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Project portfolio management on steroids: Simulating portfolio decisions using value driver trees

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Abstract

Purpose: Project portfolio management is the coordinated management of one or more portfolios. The goal is to support portfolio decisions by balancing existing projects and new project applications into a portfolio mix that has the greatest potential to achieve strategic objectives and create value. Many portfolio decisions are interdependent, as each project has the potential to have a negative or positive impact on other projects. Therefore, it is important to simulate the effect of individual or combined decisions on the overall value of the portfolio. However, organisations frequently lack methods to efficiently and effectively support portfolio decisions, particularly 'what-if' simulations that can be run 'on the fly' during discussions in the decision-making body. In other application areas, value driver trees have proven to be a practicable solution. However, value driver trees have not yet been considered for project portfolio management. This paper answers the following research question: How can existing portfolio management processes be expanded through simulations using value driver trees?
Methodology: The methodology follows Peffers et al.'s (2007) design science research process, using an illustrative case study for demonstration. The research gap was identified through a systematic literature review.
Findings: A process model for utilizing value driver trees for the purpose of portfolio simulation was developed in line with situational method engineering. The process model was then demonstrated and evaluated using an illustrative application scenario. Portfolio simulations based on value driver trees have the potential to improve the quality of interdependent portfolio decisions through 'what-if' simulations. This study extends the research on project portfolio decisions by using simulations based on value driver trees. Moreover, it provides practitioners with a process model to support the organisational implementation of the approach, thereby increasing the likelihood of successful deployment.

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1. Introduction

1.1. Context

A **project portfolio** is a collection of projects or programs grouped together to achieve strategic business objectives [1]. **Project portfolio management** is the coordinated management of one or more portfolios [2]. It involves the identification, prioritisation, approval, balancing, control, and termination of projects. Portfolio management is crucial for the survival and growth of an organisation. It enables organisations to invest in the appropriate programs and projects based on the current environmental conditions and strategic objectives such as market share or social sustainability [3].

The organisational roles responsible for portfolio decisions seek to balance existing projects and new project applications into a portfolio mix that has the greater potential to collectively support and achieve strategic objectives [1, 3]. The result of the **project selection** process is a prioritised list of projects that represent the best value for the organisation based on available capacity. The subsequent process of **portfolio governance and management** aims to actively cultivate the portfolio mix with the greatest potential to collectively support the organisation's strategic objectives [1]. In this context, **value** is the primary focus of portfolio management, defined as the entire quantifiable and qualifiable benefits, worth, and usefulness of the organisation. Since value-based management seeks to maximize the value of the organisation [4], it is necessary to manage this success-critical process in a customer-focused manner. In this case, customers are the portfolio sponsors and the portfolio governance board, taking the decisions on the portfolio mix [1].

1.2. Problem identification and motivation

A **Portfolio Management Information System (PMIS)** comprises policies, processes, and tools for collecting, integrating, visualising, preserving, and disseminating portfolio management results [1]. Among others, the PMIS answers questions such as the following: Which (mix of) portfolio components best support the organisation's strategic objectives? Which new component should be added to the portfolio, which should be discontinued? The term 'component' refers to subsidiary portfolios, programs, and projects that are managed in a coordinated manner to improve the overall value for the organisation. In cases where portfolio decisions are interdependent, each component has the potential to have a negative or positive impact on other objectives. Therefore, it is important to simulate the effect of individual decisions regarding the value of the portfolio.

However, many organisations use simple tools such as weighing and rating systems, pair-wise comparisons, and decision-conferencing techniques to align their portfolio with their strategy and reach a consensus on the relative merits of various projects [3]. Others use methods of isolated benefit assessment of individual projects such as payback period or net present value (NPV) for portfolio decisions. Organisations frequently lack advanced methods to efficiently and effectively support portfolio decisions. In particular, tool-based 'what-if' simulations that can be updated 'on the fly' during discussions in the decision-making body would support decision-making. In this regard, the simple simulation of the value impact of alternative portfolio scenarios is a gap in practice.

