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ABSTRACT

Recent research has shown that companies face considerable difficulties in implementing a value-based management of their IT portfolios. This paper therefore presents an approach for measuring and managing the business value of IT investments. To ensure practicability, our approach is derived from a set of practice-based requirements extending previous empirical work. In our conceptual model we distinguish between capital budgeting and ongoing value management. For capital budgeting we propose to assess IT investments according to their expected business value by using net present value analysis and a scoring model. For ongoing value management we recommend to keep track of a set of project specific key performance indicators to ensure that the desired benefits are realized. In order to link these two fundamental processes, value drivers and measurable performance indicators have to be identified. Thus we combine established evaluation for an integrated IT Portfolio assessment considering financial, non-financial and risk effects as well.

Keywords

Business Value of IT, IT Controlling, IT Portfolio, Benefits Management, IT Management, Information Systems Evaluation.

INTRODUCTION

A few years ago Nicolas Carr (2003) claimed that IT had become a commodity with a diminishing strategic importance for businesses. In his controversial article "IT Doesn't Matter" he advises companies to spend less on IT and focus on vulnerabilities, not opportunities. The question, if IT investments do matter, concerns CIOs and CEOs in the same way. A common complaint of executives is that the business value of expensive IT investments often remains unclear (Ross & Weil, 2002 85). To avoid IT-budget misallocations, it is necessary to predict the benefits of IT investments. The evaluation of IT benefits becomes a vital topic for companies to ensure survival and sustained growth (Irani & Love, 2002 79). Nevertheless, four out of ten companies do not measure the business value of their IT investments at all. Moreover, in those companies that measure IT value the executives' confidence in the results is stunningly low (Alter, 2006 58). There is also no common understanding about the role of monetary evaluations. Methods which go beyond monetary calculations are not commonly used in practice because of their complexity or subjectivity (Renkema & Berghout, 1997 9). There is a need for research that improves these approaches based on a deeper understanding of the evaluation process of IT investments in practice.

Value of IT

Before we turn to the aspects of value-based IT Management it is necessary to define the term *business value of IT* which is not consistently used in literature (Bannister & Remenyi, 2000). Following Berghout and Renkema (1997 2), we define the value of an information system (IS) as the outcome of both *financial* and *non-financial consequences*. Negative consequences are referred to as *costs*, positive consequences as *benefits*. IS literature makes a distinction between different categories of benefits: cost savings, increase of productivity and competitive advantages (Parker & Benson, 1986). Dependent on the category, different ways of evaluation have to be chosen. In addition, we want to point out that IT investments do not create value per se. But even though a direct connection between IT investments and company performance could not been proven yet (Kohli & Devaraj, 2003 127), IT can contribute to the company's value by enabling optimized business processes or new business models (Wigand et al., 1997).

Value-Based IT Management

Managing their company's IT portfolio is an important issue for CIOs. This includes the evaluation of both existing and proposed IT activities in order to increase the value added to the company. Especially since the *shareholder value concept* (Rappaport, 1986) has found its way into the minds of corporate managers, IT departments have to proof that they create value. Hence, value-based IT management has to find financial and non-financial metrics to measure business value throughout the full IS life cycle. Moreover, this requires processes for evaluating and prioritizing investment alternatives as well as for tracking of IS benefits after development is completed. Improving the value added by balancing risk and return is the fundamental idea of IT Portfolio Management (Jeffery & Leliveld, 2004 p. 41). Similar to Maizlish and Handler (2005 p. 21) we distinguish between the *project portfolio* that includes medium-term to short-term investments in new IT resources and the *asset portfolio* which includes the portion of the IT that is currently in operation and maintenance.

REVIEW OF COMMON IT EVALUATION METHODS

IS evaluation approaches can be systemized according to their purpose. Walter and Spitta (2004 p. 173) distinguish between *effect-assessing* and *effect-locating* evaluation approaches. The first type assumes that all necessary data are available and thus focus on the calculation and description of investment impacts. The second type aims at locating these impacts and the relevant data for the assessment. The model of Retter and Bastian (1995) is a good example for an effect locating approach. Direct and indirect effects of potential IS investments should be discovered with the help of process chains and effect chains. The critical success factors method (Rockhart, 1979) is another example of an effect-locating approach.

