P_3 and P_4 accordingly.

Project		Period 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Project 1	Costs	26	163	229	386	532	725	948	1.029	1.165	1.251	1.404	1.468	1.468	1.468	1.468	1.468	1.468
	+ Inflation		1	1	4	7	12	19	24	31	37	47	54	54	54	54	54	54
	- Tax Reduction due to depreciation													12	24	37	49	61
	= Subtotal	26	164	230	390	539	737	967	1.053	1.196	1.288	1.451	1.522	1.509	1.497	1.485	1.473	1.460
Project 2	Costs	67	132	187	292	315	429	429	429	429	429	429	429	429	429	429	429	429
	+ Inflation			1	3	4	7	7	7	7	7	7	7	7	7	7	7	7
	- Tax Reduction due to depreciation							4	7	11	14	18	21	25	29	32	36	39
	= Subtotal	67	132	188	295	319	436	432	428	425	421	418	414	411	407	403	400	396
Project 3	Costs													148	274	441	552	584
	+ Inflation													6	12	21	27	31
	- Tax Reduction due to depreciation																	
	= Subtotal												154	286	462	579	615	
Project 4	Costs													378	1.519	1.648	1.933	2.707
	+ Inflation													15	66	76	95	141
	- Tax Reduction due to depreciation																	
	= Subtotal												393	1.585	1.724	2.028	2.848	
Project 5	Costs																	
	+ Inflation																	
	- Tax Reduction due to depreciation																	
	= Subtotal																	
Total		93	296	419	684	858	1.173	1.399	1.481	1.621	1.710	1.868	1.936	2.467	3.774	4.073	4.479	5.319

Table 5.49. Cost including inflation and tax reduction out of depreciation for portfolio 2 1/5

Project		Period 17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Project 1	Costs	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468
	+ Inflation	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	- Tax Reduction due to depreciation	73	86	98	110	122	135	147	159	171	183	196	208	220	232	245	257	269
	= Subtotal	1.448	1.436	1.424	1.411	1.399	1.387	1.375	1.362	1.350	1.338	1.326	1.314	1.301	1.289	1.277	1.265	1.252
Project 2	Costs	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429
	+ Inflation	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	- Tax Reduction due to depreciation	43	46	50	54	57	61	64	68	72	75	79	82	86	89	93	97	100
	= Subtotal	393	389	386	382	378	375	371	368	364	361	357	353	350	346	343	339	335
Project 3	Costs	715	828	837	960	1.011	1.095	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241
	+ Inflation	41	50	53	64	71	81	96	96	96	96	96	96	96	96	96	96	96
	- Tax Reduction due to depreciation							10	21	31	41	52	62	72	83	93	103	
	= Subtotal	756	878	890	1.024	1.082	1.176	1.337	1.326	1.316	1.306	1.295	1.285	1.275	1.264	1.254	1.244	1.233
Project 4	Costs	2.843	3.077	3.181	3.923	4.270	4.697	5.167	5.571	5.896	6.131	6.781	7.007	7.341	7.707	8.370	8.699	8.992
	+ Inflation	157	178	193	254	287	334	386	435	478	513	588	629	685	746	839	901	961
	- Tax Reduction due to depreciation																	
	= Subtotal	3.000	3.255	3.374	4.177	4.557	5.031	5.553	6.006	6.374	6.644	7.369	7.636	8.026	8.453	9.209	9.600	9.953
Project 5	Costs																	
	+ Inflation																	
	- Tax Reduction due to depreciation																	
	= Subtotal																	
Total		5.596	5.958	6.074	6.995	7.417	7.968	8.636	9.062	9.405	9.648	10.347	10.587	10.952	11.352	12.082	12.448	12.774

Table 5.50. Cost including inflation and tax reduction out of depreciation for portfolio 2 2/5

Project		Period 34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Project 1	Costs	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468
	+ Inflation	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	- Tax Reduction due to depreciation	281	294	306	318	330	343	355	367	379	391	404	416	428	440	440	440	440
	= Subtotal	1.240	1.228	1.216	1.203	1.191	1.179	1.167	1.155	1.142	1.130	1.118	1.106	1.093	1.081	1.081	1.081	1.081
Project 2	Costs	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429
	+ Inflation	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	- Tax Reduction due to depreciation	104	107	111	114	118	122	125	129	129	129	129	129	129	129	129	129	129
	= Subtotal	332	328	325	321	318	314	310	307	307	307	307	307	307	307	307	307	307
Project 3	Costs	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241
	+ Inflation	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96
	- Tax Reduction due to depreciation	114	124	134	145	155	165	176	186	196	207	217	228	238	248	259	269	279
	= Subtotal	1.223	1.213	1.202	1.192	1.182	1.171	1.161	1.151	1.140	1.130	1.120	1.109	1.099	1.089	1.078	1.068	1.058
Project 4	Costs	9.518	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102
	+ Inflation	1.046	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149
	- Tax Reduction due to depreciation			84	168	253	337	421	505	589	673	758	842	926	1.010	1.094	1.179	1.263
	= Subtotal	10.564	11.251	11.167	11.083	10.999	10.915	10.831	10.746	10.662	10.578	10.494	10.410	10.325	10.241	10.157	10.073	9.989
Project 5	Costs			207	408	660	751	907	1.077	1.266	1.296	1.529	1.667	1.686	1.725	1.725	1.725	1.725
	+ Inflation			26	53	88	103	128	156	188	196	237	265	274	286	286	286	286
	- Tax Reduction due to depreciation															14	29	43
	= Subtotal		233	461	748	854	1.035	1.233	1.454	1.492	1.766	1.932	1.960	2.011	1.997	1.983	1.968	
Total		13.359	14.020	14.143	14.261	14.437	14.433	14.504	14.591	14.705	14.637	14.805	14.863	14.784	14.729	14.620	14.511	14.402

Table 5.51. Cost including inflation and tax reduction out of depreciation for portfolio 2 3/5

Project		Period 51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
Project 1	Costs	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468
	+ Inflation	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	- Tax Reduction due to depreciation	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440
	= Subtotal	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081
Project 2	Costs	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429
	+ Inflation	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	- Tax Reduction due to depreciation	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
	= Subtotal	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307
Project 3	Costs	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241
	+ Inflation	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96
	- Tax Reduction due to depreciation	290	300	310	321	331	341	352	362	372	372	372	372	372	372	372	372	372
	= Subtotal	1.047	1.037	1.027	1.016	1.006	995	985	975	964	964	964	964	964	964	964	964	964
Project 4	Costs	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102
	+ Inflation	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149
	- Tax Reduction due to depreciation	1.347	1.431	1.515	1.599	1.684	1.768	1.852	1.936	2.020	2.105	2.189	2.273	2.357	2.441	2.526	2.610	2.694
	= Subtotal	9.904	9.820	9.736	9.652	9.568	9.484	9.399	9.315	9.231	9.147	9.063	8.978	8.894	8.810	8.726	8.642	8.558
Project 5	Costs	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725
	+ Inflation	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286
	- Tax Reduction due to depreciation	58	72	86	101	115	129	144	158	172	187	201	216	230	244	259	273	288
	= Subtotal	1.954	1.939	1.925	1.911	1.896	1.882	1.868	1.853	1.839	1.824	1.810	1.796	1.781	1.767	1.753	1.738	1.724
Total		14.293	14.185	14.076	13.967	13.858	13.749	13.640	13.531	13.422	13.324	13.225	13.127	13.028	12.929	12.831	12.732	12.634

Table 5.52. Cost including inflation and tax reduction out of depreciation for portfolio 2 4/5