The common goal of portfolio management is to further increase the value of a company in line with its strategy. Rappaport [5] defines **value** as 'shareholder value', which refers to the maximisation of a company's monetary value from the perspective of its shareholders. In this context, value drivers are financial or operational determinants that have a causal relationship with positive shareholder value [6]. To help manage these central value drivers, value driver trees (VDTs) are a proven tool in the field of value-based management [7]. VDTs are a systematic method for linking operational value drivers to strategic (financial) target indicators of a company [7]. Due to their methodological nature, they could also be an effective and efficient solution to simulate the impact of project applications and support overall portfolio balancing decisions. Despite their potential, however, there have been no attempts to integrate VDTs into

PMIS as a solution for portfolio simulation (see the systematic literature review; section 2). In particular, there is no process model available that guides the use of VDTs to project evaluation and portfolio balancing.

1.3. Objectives for a solution

The problem statement indicates that practitioners need a structured approach including guidance on objectives, inputs, procedures, outputs, methods, and success factors at each step of the process. Building on this, this study pursues two objectives. First, it aims to identify the **benefits and limitations of VDTs** for value-based management of the process of portfolio balancing to understand how VDTs can be used for simulating and analysing the (financial) impact of alternative decision scenarios. Secondly, a **process model** must be developed to systematically guide such simulations of portfolio decisions using VDTs. A process model is a mapping of the activities to be performed within the context of an overall task [8, 9]. It encourages a common understanding of the process and cross-functional cooperation between the parties involved. In the context of project portfolio management, such a standardized process can provide structured guidance for selecting and managing the optimum set of project-oriented initiatives that deliver the maximum in business value [10].

This paper unfolds as follows: Section 2 provides a systematic literature review to identify the research gap and to confirm the underlying research problem. The research method is introduced in Section 3. In line with Peffers et al.'s [11] design science research process, the targeted process model is developed in section 4 and demonstrated as well as evaluated in section 5. Section 6 communicates the contributions and limitations of the study.

2. State-of-the-research

2.1. Systematic literature analysis

To sharpen the research agenda, the current state of research had to be determined through a systematic literature review following the framework of Vom Brocke et al.[12]. Relevance was enhanced by avoiding repetitive analysis of what is already known [13], and rigour is derived from effective use of the existing knowledge base [14]. The literature search was conducted using a set of 12 mostly combined keywords (e.g., "project portfolio/project evaluation" AND "value driver tree") in five databases (Web of Science, Emerald, IEEE Xplore, ScienceDirect, Sage). A preliminary evaluation of article titles and abstracts reduced the number of publications from 799 to a sample of 30 articles based on the following criteria: up-to-dateness, relevance, authority, accuracy, and purpose. To ensure a high quality of sources, the focus was on publications in scientific journals and conference proceedings. The relevant articles were evaluated using a concept matrix.

2.2. Results

The aim of the literature review was to answer two questions: (1) What methods are commonly proposed in the literature for project evaluation and portfolio balancing and to what extent do they allow a fast and accurate simulation of portfolio decisions in terms of value creation? (2) Has the use of VDTs for simulating portfolio decisions already been proposed, and if so, is there a clear application guidance in the form of a process model?

Regarding the first question, a variety of methods have been proposed for the purpose of project portfolio management. Examples include scoring models, classical simulation methods, and scenario analyses [see e.g. 15, 16] or cluster analyses [17]. However, all these methods lack a simple and fast simulation "on the fly" as well as a focus on target indicators of value creation (e.g. Economic Value Added). As a result, it is difficult for practitioners to understand how portfolio decisions contribute to value maximisation. The use of VDTs to address these issues has only been identified once [18].

Regarding the second question, it was found that only one proposal for the use of VDTs in the context of project portfolio management has been made [18]. However, there is no generic process model that can be integrated into the classic project portfolio management process [19] and that can provide practitioners with guidance on the appropriate use of VDTs.

In summary, three findings can be summarized in terms of a research gap: First, while a variety of methods have been proposed for project portfolio management tasks, few of them are able to perform simulations "on the fly," and none of them allow for simulating the impact on the organisation's overall value creation. Second, with one exception ([18], the use of VDTs for project portfolio management in general and project evaluation and balancing in particular is largely unknown. Third, there is no process model that provides practitioners with guidance on the use of VDTs in project portfolio management.

3. Research methodology

Design science provides a suitable methodological framework for construction-oriented research projects [20]. In essence, this research paradigm seeks to scientifically develop innovative artifacts that improve the capabilities of people and organisations [14]. This study follows the **design-science research process** presented by Peffers et al. [11], which is comprised of six steps: *problem identification and motivation*, *objectives for a solution*, *design and development*, *demonstration*, *evaluation*, and *communication*. The methodology is oriented towards Peffers et al. [11] and the guidelines of Hevner et al. [14].