Effect-assessing methods can be subdivided into financial, multi-criteria and indicator approaches. Financial approaches exclusively consider financial factors. Multi-criteria approaches appraise investments using a score combining financial and non-financial factors. Indicator approaches finally use figures that combine financial and quantitative, non-financial factors to report on economically relevant issues in a concentrated form.

The first class is exemplified by the traditional capital budgeting techniques such as *net present value (NPV) analysis*, *internal rate of return calculation* and *payback method* (Farbey et al., 1993). Although these methods are regarded as mostly theoretically correct and are commonly accepted in practice there are significant drawbacks. Certain cash flows as required by the majority of financial approaches are rarely directly attributable to an IS and difficult to estimate.

Information Economics (Parker & Benson, 1988) and the enhanced approach of *New Information Economics* (Benson et al., 2004a) are examples for multi criteria approaches that are designed for IT investment decisions in particular. Both consider financial, non-financial and risk effects.

A widespread example for indicator approaches is the *Balanced Scorecard* (Kaplan & Norton, 1992) modified for IT evaluation (as exemplified by Jonen et al., 2004; van der Zee & de Jong, 1999). But there are many more examples of IT performance measurement systems building upon a set of financial and non-financial indicators (e.g. COBIT, 2007; van der Zee, 1996).. The advantages of indicators are that they can easily be calculated and compared to other companies.

Most of the methods presented here focus on the ex-ante evaluation of IT investments. There is less methodological support for evaluating projects after the development is completed. Only New Information Economics explicitly addresses the matter of assessing the business impact of existing IT activities (Benson et al., 2004b p. 44). Besides that, primarily indicator approaches are used for ex-post assessment. However, these indicators rather refer to the IT portfolio as a whole than reveal the value of a single IS.

Different authors urge that assessing the risk of IT investments should be an essential component of the evaluation process (Jeffery & Leliveld, 2004; Verhoef, 2002; Wen et al., 1998). In the context of traditional capital budgeting techniques, risk is considered by either adjusting the discount rate or the cash flows. Additionally *Sensitivity Analysis* and *Scenario Analysis* are common approaches to account for uncertainty (Brealey et al., 2006 p. 245). Though frequently discussed in IS literature the *Real Option Analysis* (Benaroch & Kauffman, 1999; Santos, 1991) and quantitative portfolio management approaches (Verhoef, 2002; Wehrmann et al., 2006) are less common in practice (Alter, 2006 p. 61). Multi criteria approaches often rely on subjective risk scores covering different categories of risk.

As most IT investments involve financial and non-financial benefits at the same time, Wen et al. (1998) suggest an evaluation should always consider both financial and non-financial factors. Today it is clear that no single financial method provides the possibility of adequately assessing the business value of any IT asset (Renkema, 2000 p. 162). One possible solution is to combine several evaluation approaches. But not all approaches are compatible to each other and the whole evaluation process can become very expensive. There is a lack of concepts for choosing the appropriate evaluation approach in each case and for integrating the results into a holistic picture.

REQUIREMENTS FOR VALUE-BASED IT MANAGEMENT - EMPIRICAL FINDINGS

At first we want to highlight the current situation how companies implement value-based IT management. Building on Veith et al (2007) work and extended through four in-depth case studies on large German financial services companies we present empirical requirements for value-based IT management approaches.

Current situation

This section aims at revealing how IT environments are managed today and if there is room for improvement. For this purpose, we first examine the process of evaluating and prioritizing investment alternatives. Secondly, we analyze how companies track value added throughout the full project life cycle.