Project		Period																
		68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	Total
Project 1	Costs	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468	1.468
	+ Inflation	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	- Tax Reduction due to depreciation	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440
	= Subtotal	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081	1.081
Project 2	Costs	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429
	+ Inflation	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	- Tax Reduction due to depreciation	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
	= Subtotal	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307
Project 3	Costs	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241	1.241
	+ Inflation	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96
	- Tax Reduction due to depreciation	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372
	= Subtotal	964	964	964	964	964	964	964	964	964	964	964	964	964	964	964	964	964
Project 4	Costs	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102	10.102
	+ Inflation	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149
	- Tax Reduction due to depreciation	2.778	2.862	2.946	3.031	3.031	3.031	3.031	3.031	3.031	3.031	3.031	3.031	3.031	3.031	3.031	3.031	3.031
	= Subtotal	8.473	8.389	8.305	8.221	8.221	8.221	8.221	8.221	8.221	8.221	8.221	8.221	8.221	8.221	8.221	8.221	8.221
Project 5	Costs	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725	1.725
	+ Inflation	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286	286
	- Tax Reduction due to depreciation	302	316	331	345	359	374	388	402	417	431	446	460	474	489	503	518	518
	= Subtotal	1.709	1.695	1.681	1.666	1.652	1.638	1.623	1.609	1.594	1.580	1.566	1.551	1.537	1.523	1.508	1.494	1.494
Total		12.535	12.437	12.338	12.240	12.225	12.211	12.196	12.182	12.168	12.153	12.139	12.125	12.110	12.096	12.081	12.067	12.067

Table 5.53. Cost including inflation and tax reduction out of depreciation for portfolio 2 5/5

P_2 finished 9,8% below budget (actuals of 389 instead of 429 planned) and on time and started delivering the benefits – however the project is 32% behind expectations as table 5.54 shows.

The detailed view of the benefit figures shown in the tables 5.55 and 5.56 demonstrates that the implicit assumption that P_3 is required because the customer base grows rapidly might not turn out to be true: the base grew 48% less than expected. This should have raised the question as to whether P_3 should be continued. Because the growth of the customer base was still expected without checking the numbers, the project was continued in real life. The project management should have considered interrupting it, at least temporarily, for further deliberations and analysis. Another argument for not stopping P_3 would also have been that the contract with a vendor was signed already. Had the company stopped the project, it would have needed to pay the vendor anyway.

The remaining development of the project portfolio in snapshot 1 can be seen in table 5.57.

5.2.4 Snapshot 2

The point in time the project is scrutinized again is period 22. The situation of the project portfolio worsens. P_3 and P_4 are still ongoing in parallel. Both projects exhibit delays, whereby the ones in P_4 are larger (the SPI is only 0,72) and more critical as the results of the project fulfill regulatory requirements. From a cost perspective the picture for the projects looks as described in the figures 5.17 and 5.18.

Costs for project: Project 3

Portfolio Overview

Cost type		0	1	2	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	83	84	85	Total Cost
Investments	PV							0	9	5	1	0	3	7	4	5	8	3	4							49
	AC							0	10	5	1	0	3	9	3	3	0	0	0							34
Labour	PV							145	113	159	105	30	126	105	1	115	39	79	138							1.155
	AC							150	147	130	92	33	143	65	1	131	0	0	0							892
Risks	PV							3	4	3	5	2	2	1	4	3	4	2	4							37
	AC							2	2	2	5	2	2	1	3	3	0	0	0							22
Total	PV							148	126	167	111	32	131	113	9	123	51	84	146							1.241
	AC							152	159	137	98	35	148	75	7	137										948
	EV							1%	7%	39%	44%	45%	55%	58%	65%	72%										72%
	SV							-136	-187	43	-6	-26	-32	-108	-30	-66										
	CV							-140	-224	36	0	-23	-46	-84	-4	-54										
	SPI							0,08	0,32	1,10	0,99	0,96	0,95	0,87	0,96	0,93										
	CPI							0,08	0,28	1,08	1,00	0,96	0,94	0,90	0,99	0,94										

Fig. 5.17. Snapshot 2 of cost and progress in P_3 in portfolio 2

	Period										
	6	7	8	9	10	11	12	13	14	15	16
PV	0,0005	0,0018	0,0040	0,0071	0,0110	0,0156	0,0211	0,0272	0,0341	0,0417	0,0500
EV	0,0000	0,0001	0,0002	0,0005	0,0010	0,0014	0,0036	0,0141	0,0183	0,0313	0,0338
Var	-0,0005	-0,0017	-0,0039	-0,0066	-0,0100	-0,0142	-0,0174	-0,0131	-0,0159	-0,0104	-0,0162
PI	0,00	0,05	0,04	0,07	0,09	0,09	0,17	0,52	0,54	0,75	0,68

Table 5.54. Development of the benefits out of P_2 in portfolio 2 at snapshot 1

BSC Value		Period										
		6	7	8	9	10	11	12	13	14	15	16
Retail revenue	PV	83	167	250	333	417	500	583	667	750	833	917
	EV	24	82	133	192	253	277	313	354	428	474	562
	Var	-59	-85	-117	-141	-164	-223	-270	-313	-322	-359	-355
	PI	0,29	0,49	0,53	0,58	0,61	0,55	0,54	0,53	0,57	0,57	0,61
Market rating	PV				1	1	1	1	1	1	1	2
	EV							1	1	1	1	1
	Var				-1	-1	-1					-1
	PI							1,03	0,90	0,80	0,72	0,65
Retail customer	PV	1.889	3.778	5.667	7.556	9.444	11.333	13.222	15.111	17.000	18.889	20.778
	EV	1.699	3.617	3.872	4.325	4.659	6.107	6.770	7.411	9.599	10.538	10.800
	Var	-190	-161	-1.795	-3.231	-4.785	-5.226	-6.452	-7.700	-7.401	-8.351	-9.978
	PI	0,90	0,96	0,68	0,57	0,49	0,54	0,51	0,49	0,56	0,56	0,52
Customer satisfaction rating	PV				1	1	1	1	1	1	1	2
	EV								1	1	1	1
	Var				-1	-1	-1	-1				-1
	PI								0,90	0,80	0,72	0,65
Percentage deals/offers	PV		1%	1%	1%	1%	2%	2%	2%	2%	3%	3%
	EV				1%	1%	1%	1%	1%	2%	2%	2%
	Var		-1%	-1%			-1%	-1%	-1%	-1%	-1%	-1%
	PI				0,90	0,72	0,60	0,51	0,45	0,80	0,72	0,65
Products per customer	PV											
	EV										1	1
	Var										1	1
	PI											

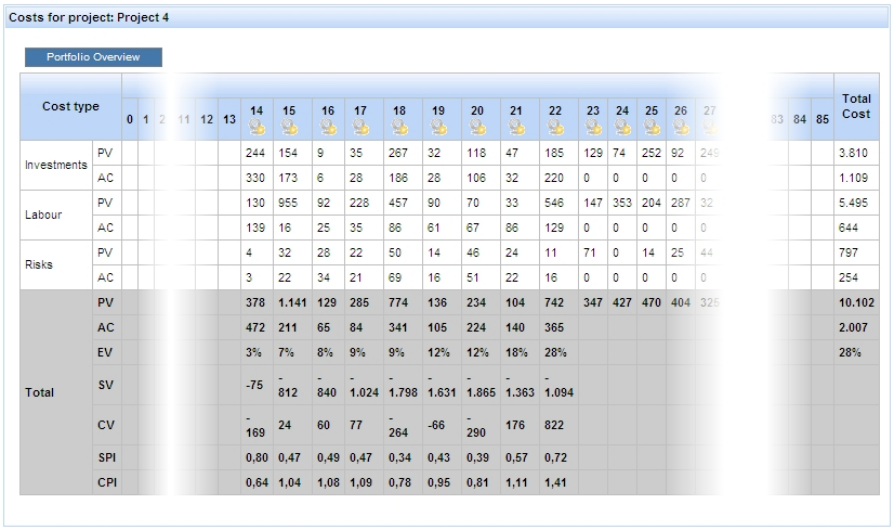
Table 5.55. Development of the benefits out of P_2 in portfolio 2 at snapshot 1 in detail 1/2