The goal of this design-oriented research is to develop a practicable artifact in the form of a process model for the application of VDTs in project evaluation and portfolio balancing. The design-science research process [11] is implemented as follows: *Problem identification and objective formulation* were carried out based on a systematic and comprehensive **literature review** (section 2). The principles of **situational method engineering** [21] were used to design and develop a method (here: VDTs) for a specific application situation (here: project evaluation and portfolio balancing). An **illustrative application scenario** is used in order to *demonstrate* the process model and to obtain insights for the *evaluation*. This multi-method approach is widely used and validated in current research [22, 23]. The results are summarized and *communicated* in section 6.

4. Design and development

4.1. Overview and design principles

The artefact solution to be designed is a process model for the application of VDTs for the purposes of project evaluation and portfolio balancing. The process model provides a systematic framework for the temporal and logical structuring of activities (including responsibilities) to be performed for the data-driven evaluation of project portfolio decisions using VDTs. The target group includes, on the one hand, the organisational roles that decide on the inclusion and removal of projects in the portfolio, such as a steering committee. On the other hand, the roles such as a PMO that prepare such decisions, for example by calculating the financial impact of project proposals [1, 3].

Methodologically, the principles of **situational method engineering** [21] are adapted as part of the design process. Here, the goal is to adapt the proven method of VDTs to the situational context of project evaluation and portfolio balancing (see Fig. 1). To ensure the quality of a process model, compliance with the principles of proper modeling is adhered to [24].

4.2. Situational method engineering

Situational method engineering originates from software engineering and is a concept that guides the development of methods that are situation-specific [21]. The goal is to tailor a method in its characteristics in such a way that it meets the requirements of a specific situation and support a specific task. As a result of this study, an artifact will be developed that accomplishes this. The procedure and framework conditions (see Fig. 1) of the corresponding engineering are outlined below.