Our case studies show – analogous to Veith et al. (2007 p. 1196) and Jeffery and Leliveld (2004 p. 42) – that most companies require a business case with a return on investment calculation for capital budgeting. As a solely monetary-oriented management of IT is seen as not feasible or at least as questionable (Veith et al., 2007 p. 1198) many companies supplement the business case with non-financial assessments regarding for example strategy alignment, urgency and interdependencies. Some companies use scoring models to quantify these aspects, others rely on qualitative statements. Risk evaluation is conducted mainly qualitatively and focused on project risks at the development stage. Risks of benefit realization are mostly not considered. Although a significant amount of work is put into theses formal evaluations the investment decision itself is often not based on the formal results. Corresponding to other research (Bannister & Remenyi, 2000 p. 231; Farbey et al., 1999 p. 191) we observed that many decisions are justified as "acts of faith", "gut instinct", "got to do" or simply "strategic". The reason behind that could be the executives' mistrust towards benefit evaluation methods or generally an inconsistent understanding of how IT value is defined.

When it comes to tracking the value added of existing IT assets, most participating companies have recognized a need for action. Jeffery and Leliveld (2004 p. 42) found out that 59% of the companies in their study regularly perform financial ex-ante evaluation of IT projects, while only 25% measure the realized benefits after completion. Examining ongoing management reporting, Veith et al. (2007 p. 1198) discover that costs are clearly emphasized. The majority of participating companies uses a balanced scorecard for reporting non-monetary indicators. The explicated value added is not included in any of these reports. Interviewees primarily mention measurement difficulties and resistance of business divisions as reasons for insufficient benefit tracking. Moreover, we realized that the link between ex-ante evaluation and ex-post tracking is often missing.

Requirements

According to Veith et al. (2007 p. 1199), we derived a set of requirements from the empirical observations as shown in table 1. An approach for value-based IT Management should be capable of supporting both capital budgeting and tracking value realization while considering both financial and non-financial effects.

No.	Requirement
1	Value-based IT management should improve transparency regarding current business impact and value added of IT assets.
2	Within the scope of value-based IT management, investments should be consequently controlled regarding their objective achievement and underlying assumptions.
3	To justify investments value-based IT management, should be able to communicate the IT value added towards business executives.
4	Value-based IT management has to incorporate ex-ante (capital budgeting) and ex-post (value tracking) evaluation.
5	Value-based IT management requires decision relevant costs and benefits to be quantified and thus made measurable.
6	Value-based IT management should not focus solely on monetary figures.
7	In addition to costs and benefits, value-based IT management should consider risk.
8	Value-based IT management should be capable of estimating the alignment of IT assets to business strategy.

Table 1. Practice requirements for value-based IT management

CONCEPT DEVELOPMENT: VALUE-BASED IT MANAGEMENT

In order to develop an approach for value-based IT management, we propose according to practice requirement No. 4 two core processes: one addressing capital budgeting and the other one addressing ongoing value management. So-called *value drivers*, which are identified during capital budgeting and monitored during value management, link both processes. The overall objective is to maximize IT value added in consideration of risk. Based on the insight that no single financial approach is capable of adequately assessing the value of any IT asset, we combine different evaluation methods to obtain a complete picture of value added. Figure 1 shows an overview of the value-based IT management process. In the following we will describe the *capital budgeting process* and the *value management process* as well as recommended evaluation techniques.