BSC Value		Period										
		6	7	8	9	10	11	12	13	14	15	16
Retail customers lost	PV	1	1	2	2	3	3	4	4	5	6	6
	EV		1	1	2	2	3	3	3	3	3	4
	Var	-1		-1		-1		-1	-1	-2	-3	-2
	PI		0,90	0,60	0,90	0,72	0,90	0,77	0,67	0,60	0,54	0,65
Product profitability	PV	%	1%	1%	1%	1%	2%	2%	2%	2%	3%	3%
	EV	%	%	%	%	1%	1%	1%	2%	2%	2%	2%
	Var	%	-1%	-1%	-1%	%	-1%	-1%	%	%	-1%	-1%
	PI					0,72	0,60	0,51	0,90	0,80	0,72	0,65
Duration of retail applications	PV	1	1	2	2	3	3	4	4	5	6	6
	EV		1	1	1	2	2	2	2	3	4	4
	Var	-1		-1	-1	-1	-1	-2	-2	-2	-2	-2
	PI		0,90	0,60	0,45	0,72	0,60	0,51	0,45	0,60	0,72	0,65
Number of resources for retail applications	PV	2	3	5	7	8	10	12	13	15	17	18
	EV	1	1	2	4	5	7	9	10	11	12	13
	Var	-1	-2	-3	-3	-3	-3	-3	-3	-4	-5	-5
	PI	0,60	0,30	0,40	0,60	0,60	0,70	0,77	0,75	0,73	0,72	0,71
Efficiency of retail collection	PV	%	1%	1%	1%	1%	2%	2%	2%	2%	3%	3%
	EV	%	%	%	%	%	%	%	%	%	%	%
	Var	%	-1%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-3%	-3%
	PI				0,90	0,72	0,60	0,51	0,45	0,80	0,72	0,65
Motivation Index	PV				1	1	1	1	1	1	1	2
	EV						1	1	1	1	1	1
	Var				-1	-1						-1
	PI						1,20	1,03	0,90	0,80	0,72	0,65
Turnover rate	PV				1	1	1	1	1	1	1	2
	EV							1	1	1	1	1
	Var				-1	-1	-1					-1
	PI							1,03	0,90	0,80	0,72	0,65
Training hours	PV	833	1.667	2.500	3.333	4.167	5.000	5.833	6.667	7.500	8.333	9.167
	EV	269	409	943	1.104	1.273	2.038	2.924	3.534	3.794	4.518	5.227
	Var	-564	-1.258	-1.557	-2.229	-2.894	-2.962	-2.909	-3.133	-3.706	-3.815	-3.940
	PI	0,32	0,25	0,38	0,33	0,31	0,41	0,50	0,53	0,51	0,54	0,57
Ethics violations	PV				1	1	1	1	1	1	1	2
	EV								1	1	1	1
	Var				-1	-1	-1	-1				-1
	PI								0,90	0,80	0,72	0,65

Table 5.56. Development of the benefits out of P_2 in portfolio 2 at snapshot 1 in detail 2/2

Description		Period																
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Project 1	Costs	18	181	253	420	601	816	1.067	1.171	1.310	1.421	1.608	1.653	1.693	1.709	1.709	1.709	1.709
	+ Inflation		1	2	4	8	14	21	27	35	43	54	61	68	74	74	74	74
	- Tax Reduction due to depreciation															14	28	43
	= Subtotal	18	181	255	424	609	830	1.088	1.198	1.345	1.463	1.662	1.714	1.761	1.783	1.769	1.755	1.740
	EV	1%	13%	16%	29%	31%	60%	67%	70%	82%	84%	90%	93%	96%	100%			
	SPI	0,56	1,17	1,03	1,10	0,86	1,21	1,04	1,00	1,03	0,99	0,94	0,93	0,96	1,00			
	CPI	0,82	1,05	0,93	1,01	0,76	1,08	0,92	0,88	0,92	0,87	0,82	0,82	0,83	0,86			
	PI															0,28	0,62	0,47
Project 2	Costs	55	132	180	283	301	389	389	389	389	389	389	389	389	389	389	389	389
	+ Inflation		0	1	3	4	6	8	8	8	8	8	8	8	8	8	8	8
	- Tax Reduction due to depreciation							3	6	10	13	16	19	23	26	29	32	36
	= Subtotal	55	133	181	286	305	396	394	390	387	384	381	377	374	371	368	364	361
	EV	9%	19%	48%	63%	75%	100%											
	SPI	0,58	0,62	1,10	0,93	1,02	1,00											
	CPI	0,72	0,62	1,15	0,96	1,07	1,10											
	PI								0,05	0,04	0,07	0,09	0,09	0,17	0,52	0,54	0,75	0,68
Project 3	Costs															148	274	441
	+ Inflation															7	14	24
	- Tax Reduction due to depreciation																	
	= Subtotal														155	288	465	
	EV															1%	7%	39%
	SPI															0,08	0,32	1,10
	CPI															0,08	0,28	1,08
	PI																	
Project 4	Costs															378	1.519	1.648
	+ Inflation															18	76	87
	- Tax Reduction due to depreciation																	
	= Subtotal														396	1.595	1.735	
	EV															3%	7%	8%
	SPI															0,80	0,47	0,49
	CPI															0,64	1,04	1,08
	PI																	

Table 5.57. Overview on portfolio 2 at snapshot 1



Cost type		0	1	2	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	83	84	85	Total Cost
Investments	PV							244	154	9	35	267	32	118	47	185	129	74	252	92	249				3.810
	AC							330	173	6	28	186	28	106	32	220	0	0	0	0	0				1.109
Labour	PV							130	955	92	228	457	90	70	33	546	147	353	204	287	32				5.495
	AC							139	16	25	35	86	61	67	86	129	0	0	0	0	0				644
Risks	PV							4	32	28	22	50	14	46	24	11	71	0	14	25	44				797
	AC							3	22	34	21	69	16	51	22	16	0	0	0	0	0				254
Total	PV							378	1.141	129	285	774	136	234	104	742	347	427	470	404	325				10.102
	AC							472	211	65	84	341	105	224	140	365									2.007
	EV							3%	7%	8%	9%	9%	12%	12%	18%	28%									28%
	SV							-75	-812	-840	-1.024	-1.798	-1.631	-1.865	-1.363	-1.094									
	CV							-169	24	60	77	-264	-66	-290	176	822									
	SPI							0,80	0,47	0,49	0,47	0,34	0,43	0,39	0,57	0,72									
	CPI							0,64	1,04	1,08	1,09	0,78	0,95	0,81	1,11	1,41									

Fig. 5.18. Snapshot 2 of cost and progress in P_4 in portfolio 2

The reason why P_4 is behind schedule, although the financials look very good, (the CPI is 1,41) seems to be that many resources are required for P_3 and these are not available as planned. P_3 is close to being within plan with small variances but the development of the benefits from P_2 has still not progressed as expected. The situation became even worse compared to snapshot 1 as can be seen in the tables 5.58 and 5.59.