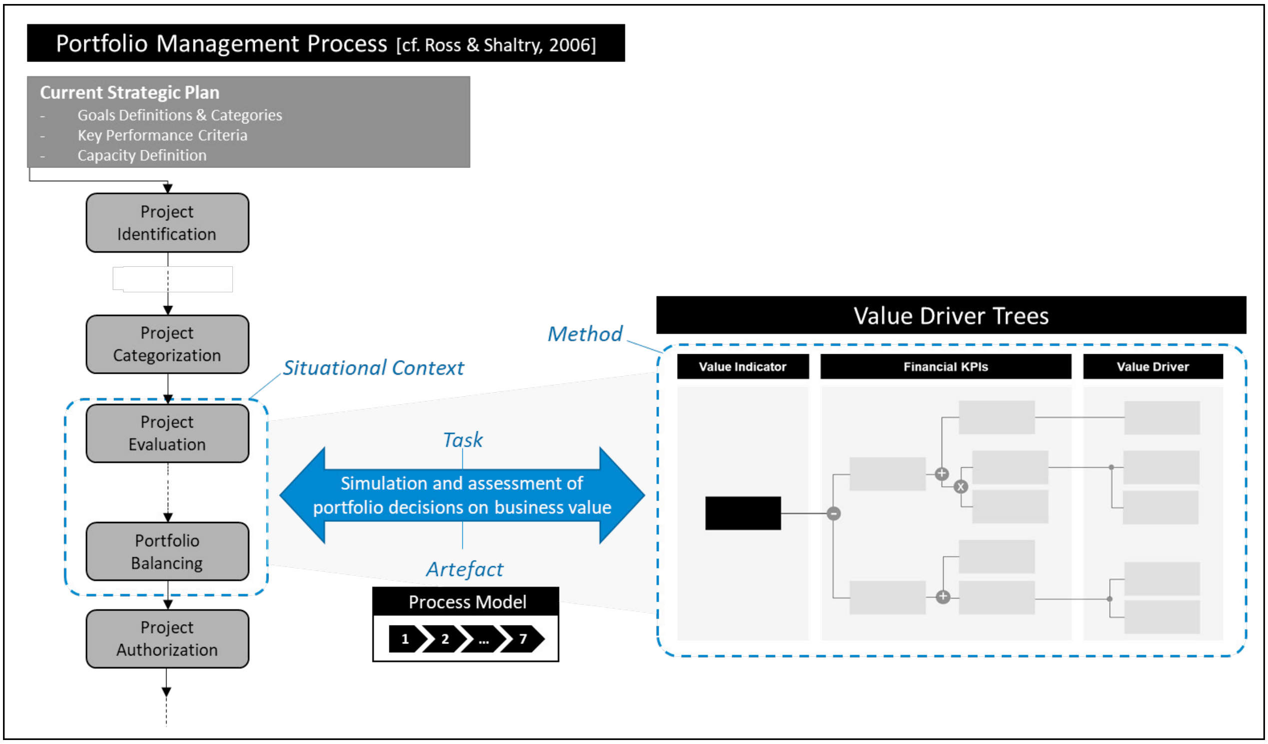

Fig. 1. Overview of the artifact (own representation).

First, the **situational context** must be specified. This is derived from the PMI's Project Portfolio Management Process [see 19]. Specifically, this involves the process steps of project evaluation and portfolio balancing. Project evaluation involves the generation of a short list of projects (portfolio components) based on a data-based evaluation method. Portfolio balancing is the process of incorporating the portfolio component mix with the greatest potential.

Secondly, the **specific task** to be supported is specified. This is the simulation and assessment of project or portfolio decisions with regard to a consistent increase in business value. A simulation is an imitative representation of a process or a system as it might exist in the real world [25]. To balance a portfolio, it is essential to analyse how adding or removing components affects financial and capacitive targets. Simulations support to negotiate the value to be created by the portfolio: against the strategic objectives for the overall portfolio, and within the portfolio, where each of its components is assessed against the value framework [1]. Simulations can also maximize the return from the investment in the portfolio for both initial planning as well ongoing performance monitoring and controlling.

Thirdly, the **method** to be adapted must be selected. For the purposes of the task described, the use of VDTs is suggested. VDTs are “a systematic method for the analytical explication of logical cause-effect chains between (a) financial (value-oriented) results and (b) their performance-oriented (monetary as well as nonmonetary) determinants—so-called “value drivers” [26, p. 1]. Because of these methodological characteristics, VDTs are a promising method for a targeted (by focusing on a strategic value indicator) and at the same time holistic (by mapping an entire business model) simulation of project and portfolio decisions.

Finally, an **artifact** is developed that supports the feasible application of the method for the execution of the described task in the corresponding situational context. For such a customization of the method, a process model will be developed (see section 4.2) and demonstrated and evaluated (see section 5).

4.3. Process model for portfolio decisions with simulations using value driver trees

The proposed process model is integrated into the PMI standard for portfolio management described by Ross and Shaltry [19], specifically the outlined portfolio management processes (see an extract in Fig. 1). As described, the objective of this process model is to guide the integrated use of VDTs for the purposes of project evaluation and portfolio balancing. At the same time, the steps of the process model are based on the portfolio management process described by Ross and Shaltry [19] in order to ensure a systematic and consistent approach.

To understand the process model, it is first important to define the organisational roles involved. Key organisational roles for portfolio decisions involve the sponsors, the portfolio governance board, as well as the the portfolio, program, and project management office (PMO). A **portfolio sponsor** is an individual or group that provides resources to the portfolio and is responsible for delivering the intended value contribution. [1]. This role is often filled by an executive member of the portfolio governance board. A **portfolio governance board** determines the governance practices and provides the leadership, oversight, and decision making. Typically, the responsibilities include not only governance, but also management tasks such as aligning the portfolio with the organisation's goals; controlling prioritized allocation of resources; making and communicating according decisions. At the portfolio level, a **PMO** is an organisational entity that provides a variety of capabilities and processes supporting portfolio management, such as identifying, coordinating, and controlling portfolio components; and facilitating resource allocation in alignment with organisational strategy and goals [1]. The PMO typically acts as a stakeholder throughout the portfolio's life cycle and recommends the selection, termination, or initiation of activities necessary to ensure that the portfolio remains aligned with the organisation's strategic objectives.

The **process model** (see Table 1) consists of a total of seven steps in which varying roles are involved. The operational implementation of the VDT-based simulations is primarily in the hands of the PMO. Compared with the standard approach as part of the portfolio management process [see 19], the central methodological difference is to be emphasized. Instead of categorizing and evaluating components with a scoring model comprising weighted key criteria, the evaluation of components is carried out on the basis of a uniform VDT that simulates individual and combined portfolio effects on value drivers and ultimately a key value indicator. This enables fast and flexible simulation of portfolio decisions, with an objectively calculable effect on a central key value indicator. The practical implementation of the process model with its individual steps is described in the following section.