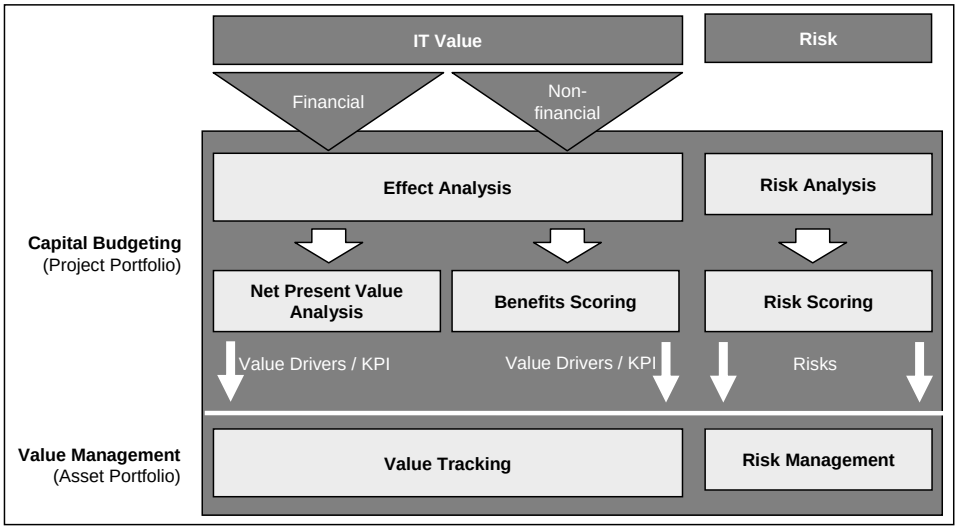

Figure 1. Value-based IT Management Process Overview

Capital Budgeting Process

The purpose of the process presented below is supporting capital budgeting and investment decision making. It consists of three main steps, which are *effect analysis and assessment, risk analysis and assessment* and finally *portfolio visualization*.

Effect Analysis

Firstly, it is necessary to identify and understand all relevant positive and negative consequences of an IT investment alternative. As the identification of costs is generally regarded as rather straightforward we will focus on benefits here. IT benefits can arise in different business divisions, be indirect and may not be obvious at first glance. This makes it impossible to apply one standardized procedure. Depending on the category of desired benefits, different effect locating approaches are suitable. One helpful approach – primarily to identify cost savings and productivity approaches – are process chains and effect chains as proposed by Retter and Bastian (1995). Otherwise the critical success factors approach is more suitable to locate competitive advantage effects. Once all benefits are collected the *value driver network* (VDM) can be built. Figure 2 shows an example for a VDM. In the top layer you can find the identified IT benefits for which quantification is often difficult or even impossible. Arrows indicate cause-effect relations. The bottom layer includes the company's strategic business objectives. For the construction of the VDM the evaluation team has to find so called value drivers that create a cause-effect relation with one ore more strategic objectives. Each value driver can be quantified and measured with financial or non-financial performance indicators (requirement No. 5). To identify the value drivers we propose a two-step approach. Firstly, IT-benefits are mapped on measurable business indicators. In the second step each indicator has to be examined with regard to its effects on the strategic objectives. The completed VDM is the foundation of the benefits evaluation.

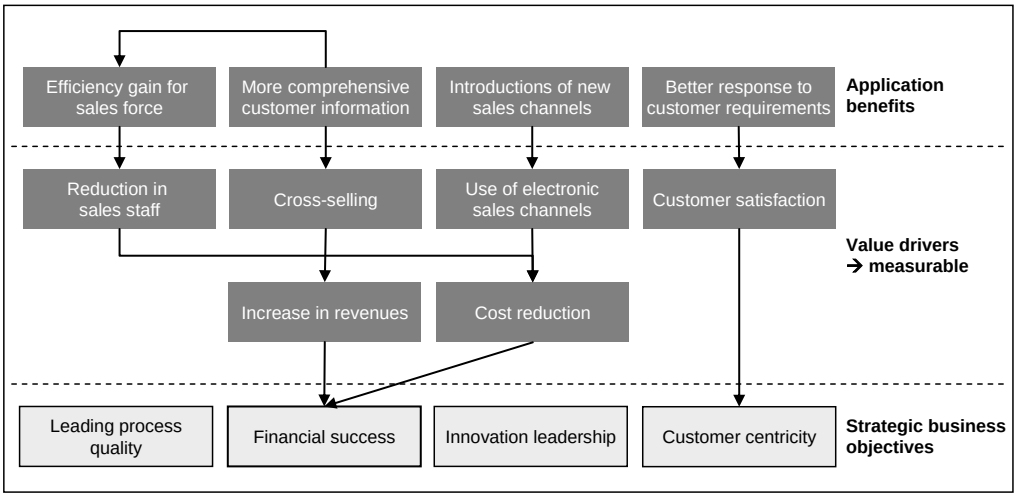

Figure 2. Example of Value Driver Network (Introduction of CRM-system)