	Period						
	16	17	18	19	20	21	22
PV	0,0500	0,0589	0,0685	0,0786	0,0893	0,1006	0,1125
EV	0,0338	0,0348	0,0406	0,0423	0,0436	0,0429	0,0488
Var	-0,0162	-0,0241	-0,0279	-0,0363	-0,0457	-0,0577	-0,0637
PI	0,68	0,59	0,59	0,54	0,49	0,43	0,43

Table 5.58. Development of the benefits out of P_2 in portfolio 2 at snapshot 2

BSC Value		Period 16	17	18	19	20	21	22
Retail revenue	PV	917	1.000	1.083	1.167	1.250	1.333	1.417
	EV	562	635	691	768	861	903	975
	Var	-355	-365	-392	-399	-389	-430	-442
	PI	0,61	0,64	0,64	0,66	0,69	0,68	0,69
Market rating	PV	2	2	2	2	2	2	2
	EV	1	1	1	1	1	1	2
	Var	-1	-1	-1	-1	-1	-1	
	PI	0,65	0,60	0,55	0,51	0,48	0,45	0,85
Retail customer	PV	20.778	22.667	24.556	26.444	28.333	30.222	32.111
	EV	10.800	11.673	13.095	14.037	15.802	16.986	17.245
	Var	-9.978	-10.994	-11.461	-12.407	-12.531	-13.236	-14.866
	PI	0,52	0,51	0,53	0,53	0,56	0,56	0,54
Customer satisfaction rating	PV	2	2	2	2	2	2	2
	EV	1	1	1	1	1	1	1
	Var	-1	-1	-1	-1	-1	-1	-1
	PI	0,65	0,60	0,55	0,51	0,48	0,45	0,42
Percentage deals/offers	PV	3,00%	3,00%	4,00%	4,00%	4,00%	4,00%	5,00%
	EV	2,00%	2,00%	2,00%	2,00%	2,00%	2,00%	3,00%
	Var	-1,00%	-1,00%	-2,00%	-2,00%	-2,00%	-2,00%	-2,00%
	PI	0,65	0,60	0,55	0,51	0,48	0,45	0,64
Products per customer	PV	1	1	1	1	1	1	1
	EV	1	1	1	1	1	1	1
	Var							
	PI	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Retail customers lost	PV	6	7	7	8	8	9	9
	EV	4	4	4	4	4	2	5
	Var	-2	-3	-3	-4	-4	-7	-4
	PI	0,65	0,60	0,55	0,51	0,48	0,22	0,53
Product profitability	PV	3,00%	3,00%	4,00%	4,00%	4,00%	4,00%	5,00%
	EV	2,00%	2,00%	3,00%	3,00%	3,00%	3,00%	4,00%
	Var	-1,00%	-1,00%	-1,00%	-1,00%	-1,00%	-1,00%	-1,00%
	PI	0,65	0,60	0,83	0,77	0,72	0,67	0,64
Duration of retail applications	PV	6	7	7	8	8	9	9
	EV	4	4	5	5	5	6	6
	Var	-2	-3	-2	-3	-3	-3	-3
	PI	0,65	0,60	0,69	0,64	0,60	0,67	0,64
Number of resources for retail applications	PV	18	20	22	23	25	27	28
	EV	13	15	17	18	19	20	20
	Var	-5	-5	-5	-5	-6	-7	-8
	PI	0,71	0,75	0,78	0,77	0,76	0,75	0,71
Efficiency of retail collection	PV	3,00%	3,00%	4,00%	4,00%	4,00%	4,00%	5,00%
	EV	2,00%	2,00%	3,00%	3,00%	3,00%	3,00%	4,00%
	Var	-1,00%	-1,00%	-1,00%	-1,00%	-1,00%	-1,00%	-1,00%
	PI	0,65	0,60	0,55	0,77	0,72	0,67	0,64
Motivation Index	PV	2	2	2	2	2	2	2
	EV	1	1	1	1	1	1	1
	Var	-1	-1	-1	-1	-1	-1	-1
	PI	0,65	0,60	0,55	0,51	0,48	0,45	0,42
Turnover rate	PV	2	2	2	2	2	2	2
	EV	1	1	1	1	1	1	1
	Var	-1	-1	-1	-1	-1	-1	-1
	PI	0,65	0,60	0,55	0,51	0,48	0,45	0,42
Training hours	PV	9.167	10.000	10.833	11.667	12.500	13.333	14.167
	EV	5.227	5.498	6.115	6.734	7.455	7.762	7.978
	Var	-3.940	-4.502	-4.718	-4.933	-5.045	-5.571	-6.189
	PI	0,57	0,55	0,56	0,58	0,60	0,58	0,56
Ethics violations	PV	2	2	2	2	2	2	2
	EV	1	1	1	1	1	1	1
	Var	-1	-1	-1	-1	-1	-1	-1
	PI	0,65	0,60	0,55	0,51	0,48	0,45	0,42

Table 5.59. Development of the benefits out of P_2 in portfolio 2 at snapshot 2 in detail

Although the performance of gaining the benefits decreases, the amount that seems to be realized within the observation period is about 43% of the expected one. The critical question that should be answered here is, whether

it would have made more sense to stop P_3 and move all the resources to P_4, especially as the number of retail resources is about 46% away from its target. This would have the following advantages:

- The development of the BSC values out of P_2 could be observed to see whether the investment in P_3 is still justified. There is one cutback that has to be made here: the efforts for internal manpower could be saved, but the external issues and the licenses acquired must be paid for or re-negotiated.
- The resources freed from P_3 could support speeding up P_4 to fulfil the requirements in time.

In reality these questions have been raised, but they haven't been pursued. This mainly because the facts that the thesis has obtained from the realization of benefits were not available. Had they been available, the decision might have been different and to the company's advantage.

5.2.5 Snapshot 3

Snapshot 3 is taken in period 32. Meanwhile P_3 was finished on time and budget.

Costs for project: Project 3

Portfolio Overview

Cost type		0	1	2	3	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	82	83	84	85	Total Cost
Investments	PV								0	9	5	1	0	3	7	4	5	8	3	4								49
	AC								0	10	5	1	0	3	9	3	3	11	3	3								51
Labour	PV								145	113	159	105	30	126	105	1	115	39	79	138								1.155
	AC								150	147	130	92	33	143	65	1	131	48	96	127								1.163
Risks	PV								3	4	3	5	2	2	1	4	3	4	2	4								37
	AC								2	2	2	5	2	2	1	3	3	4	1	3								30
Total	PV								148	126	167	111	32	131	113	9	123	51	84	146								1.241
	AC								152	159	137	98	35	148	75	7	137	63	100	133								1.244
	EV								1%	7%	39%	44%	45%	55%	58%	65%	72%	83%	89%	100%								100%
	SV								-136	-187	43	-6	-26	-32	-108	-30	-66	19	9	-0								
	CV								-140	-224	36	0	-23	-46	-84	-4	-54	19	-7	-3								
	SPI								0,08	0,32	1,10	0,99	0,96	0,95	0,87	0,96	0,93	1,02	1,01	1,00								
	CPI								0,08	0,28	1,08	1,00	0,96	0,94	0,90	0,99	0,94	1,02	0,99	1,00								

Fig. 5.19. Snapshot 3 of cost and progress in P_3 in portfolio 2

The value derived from this project still cannot be realized because the BSC contribution values out of P_2 are far behind expectations (details can be seen in the tables 5.60 and 5.61).

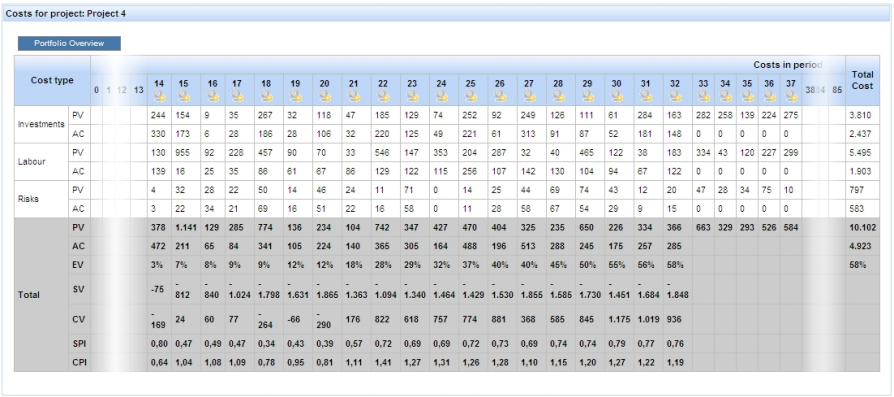
P_4 is in deep trouble because the speed of progress could not be improved due to the lack of qualified resources in charge of finishing P_3. The actual status can be seen in figure 5.20 below.