Table 1. Process model for simulating portfolio decisions using value driver trees.

No	Title	Description	Organisational role
1	Identification	Creating an up-to-date list, with sufficient information, of ongoing and new components that will be managed.	PMO
2	Value driver definition	Defining a set of relevant value drivers for portfolio decision-making, derived from the business model and strategic objectives.	PMO / Portfolio governance board/ portfolio sponsor
3	Evaluation by simulating components and portfolio scenarios based on VDTs	Providing applications for new components or component changes; stating value driver impacts. Simulating and documenting the influence of the application or change on value drivers and top-level indicator; simulating all component in the portfolio simultaneously.	PMO
4	Selection	Evaluating components on the basis of their simulated value impact and formally rejecting or selecting them for further consideration.	PMO / Portfolio governance board
5	Priorisation	Ranking components according to value impact.	PMO / Portfolio governance board
6	Portfolio balancing	Creating the portfolio component mix with the greatest potential to collectively support the organisation's strategic objectives and value maximisation.	PMO / Portfolio governance board
7	Authorisation	Formally communicating portfolio-balancing decisions and formally allocating financial and people resources required for selected components.	Portfolio governance board/ portfolio sponsor

5. Demonstration and evaluation

According to Peffers et al. [11], a **demonstration** of the developed artifact is necessary, in which the efficacy of the artifact to solve the problem is presented. Various demonstrative approaches are conceivable for this. For the initial demonstration of a conceptual process model, an application in an illustrative scenario is suitable [27]. An illustrative scenario is the "application of an artifact to a synthetic or real-world situation aimed at illustrating suitability or utility of the artifact" [27, p. 402].

Figure 2 summarizes the application scenario designed for the purposes of this study. It shows the evaluation of two project ideas (P_A and P_B) at a manufacturing company. The aim is to estimate their effects on the key value indicator "Return on Capital Employed" (ROCE). For this purpose, the individual and combined influence of the two projects on the target indicator is simulated using a value driver tree. The **process model** outlined in Table 1 is implemented as follows (see Fig. 2):

(1) *Identification*: The PMO provides a status quo of the current project portfolio with all relevant information.

(2) *Value driver definition*: A VDT on which the decision-making process is based has been prepared and updated. The corresponding value-based target indicator is ROCE and the key value drivers are, for example, the fixed costs of personnel and production as well as working capital indicators (Days Sales Outstanding [DSO]; Days Payables Outstanding [DPO]; Days Inventory [Outstanding DIO]). This decision-making logic is established by the PMO together with the portfolio sponsor and the portfolio governance board.

(3) *Evaluation by simulating components and portfolio scenarios based on VDTs*: The project (component) applications are based on a value driver tree in which the basic business model of the industrial company is mapped. The PMO requires the project manager to indicate the potential impact of the projects (P_A and P_B) on the financial KPIs and value drivers. The potential effects of the projects are individually simulated (= for the purpose of an individual project evaluation) as well as jointly simulated (= for the purpose of a collective portfolio simulation). E.g., the exemplary P_A stands for an investment in warehouse technology. This requires an expansion of assets (+ € 4 million) and a subsequent increase in fixed production costs (+ € 0.2 million), which, however, optimizes warehousing and reduces the key indicator DIO) by 2 days.

(4) *Selection*: The results are used to compare the individual influences of the components. E.g., P_A can lead to an optimization of the ROCE to 13.80 % (+ 0.17 %); P_B can lead to an optimization of the ROCE to 13.78 % (+ 0.15 %). These results support the positive selection of both components.

(5) *Priorisation*: In terms of prioritization, P would be preferable to P due to the greater value impact. As there are no capacity bottlenecks in this scenario, there is no particular reason why either component should not be approved. Therefore, a priorisation is not necessary.

(6) *Portfolio balancing*: The results are finally used to evaluate the collective influences of the components. combined, both components (P_A and P_B) can lead to an optimization of the ROCE to 13.95 % (+ 0.32 %). There are no interconnected effects on the indicators of the VDT, which in combination would lead to a negative impact on the end result. Therefore, the results presented may suggest the acceptance of both projects.