Effect Assessment

For the evaluation we distinguish between financial and non-financial effects. *NPV analysis* is used for the financial assessment while a *scoring model* helps to assess the (non-monetary) strategic impact of an investment alternative. In order to calculate the NPV of a project, cash in- and outflows have to be estimated (for details on NPV analysis see Brealey et al., 2006). We point out that only those effects should be considered that have an actual impact on the company's profit and loss statement. Productivity gains are regarded as indirect monetary benefits. They can only be considered if they lead to an increase in revenues or to cost reductions. We do not suggest the inclusion of any imputed costs at all. Translating benefits into cash flows is the critical part of the NPV analysis. The basis is the VDM, which contains financial and non-financial value drivers. Each value driver has corresponding key performance indicators (KPIs), as for example 'headcount in the sales department' for the value driver 'reduction in sales staff'. Estimating a project's cash flow requires forecasting the investment's effect on all non-financial KPIs that have a cause-effect relationship with the financial value drivers. Furthermore, it is probably necessary to introduce a series of additional assumptions to complete the cash flow estimation. In many cases these assumptions will concern general conditions. However, if additional assumptions relate to consequences of the proposed investment, it should be considered to add them to the group of value drivers. As the KPIs are the basis of value tracking when a project has gone live, they should meet a few requirements. For ongoing controlling KPIs have to be measurable with a reasonable effort. The values forecasted to estimate the cash flows have to be carefully documented because they represent the target values for later benefit tracking. In addition, a tracking schedule has to be decided. If the number of KPIs (respectively value drivers) is high, it is better to track only the most important ones. Sensitivity analysis can be applied to find out which are the most influential value drivers.

Besides NPV analysis, a non-financial evaluation has to be conducted (requirement No. 6). For this we advocate the use of a *scoring approach* to assess the strategic alignment of an investment alternative. Both practice (requirement No. 8) and academia call for *IT-business alignment* which is regarded as a key prerequisite for value creation (Avison et al., 2004). The proposed scoring approach evaluates investment alternatives on the basis of a set of predefined evaluation criteria. Before the actual assessment theses evaluation criteria have to be derived from the company's strategic objectives and weighted according to their relative importance. Financial objectives are not included. Both evaluation criteria and weights remain the same for the assessment of all investment alternatives. They only have to be changed if business strategy changes. For the actual rating the evaluation team evaluates each investment alternative against all criteria by assigning a score between 0 and 4 for each criterion depending on the investment's impact on the particular criterion. Thereby, the VDM serves as the basis for the rating. The sum of all weighted scores gives the total *business alignment score* for each investment alternative. To prevent arbitrariness and rating bias, the evaluation team should consist of members from business divisions and IT department alike. Similar to the financial assessment, value drivers and corresponding KPIs have to be named for each criterion which an IT investment is supposed to have a significant impact on. For these KPIs target values have to be defined by the evaluation team to be able to control the realization later. Table 2 demonstrates the application of the criteria rating approach.

Evaluation criterion	**Weight**	**Score**	**Weighted Score**	**Value Driver**
Highest Process Quality				
Introduction of new products	12,5%	1	0,125	
Sales efficiency	12,5%	4	0,500	Time spent on administration, Percentage of new customers
Customer Centricity				
Customer satisfaction	25,0%	3	0,750	Customer satisfaction
Complaints	13,0%	3	0,390	Handling time
On-time delivery	12,0%	0	0,000	
Innovation Leadership	…	…	…	…
…				
	Business Alignment Score		**1,765**	

Table 2. Example of Criteria Rating (Introduction of CRM-system)

Risk Analysis and Assessment

To account for the fact that the financial and non-financial evaluation is based on a series of uncertain expectations, assumptions and forecasts, the dimension risk has to be considered in IT investment decisions (requirement No. 7). In the context of the capital budgeting process we recommend firstly identifying and classifying all key risks of a certain project and secondly assess them in respect of their impact. The identification and classification is supported by a process that was developed by Junginger (2005 pp. 214-239). For each value driver all risks that jeopardize the forecasted KPI target values are collected in the first step. Afterwards the identified risks are classified according to the related phase in the IS life cycle (portfolio, project, operations) and eight generic risk categories: external environment, persons in charge, management of relationships, project management, requirements, project budgeting, personnel and technology (for details see Okujava & Remus, 2006). This compendium of all risks is the basis of the following risk evaluation as well as ongoing risk management during development and operations.