BSC Value		Period										
		22	23	24	25	26	27	28	29	30	31	32
Retail revenue	PV	1.417	1.500	1.583	1.667	1.750	1.833	1.917	2.000	2.083	2.167	2.250
	EV	975	1.009	1.077	1.077	1.222	1.269	1.319	1.341	1.353	1.429	1.520
	Var	-442	-491	-506	-590	-528	-564	-598	-659	-730	-738	-730
	PI	0,69	0,67	0,68	0,65	0,70	0,69	0,69	0,67	0,65	0,66	0,68
Market rating	PV	2	2	3	3	3	3	3	3	3	4	4
	EV	2	2	2	2	2	2	2	2	2	2	2
	Var			-1	-1	-1	-1	-1	-1	-1	-2	-2
	PI	0,85	0,80	0,76	0,72	0,69	0,65	0,63	0,60	0,58	0,55	0,53
Retail customer	PV	32.111	34.000	35.889	37.778	39.667	41.556	43.444	45.333	47.222	49.111	51.000
	EV	17.245	18.141	18.850	18.850	19.693	20.581	22.464	23.432	25.068	25.514	25.816
	Var	-14.866	-15.859	-17.039	-18.928	-19.974	-20.975	-20.980	-21.901	-22.154	-23.597	-25.184
	PI	0,54	0,53	0,53	0,50	0,50	0,50	0,52	0,52	0,53	0,52	0,51
Customer satisfaction rating	PV	2	2	3	3	3	3	3	3	3	4	4
	EV	1	1	1	1	1	1	2	2	2	2	2
	Var	-1	-2	-2	-2	-2	-2	-1	-1	-1	-2	-2
	PI	0,42	0,40	0,38	0,36	0,34	0,33	0,63	0,60	0,58	0,55	0,53
Percentage deals/offers	PV	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%
	EV	3%	3%	3%	3%	3%	3%	4%	4%	4%	4%	4%
	Var	-2%	-2%	-2%	-3%	-3%	-3%	-2%	-3%	-3%	-3%	-3%
	PI	0,64	0,60	0,57	0,54	0,51	0,49	0,63	0,60	0,58	0,55	0,53
Products per customer	PV											
	EV	1	1	1	1	1	1	1	1	1	1	1
	Var	1	1	1	1	1	1	1	1	1	1	1
	PI											

Table 5.60. Development of the benefits out of P_2 in portfolio 2 at snapshot 3 in detail 1/2

BSC Value		Period										
		22	23	24	25	26	27	28	29	30	31	32
Retail customers lost	PV	9	10	11	11	12	12	13	13	14	14	15
	EV	5	6	6	6	7	7	8	8	8	8	9
	Var	-4	-4	-5	-5	-5	-5	-5	-5	-6	-6	-6
	PI	0,53	0,60	0,57	0,54	0,60	0,57	0,63	0,60	0,58	0,55	0,60
Product profitability	PV	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%
	EV	4%	4%	4%	5%	5%	5%	5%	6%	6%	6%	7%
	Var	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%
	PI	0,64	0,80	0,76	0,72	0,69	0,65	0,78	0,75	0,72	0,69	0,67
Duration of retail applications	PV	9	10	11	11	12	12	13	13	14	14	15
	EV	6	6	7	7	8	8	8	9	9	9	10
	Var	-3	-4	-4	-4	-4	-4	-5	-4	-5	-5	-5
	PI	0,64	0,60	0,66	0,63	0,69	0,65	0,63	0,67	0,65	0,62	0,67
Number of resources for retail applications	PV	28	30	32	33	35	37	38	40	42	43	45
	EV	20	22	23	23	24	26	27	28	30	30	31
	Var	-8	-8	-9	-10	-11	-11	-11	-12	-12	-13	-14
	PI	0,71	0,73	0,73	0,69	0,69	0,71	0,70	0,70	0,72	0,69	0,69
Efficiency of retail collection	PV	5%	5%	5%	6%	6%	6%	6%	7%	7%	7%	8%
	EV	4%	4%	4%	5%	5%	5%	5%	6%	6%	6%	7%
	Var	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%
	PI	0,64	0,60	0,57	0,54	0,69	0,65	0,63	0,60	0,58	0,55	0,67
Motivation Index	PV	2	2	3	3	3	3	3	3	3	4	4
	EV	1	2	2	2	2	2	2	2	2	2	2
	Var	-1		-1	-1	-1	-1	-1	-1	-1	-2	-2
	PI	0,42	0,80	0,76	0,72	0,69	0,65	0,63	0,60	0,58	0,55	0,53
Turnover rate	PV	2	2	3	3	3	3	3	3	3	4	4
	EV	1	1	2	2	2	2	2	2	2	2	2
	Var	-1	-2	-1	-1	-1	-1	-1	-1	-1	-2	-2
	PI	0,42	0,40	0,76	0,72	0,69	0,65	0,63	0,60	0,58	0,55	0,53
Training hours	PV	14.167	15.000	15.833	16.667	17.500	18.333	19.167	20.000	20.833	21.667	22.500
	EV	7.978	8.500	10.067	10.067	10.271	11.045	11.468	11.762	11.863	12.051	12.827
	Var	-6.189	-6.500	-5.766	-6.600	-7.229	-7.288	-7.699	-8.238	-8.970	-9.616	-9.673
	PI	0,56	0,57	0,64	0,60	0,59	0,60	0,60	0,59	0,57	0,56	0,57

Table 5.61. Development of the benefits out of P_2 in portfolio 2 at snapshot 3 in detail 2/2



Costs for project: Project 4

Portfolio Overview

Cost type		Costs in period 0	1	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	84	85	Total Cost
Investments	PV					244	154	9	35	267	32	118	47	185	129	74	252	92	249	126	111	61	284	163	282	258	139	224	275				3.810
	AC					330	173	6	28	186	28	106	32	220	125	49	221	61	313	91	87	52	181	148	0	0	0	0	0				2.437
Labour	PV					130	955	92	228	457	90	70	33	546	147	353	204	287	32	40	465	122	38	183	334	43	120	227	299				5.495
	AC					139	16	25	35	86	61	67	86	129	122	115	256	107	142	130	104	94	67	122	0	0	0	0	0				1.903
Risks	PV					4	32	28	22	50	14	46	24	11	71	0	14	25	44	69	74	43	12	20	47	28	34	75	10				797
	AC					3	22	34	21	69	16	51	22	16	58	0	11	28	58	67	54	29	9	15	0	0	0	0	0				583
Total	PV					378	1.141	129	285	774	136	234	104	742	347	427	470	404	325	235	650	226	334	366	663	329	293	526	584				10.102
	AC					472	211	65	84	341	105	224	140	365	305	164	488	196	513	288	245	175	257	285									4.923
	EV					3%	7%	8%	9%	9%	12%	12%	18%	28%	29%	32%	37%	40%	40%	45%	50%	55%	56%	58%									58%
	SV					-75	-812	-840	-1.024	-1.798	-1.631	-1.865	-1.363	-1.094	-1.340	-1.464	-1.429	-1.530	-1.855	-1.585	-1.730	-1.451	-1.684	-1.848									
	CV					-169	24	60	77	-264	-66	-290	176	822	618	757	774	881	368	585	845	1.175	1.019	936									
	SPI					0,80	0,47	0,49	0,47	0,34	0,43	0,39	0,57	0,72	0,69	0,69	0,72	0,73	0,69	0,74	0,74	0,79	0,77	0,76									
	CPI					0,64	1,04	1,08	1,09	0,78	0,95	0,81	1,11	1,41	1,27	1,31	1,26	1,28	1,10	1,15	1,20	1,27	1,22	1,19									

Fig. 5.20. Snapshot 3 of cost and progress in P_4 in portfolio 2

The only thing that can be done now is to place all available resources in P_4, so as to get it finished as soon as possible. The cost side of the project is still doing fine, so all efforts can be spent on adhering to the schedule.

5.2.6 Conclusions from portfolio 2

Portfolio 2 presented a scenario that contained hidden information beginning with the selection of the projects for the portfolio. In actual situations these "implicit" dependencies are not recognized, because the benefits are neither planned nor measured. Therefore, they remain a mobile target which can, obviously, lead to wrong decisions such as P_3 in this example. Whether the investment into P_3 would pay back or not remains open now, but one thing is sure: having waited for the development of the benefits of P_2 would have insured this investment.

Another important outcome resulting from working with this portfolio is that in reality most projects experienced delays in schedule or costs overruns. It is rare that all projects in a project portfolio finish on time and within budget. The likelihood that a portfolio exceeds budgets and time and does not satisfy expectations is unfortunately higher than the other way around.

6

Achieved results, contributions and identified limitations

This thesis started with looking at the state of the art of IT project portfolio management (PPM) and its applications in terms of processes and organizational structures. The review led to the conclusion that the currently used methodology focuses on maximizing financial results in the short run rather than seeking a proper selection of projects supporting the company's strategic development. One explanation for this could be that the strategy and the critical measures for implementing it cannot be described in a proper way. The methodical basis to resolve this issue was developed by Robert S. Kaplan and David P. Norton with their presentation of the Balanced Scorecards (BSCs) methodology, as described in section 3.1. However, the methodology of BSCs does not cover their application in project portfolios. This means that the daily business could be adjusted according to a BSC but the structure of a project portfolio and the successful implementation of major changes going along with the strategy was not addressed.

Although this issue is widely recognized and several additional weaknesses (see section 1.1.1) have been documented, the step of adapting the methodology of PPM to achieve its natural goal – the best possible support for the implementation of a company's strategy by applying the latest methodologies it is based on – has not been taken so far.

The research on this topic turned out that there are different existing methodologies for Project Portfolio Management in the field – however, none of the existing ones manages to cover all the requirements as it was discussed in chapter 4. For this reason a new framework needed to be created. The research method used is the design research approach because a completely new hypothesis needed to be built and verified with data taken from a real environment. The creation of the framework was driven by results taken from the study of literature and practical experience taken from my job as a project manager and a project portfolio manager.

The developed framework is based on a **meta-model** defining the general elements for a strategy-based PPM model. Besides being the basis for the model developed in this thesis, it can be further used for any BSC related approach towards PPM that needs to be specifically extended for covering certain aspects in any industry. This ensures that the approach developed in this thesis has the flexibility to support any further research in this field.

As mentioned above, the **model** developed in the thesis is based on this meta-model. It consists of elements of proven technologies (Balanced Scorecards, Earned Value Management, Risk Management and Project Portfolio Management). The vital results in terms of differences between the model in this thesis and the current state of the art implementations are:

- Project portfolios are not continuously distributed as current approaches suggest but are following discrete distributions

- The transparent alignment of BSCs and project portfolios to implement the strategy of a company is achieved by directly measuring the contribution of a project on the benefit measures defined in the BSC

- The contribution of IT projects to the strategy of a company is unified regardless of the projects operating in the same or in different fields. This is achieved by calculating the option value out of a set of relative contributions

- The quality of estimates for Planned Values (PVs) of benefit measures is improved by using an estimation function developed in the discipline of Risk Management

- The concept of Earned Value Management (EVM) with some of its components (Planned Value, Earned Value, Variance and Performance Index) is applied to measures of a BSC

The presented **method** builds on the recommendations of the methodologies used and, additionally, includes best practice experience of internationally active companies. The key elements of the method to improve the state of the art can be summarized as follows:

- The *identification of needs, goals and objectives* is no longer a process step that is isolated in project portfolio management and bases its goals and measures on financial indicators but is instead merged with the definition phase of a BSC development. This ensures that measures for activities in the execution of daily processes are the same as the ones applied for the implementation of project portfolios.

- The *selection of the best combination of projects* for a project portfolio is usually done based on financial indicators (e.g. the Net Present Value

(NPV) which try to represent the benefit of a project or project portfolio. These are roughly estimated and accumulated during the budgeting period and the assumptions behind cannot be manifested. This thesis changes the approach in various aspects:

  - The prioritization is no longer done based on a randomly chosen financial indicator but on BSC measures that were defined to be the driving ones for a company towards the successful implementation of its strategy.

  - The value of projects during the prioritization does not only consider the value of the project itself but the value of the whole chain of projects in case of dependencies. This ensures that projects with high option values are selected even if they have predecessors which do only act as enabler and have a low contribution to the strategy.

  - The constraints described in the model are no longer assumed to be fully exchangeable with financial investments but are captured by their nature. This means that the project portfolio manager of a company is in the position to explicitly describe the shortages the company has for executing a desired project portfolio.

- In the *planning and execution of projects* the approach is extended in various aspects as well:

  - The planning is not limited to cost relevant aspects of the projects in the project portfolio but applies a qualified estimation for all BSC measures influenced by a project. This results in an extension of the planning period as many of the parameters of the BSC are affected during a certain period after the finalization of the project.

  - Inflation must be kept in mind as project portfolios with a duration of several years see budgeted costs increasing by this factor without having any mismanagement. An inflation rate of 4% means 12.49% higher project portfolio costs than estimated in year three.

  - The calculation of tax-reductions out of depreciation is another important factor with huge importance. It can reduce the cost of a project portfolio by a significant amount and thereby influences the option value of projects or project chains in a project portfolio dramatically. An important fact that needs to be remembered here is, that only CAPEX (capital expenditures) can be considered for calculating depreciation.

- The *monitoring of portfolio performance and the realization of benefits* are two separated process steps in the state of the art PPM process. In reality this leads to a distinction between the control of deliverables and cost for projects on one side and the implementation of expected benefits on the other. Besides the fact that the control of the achievement of benefits is often neglected, this separation is not natural: benefits from the project might already have been achieved during its execution and there are for sure several effects of projects that need to be controlled after the finalization of a project (e.g. if the depreciation needs to be changed after the activation of an asset).

The framework developed in this thesis has been implemented in a **tool** to be able to test and to demonstrate the consolidated findings. The implementation showed that an effective tool is inevitable to make use of the presented framework as the calculations are too complex and time-consuming to be executed manually. Furthermore, as soon as the data is entered the tool provides a hands-on decision support which is traceable for all decision makers and auditors. The supported functions of the tool can be summarized as follows:

- Capture of master data (portfolios with their targets and constraints, options for projects with a rough picture of their investments, risks and expected needs for human resources and contributions to the BSC factors as well as the dependencies between various project options)

- Prioritization and selection of project options in a project portfolio based on option values and the constraints and targets of the project portfolio

- Planning of project relevant control data. This covers the detailed planning of
  - investments, risks and human resources,
  - contribution factors to BSC measures,
  - inflation and
  - tax-reductions coming from depreciation.

  The data from the planning phase allows the creation of a radar chart over time as shown in figure 4.6.

- Monitoring and controlling of the cost in the project portfolio and the achievements in terms of contributions to the BSC measures. The tool offers the ability to capture actual information and calculates the variances and performance indicators for all relevant measures to provide a sound standing decision basis for the stakeholders of the project portfolio. As also highlighted in the process step for the monitoring of portfolio performance and the realization of benefits, the tool support does not end with the finalization of a project in the portfolio but with the end of the monitoring phases of the projects in the portfolio – this implies that all BSC

measures can be tracked against their plan values to gain lessons learned in comparison to their expected developments.