A risk-scoring model is applied to assess the impact of the identified risks. The evaluation team qualitatively estimates the two dimensions 'probability of occurrence' and 'impact on the proposed value added' for each risk category. For this a rating scale between 0 and 4 is used. A probability rating of 0 means very low probability and 4 means very high probability; an impact rating of 0 stands for no noticeable impact and 4 stands for substantial impact. Using formula 1 both ratings are aggregated to a single score. Thus we get a risk score between 0 and 24 for each of the eight risk categories. Finally the total risk score of the investment alternative is calculated by averaging over the eight risk scores.

$$risk\ score\ (category\ i) = (probability_i + 1) \cdot (impact_i + 1) - 1$$

Formula 1. Risk score calculation

Portfolio Visualization

After evaluating the value and risk of all investment proposals the results are visualized in a 2-dimenesional portfolio view, which helps the decision maker to prioritize among the different alternatives. In contrast to the Information Economics approach, for example, we forego aggregating the financial, non-financial and risk aspects to a single score because this would significantly reduce information content and transparency. To show all three dimensions in one chart anyway, we suggest using a matrix similar to the famous BCG matrix. Every investment alternative is illustrated by a colored bubble in the chart. The horizontal axis represents the business alignment score, which is between 0 and 4; the vertical axis represents the NPV. The projects' risk score is indicated by the color of the bubble. The darker the color is the higher the risk. Finally the size of the bubble represents the capital expenditure necessary to undertake the project. Figure 3 exemplifies the portfolio visualization. Depending on the position of an investment alternative within the matrix, there are different priorities. The highest priority is assigned to such projects that have a positive NPV and have a high business alignment score. Projects positioned in the lower left quadrant should be rejected based on these considerations.

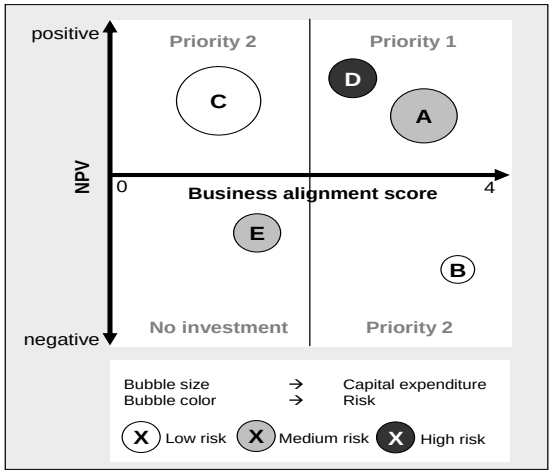

Figure 3. Visualization of a project portfolio

Value Management Process

As soon as an asset has gone live it is part of the asset portfolio and value-based IT management has to ensure that the proposed value added is realized according to plan. This is the purpose of the value management process that covers *value tracking*, *risk management* and *reporting*. The key objectives are to control organizational behavior and to foster organizational learning.

To measure the value added of IT assets, both costs and benefits have to be taken into account. We do not want to focus on costs here as ongoing cost control is sufficiently covered by the topic of IT budgeting. Benefits tracking requires determining both financial and non-financial benefits. Whereas cash flows from cost reductions can mostly be identified and quantified, cash flows from increase in sales are difficult to attribute to a particular IT asset due to a number of possible external influences. In either case exact measurement requires a considerable amount of time and effort. To perform value tracking in an efficient manner anyway, we propose the use of KPIs that represent the key value drivers of an IT project. The value drivers have a cause-effect relationship with the intended benefits. Because of this relationship we can measure value added without measuring benefits directly. It is sufficient to compare the actual values of the KPIs with the target values defined in the capital budgeting process. The complete value tracking process is illustrated in figure 4. After measuring the KPI, the target performance level can be calculated according to formula 2 as the ratio of actual variation to target variation.

$$Performance\ level_T = \frac{actual\ variation_T}{target\ variation_T} = \frac{actual_{t=T} - actual_{t=0}}{target_{t=T} - actual_{t=0}}$$

Formula 2. Performance level calculation

If the performance level is below a certain threshold, a variance analysis should be carried out to discover the reasons for the variance. Basically variances can be controllable and non-controllable. Corrective action can only be implemented in case of controllable variances, which either result from shortcomings in the planning or in the execution stage. Examples for corrective actions are technical adjustments, organizational measures or even the shutdown of an IS. In case of extensive actions it is necessary to redefine target values and/or the schedule for future value tracking. Thereafter the process restarts with measuring at the next scheduled date.

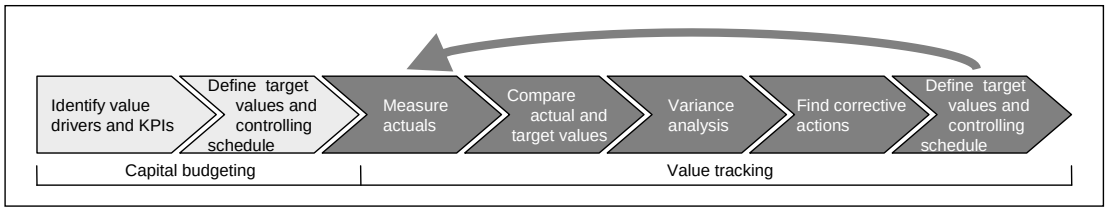

Figure 4. Value tracking process

The value tracking process can be understood as a part of the benefits management process. Ward and Daniel (2006 p. 113) point out that ex-post evaluation of IT investments is one of the factors having a significant impact on the success of new IS.

For risk management we suggest a cyclic risk management process (Junginger 2004) including risk identification, risk analysis, risk assessment and risk treatment. Even though the process is initiated during capital budgeting, it is important that risk management is continued when IT assets have gone live. The risk condition and all measures of risk treatment have to be monitored continuously.

In order to achieve the objectives of the value management, it is not sufficient to gather information about actual KPIs, risks, variances, explanations and ideas for corrective action. All information has to be edited and forwarded to executives and the responsible personnel in order to initiate the desired actions and to learn for future investment decisions. Therefore a *value report* is created regularly for each IT asset. Besides planning data from capital budgeting, the report shows all KPI and their respective performance levels as well as any changes in the risk condition. If a significant variance is detected, a deviation report should be attached containing analysis and interpretation of variances and ideas for corrective action and risk mitigation. But value added should not only be reported for single assets. The *value map* is a compilation of all value reports, mapping the value added for the entire enterprise IT landscape. In a value map (figure 5) all applications are arranged according to the supported business processes. For each application the basic information from the value report is displayed. The coloring, which symbolizes the overall performance level, points out variances at first sight.