The Proof of Concept (PoC) prototype presents the implementation of the core ideas of this thesis based on data obtained from a real-life environment. It shows that the decisions taken in real life were often based on incomplete information, although the data could have been made transparent. This led to wrong assumptions and decisions which caused failures in investments and delays. Furthermore, the POC prototype proved the ability of the framework to improve PPM in a way to not only align project portfolios with the strategy of a company but to also help decision makers taking the right actions by having meaningful indicators which are based on facts.

The PoC's limitations are clearly discernible because not all data required to fully test the items presented in this this thesis has been measured by now. Thus the missing information leaves room for interpretation unless the missing data can be collected accurately. A large number of data is created and processed using this approach which leaves no possibility for processing it without software support. The data used and the conclusions drawn in the PoC prototype lead to the conviction that the tool itself is essential for an optimization of management decisions. This is not because the number of factors considered is increased but because the performance of these factors can be measured in addition to such classical figures as cost and schedule.

Further, the scalability of the system in the PoC could only be tested based on the available data. Up to the portfolio sizes tested and explained in the PoC, there were no scalability issues – project portfolios in a larger context were out of scope for this thesis.

Another possible limitation must also be mentioned here: although the developed approach seems to be applicable to various industries, the POC prototype has – so far – been tested only for IT Project Portfolio Management in the financial industry. Whether this approach can be utilized in the same way by other domains and other industries can be confirmed from a theoretical point of view. However, it still needs to be verified by a practical application of this thesis in different environments.

7

Conclusion and future work

It is clear that business analysts must stop treating Strategy Development, Strategy Implementation and IT Project Portfolio Management separately, because none of these disciplines can operate without each other. All of them are vital links in a chain between the long- and short-term development of the company, as well as between the management and the work force. This is especially true for the alignment with IT. Companies are no longer driven by optimized processes in their daily business but by effective methods for the development and implementation of the future daily business. This is a core challenge of the coming years. The business competition will be moving away from concentrating on firm's current results, shifting attention to the expected results the future might bring. The share prices already reflect this trend today but companies are behind in applying the new methodologies to make considerable adaptations to fulfill the changed expectations.

The top management will have to change the focus away from purely financial targets to an holistic approach. This means a more complex environment to work- and take decisions in, but is the only way to provide an analytical base that will guide companies into the future successfully. Furthermore, this new management will have to evolve from an event-triggered process to a continuously executed process – as the ability to adapt to the needs of markets will be the key factor of success. This will result in even faster product cycles and will require the highest level of flexibility from the management. In this process it will be essential to have transparency between strategic goals and the IT project portfolio that needs to be prioritized properly in order to achieve these goals. A change in the strategy might then result in an immediate closing down of projects in a portfolio or even whole portfolios.

This scenario represents a special challenge for consultants, since the fields of strategy and operations have to be linked more closely. They are currently often handled separately and are even considered to be a job of two different classes of consultants: one group that develops the vision and the strategy

together with the companies (usually the more expensive category). The second group that implements what has been decided strategically (normally the cheaper category). This separation hinders the successful implementation of strategic IT project portfolio management because these tasks are not covered by one and the same consultant in an end-to-end approach. Therefore, the implementation of strategies becomes a nightmare for the companies as the link – the most important part – was neither considered when developing the strategy nor when structuring the IT project portfolio.

Software vendors also need to change and will have to merge their tools to provide a consistent flow from strategy development to the execution of projects by providing transparency at all stages. At this point they are focusing on similar issues as the consultants, although the coverage of an end-to-end approach is the critical success factor.

From a methodical point of view the developed meta-model is a cornerstone for BSC-based PPM. It provides the opportunity to develop further models based on it that can be fully adjusted to the needs of any industry. The reason lies in the fact that the relations of important parts of a successful BSC model and the vital parts of an effective PPM model are defined by addressing industry-specific extensions at the same time. The model developed in this thesis is an implementation that has been tailored for IT in the financial industry – adjustments needed for adapting the meta-model for another sector can be done the same way as it was carried out for this model:

- The BSC-part of the model was implemented by defining a set of four possible target indicators (fixed value, range, minimal value or maximum value) and their representation over time (the calculation of an option value and its representation in a radar chart). Other models derived from the same meta-model might see the need for using fixed values only, limiting the number of indicators or weighting the indicators for the calculation of an option value for example.
- The EVM-part of the model defined a set of indicators that measure the progress of projects in the project portfolio. In this model the indicators were constructed in a way that they can be applied to any indicator defined in the BSC. This is an advantage because there are no limitations in terms of figures they can be applied to but it can also be a disadvantage as specific transformations needed for certain indicators are not considered. Future models could realize such adaptations simply by extending the meta-model accordingly.
- In the part related to Risk Management this model uses a weighting of the lowest possible, probable and highest possible value to achieve a qualified planned value for estimating the development of figures over time. Especially in the field of value estimation functions the range of already

developed and available formulas is significant. Whatever approach is chosen, it can be implemented with the presented meta-model.
- The IT Project Portfolio Management related part was implemented with a set of fixed measures to be observed (investments, duration, labor effort, skills and project risks) and by considering inflation and depreciation when presenting and managing the project portfolio. Industries that cannot activate assets because their projects may need other targets (e.g. projects in social environments) might not need depreciations in their model but could see the need for an additional indicator such as, for example, supporting organizations. Moreover, this part explained how dependencies are defined and calculated. The assumption that there is only a single type of dependency might not be true for any portfolio – it could be reasonable to differentiate between market-, competitor- or even politically-driven dependencies.

Generally the developed framework could be used as the foundation for further research in fields dealing with the

- alignment of strategy and operations
- optimization of selection of projects for project portfolios
- planning of projects in a project portfolio
- tracking and monitoring of projects in a project portfolio
- control of the benefits that could be achieved compared to the ones planned

There are four major fields, where further research to improve the use of BSCs for the selection, planning and monitoring of project portfolios is obvious and can be based on the outcomes of this thesis:

1. The implementation of Balanced Scorecards calls for improvement in a way to make sure that the vital measures – especially the α-figures – are detected. Currently the measures chosen may often represent the obvious but not the critical criteria for the BSCs. Therefore the BSCs are not supported for a long time after the creation since the continuous improvement does not work for a completely inaccurate baseline.

2. The contribution figures for single projects – and therefore for the whole project portfolio – are difficult to estimate because they depend on many factors. Even more challenging is that there is an interference of various projects within the project portfolio on various α-figures. It is very difficult to clarify the amount of contribution per project as the determination of the initiating project is probably a more philosophical question and might be very hard to measure. In this case pragmatic breakdowns may be the most efficient solutions. However, these have not been developed so far and thus represent a very important field for further research.

3. As soon as the validation phase begins, the challenge continues since the benefits may be measured exactly but the assignment to the project that

caused the effect might not always be easy, especially if more than one project contributes to a single measure or if there are projects in the portfolio accounting positively and others negatively to the α-figures. This issue follows more or less directly the one discussed before when moving from the planning to the execution, monitoring and controlling of projects in the project portfolio.

4. Best practices and measures should be developed per industry to cover the specific needs. This would provide companies with an easier start when moving into the direction of strategic IT project portfolio management. Further, the acceptance of the methodology would increase and measures could possibly be unified to create a basis for benchmarking companies. This would allow companies to see where they stand in comparison to their competitors and it could also be used for investors to transparently show which activities are accelerated by the company and for what reason.