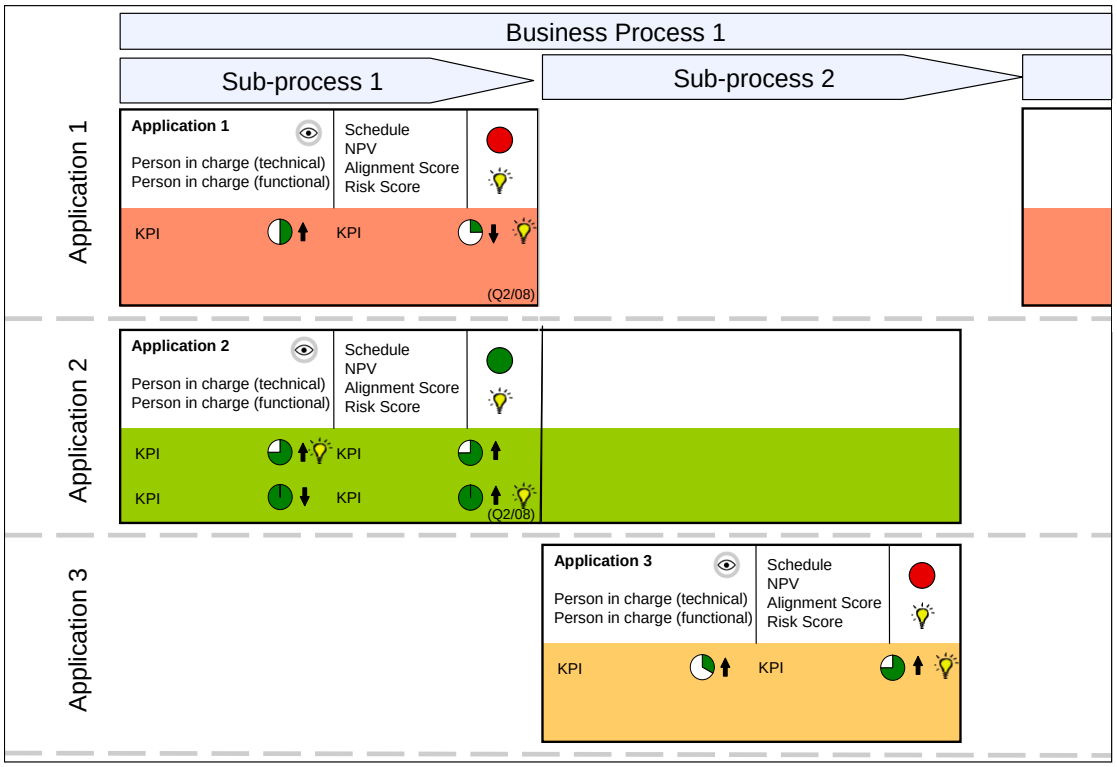

Figure 5. Example of a value map

For demonstration purposes we implemented a Microsoft Excel prototype supporting the creation of a value report. Then, we created a value map with the enterprise architecture management tool *planningIT* from *alfabet*. The prototyping verified that the requirements from our concept could be met with standard software.

STRENGTHS, LIMITATIONS AND OUTLOOK ON FUTURE RESEARCH

The majority of practice requirements have been incorporated in the approach for value-based IT management and some previously identified deficiencies have been removed. The process and the recommended techniques are grounded in respective theories. By combining different financial and non-financial evaluation approaches the business value of IT is widely captured. The value driver concept allows ongoing measurement of value added in an efficient way and therefore integrates ex-ante evaluation and benefits tracking.

Nevertheless, we have to consider that the application of the concept in practice requires considerable effort. Especially KPI measurement requires significant additional work. Implementation requires company-specific modifications and additions. The missing consideration of interdependencies is another limitation. Neither technical and functional project dependencies nor risk diversification and portfolio effects are accounted for in order to reduce complexity.

The overall concept is finally evaluated by the same group of IT decision makers that were involved in requirements elicitation using an expert focus group evaluation approach. The interview partners concluded that the concept is convincing and addresses all relevant requirements. Main obstacles to an implementation are resistance of business departments and conflicts of interest in decentralized organizations. To resolve that problem governance structures are required to manage business departments with regard to IT value added. Moreover, it was criticized that the concept does not offer a formal feedback process between value tracking and capital budgeting.

In general our value-based IT management approach could help practice to increase transparency with respect to the business value of IT. The approach shall generate additional value from improving the project portfolio (i.e. optimizing resource allocation) and capturing more value from the asset portfolio (i.e. optimizing benefits realization).

Further research has not only to be done on the practicability of the approach but empirical data on the application of the approach has to be collected. Therefore a next step would be the test of our concept in a real business environment. For this purpose, our concept has to be adapted to the needs of individual companies and implemented parallel to existing IT evaluation methods. As it is not possible to measure directly the value gained from optimizing the project portfolio, an expert survey or interviews with IT and business managers will be applied to assess the outcome of the approach. However, potential improvement in benefit realization can be shown quantitatively by analyzing the ratio of projected versus realized benefits. Together expert evaluation and ex-post analysis of benefits realization will shed light on the practical implications of our approach.

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