Especially in the current economic crisis this methodology could provide a link to creating transparency and providing best practice. The start in this direction has already been made with efforts such as Sarbanes-Oxley, COBIT and ITIL. The major difference to these methodologies is that the presented framework does not focus on controlling defined benchmarks but is tailorable to the needs of any company to optimize the results based on the company's individual strategy. At the same time the framework can be combined with any other methodology or best practice mentioned above.

From a practical point of view, this thesis provides an approach to cover the challenges for the stakeholders mentioned at the beginning of this chapter. It makes use of the Balanced Scorecard (BSC) methodology to describe the strategy of the company. By doing so, the management can move away from simply following monetary targets to enabling an holistic approach for the development of the company's IT. The implementation of the strategy described in [KN96] and [NIV02] is extended by a transparent mapping of the company's project portfolio. This enables project portfolio managers, project managers and stakeholders to follow the same key values and goals. At the same time the level and reliability of IT project portfolio management is tremendously increased, as it no longer only reviews schedules and costs, but provides an important indication to the top management as to whether the projects executed may achieve the acquired targets or not. The presentation of the actual situation is thus no longer restricted to the traditional measures (schedule, cost and quality) but also concretely shows the weaknesses based on indicators derived from the strategy. In addition, stakeholders also see the deviation from the plans which enables them to draw more accurate conclusions. The actions derived from it can also be placed more precisely.

Once the projects' intrinsic implementation is finished, the tracking of the forecasted development of the α-parameters starts. In comparison to the past, the management has the opportunity to appraise whether projects really achieve their targets or not, because most of the projects unfold their effects only some time after their finalization. Further, it cannot only be determined whether the targets were reached but also to which degree. Using the linkages defined in the BSC of the company allows forecasting the target values of the influenced parameters. This expressiveness of an indicator is not provided by the current methodologies.

From a consultant's point of view this thesis offers the possibility of providing better recommendations for the customer. This is achieved by increasing the level of transparency between the customer's needs described in the BSC and the solution options provided by the consultant. He can make use of his expertise and historic data to benchmark different options. The alternative with the highest option value gives confidence to the consultant to suggest the best solution to the customer and delivers the argumentation why this is the case at the same time. This would prevent consultants from comparing players in the same field of industry although they might have a completely different business model. The comparison indicators would move from vague relationships to proven indicators.

For software vendors this thesis offers the possibility to develop an integrated solution that matches the company's strategy with the execution of a project portfolio. Especially software vendors that already have solutions in the field of BSCs or IT Project Portfolio Management might use the model and method in this thesis as a guidance on how to successfully connect these two worlds of tool-support. Beside the positive effects for their customers, the vendors might also be in a position to open completely new fields for their customers.

Future research in this field might look into extending the approach developed in this thesis to make it applicable not only on IT project portfolios but on project portfolios in general. Possibly some assumptions taken from the field of IT projects need to be replaced by more general or abstract assumptions so that the framework can be tested against e.g. projects portfolios in the field of product development.

8

Appendix

8.1 Abstract - German Version

Aktuelle Ansätze zur Projekt Portfolio Management Analyse (PPM) fokussieren auf die Optimierung von kurzfristigen ökonomischen Zielen von Unternehmen – die Unternehmen aus der IT-Branche bilden hier leider keine Ausnahme. Dieser Ansatz wird von der Erwartungshaltung der Eigentümer gefördert, die eine rasche Verzinsung ihres eingestzten Kapitals anstreben. In der Analyse wird hauptsächlich Wert auf vielversprechende Kennzahlen wie den Kapitalwert oder den internen Zinsfuß gelegt.

Langfristig sollten die Unternehmen allerdings auf die Implementation von langfristigen Zielen fokussieren, die auch oft als die Strategie des Unternehmens bezeichnet wird. Diese stehen oft im Widerspruch zu kurzfristigen Zielen, weil sie Investitionen voraussetzen, um neue Produkte zu entwickeln und neue Märkte zu erschließen. Die Strategie eines Unternehmens kann auf vielerlei Arten dargestellt werden, wobei die Methodik der Balanced Scorecards (BSCs) entwickelt von Robert S. Kaplan und David P. Norton unter Beweis gestellt hat, eine der effektivsten zu sein.

BSCs optimieren die Entwicklung eines Unternehmes um seine strategischen Ziele zu erreichen und fokussieren dabei auch implizit auf die Abläufe im Unternehmen. Dies wird vor allem hinsichtlich der Kennzahlen aus der Prozess-Perspektive augenscheinlich. Änderungen in diesem Umfeld können selbstverständlich nicht in kleinen Schritten durchgeführt werden, sondern bedürfen der Ausführung von Projekten. Das wirft die Frage auf, wie diese an der BSC ausgerichtet werden können, um sie in vollem Umfang zu unterstützen.

Diese Arbeit beschreibt ein neues Framework für die Selektion, Planung und das Controlling von Project Portfolios unter der Verwendung der BSC Methodology, Annahmen und Methoden von der Earned Value Methode

(EVM) und Quantifizierungsregeln aus dem Risikomanagement. Die Kriterien für die Selektion von Projekten ist deren langfristiger Beitrag zum Unternehmenserfolg und nicht nur die Erreichung von kurzfristigen finanziellen Zielen.

Der Beitrag von Projekten zu den α-Faktoren einer BSC werden zusätzlich zu den klassischen Kennzahlen eines PPM Frameworks – wie Zeit und Kosten – geschätzt. Die Kosten werden als beschränkender Faktor gesehen – die Faktoren, die die Auswirkungen beschreiben sind jene, die für die Selektion und die Entwicklung des Portfolios wichtig sind. Sie beschreiben den Beitrag zur Erfüllung der langfristigen Ziele.

Während der Planungsphase eines Projekt Portfolios werden die unscharfen Annahmen aus der initialen Phase heruntergebrochen, um nicht nur die finanziellen Erträge, sondern auch die Entwicklung anderen Nutzens für das Unternehmen zu beschreiben. Das ermöglicht es dem Projekt Portfolio Management, Abweichungen im späteren Verlauf leichter zu erkennen und damit die Korrektur von falschen Entscheidungen zu erleichtern.

Das Monitoring und Controlling des Projekt Portfolios endet nicht mit dem Auslaufen der Projekte im Portfolio sondern läuft mit dem Ende der Beobachtungsperiode nach jedem Projekt aus, die die Realisierung des Nutzens beschreibt. Die Arbeit entwickelt KPIs, um die Abweichungen zwischen dem erwarteten und dem tatsächlichen Nutzen zu zeigen. Des weiteren beschreibt sie, wie diese zu interpretieren sind.

Die Arbeit endet mit einem Proof Of Concept (POC) Prototypen, der die entwickelte Methodologie mit Echtdaten aus einem IT Portfolio einer international Bank testet. Die dargestellten Algorithmen wurden in einer Web-Applikation umgesetzt, um die Verarbeitung großer Datenvolumina zu unterstützen und die Benutzbarkeit des Ansatzes zu überprüfen. Der POC beschreibt die Initialsituation des Portfolios, als auch dessen Entwicklung über die Zeit. Die gewählten Momentaufnahmen fokussieren auf den Vergleich zwischen real gesetzten Handlungen und den empfohlenen Handlungsalternativen, die aus der Methodolgie abgeleitet werden.

Unter Berücksichtigung der Erfahrungen des Autors and des Forschungsschwerpunktes der Fakultät für Computer Science wurde diese Arbeit basierend auf IT Projekt Portfolios entwickelt. Die Ergebnisse wurden ebenfalls in diesem Kontext überprüft. Die Erweiterung zu einem generellen Projekt Portfolio Management Ansatz ist offensichtlich interessant, ist aber nicht Bestandteil dieser Arbeit.

8.2 Curriculum Vitae

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Development of an extended selection algorithm for projects in a project portfolio,
International Conference on Electronic Commerce (ICEC 2008),
August 19-22, 2008 Innsbruck, Austria

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