(7) *Authorisation*: Steps (4) to (6) were evaluated by the PMO and the portfolio governance board and finally approved. The decisions are implemented and communicated together with the project sponsor.

The purpose of a subsequent evaluation is to observe how well the artifact supports a solution to the underlying problem [11]. Various criteria can be used in this evaluation. The following criteria should be used for the critical discussion of the proposed artifact [14]: *functionality*: the use of the process model has proven helpful in systematically applying VDTS to simulate portfolio decisions; *usability*: the comprehensive transparency and target orientation of the simulation and evaluation has proven to be an advantage; *accuracy*: the accuracy of the simulation depends on the validity of the modeled VDTs and on the assumptions formulated in the project application; *reliability*: the use of VDTs is repeatable and the results are stable as long as the underlying assumptions remain unchanged. In summary, the illustrative application of the approach shows that VDTs are suitable for the evaluation as well as the simulation of portfolio decisions. On the one hand, a comprehensive valuation basis is provided based on the business model und of the key value indicator; on the other hand, the valuation and simulation of project/portfolio decisions is consistently calculable, comparable and therefore objective.

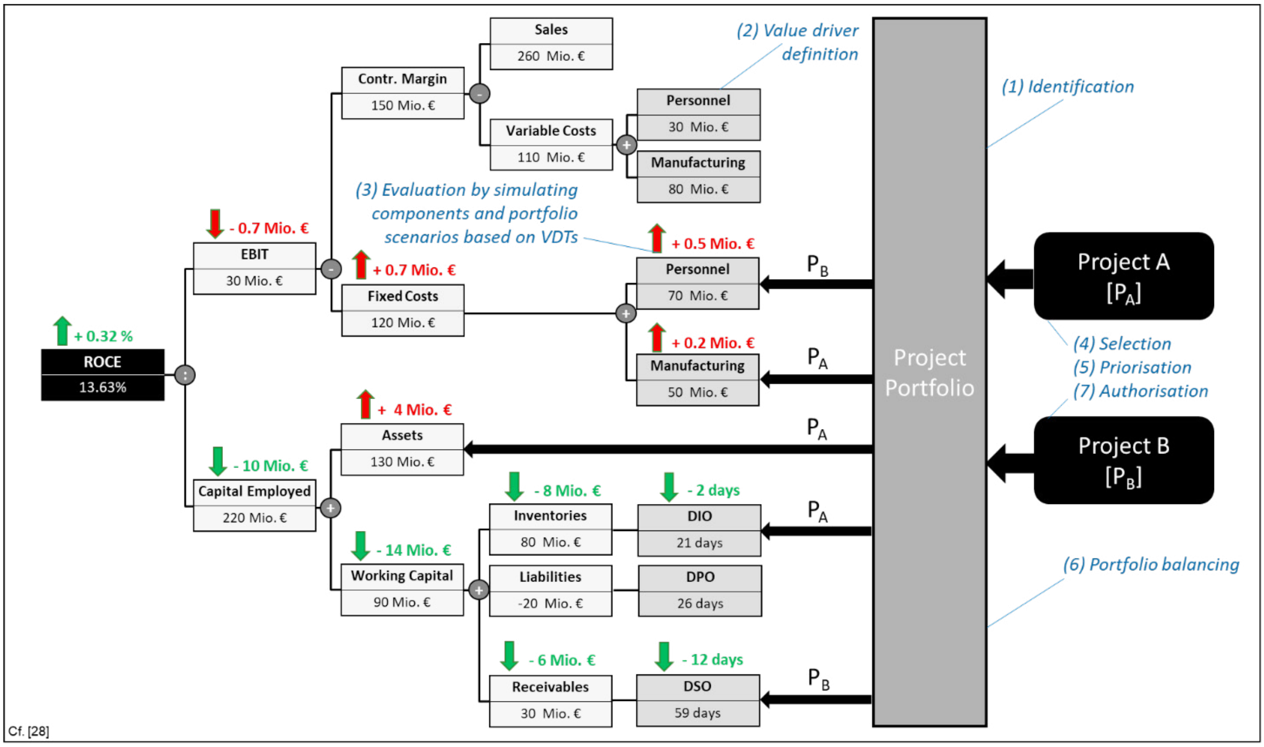

Fig. 2. Demonstration of the process model in an illustrative scenario (own representation)

6. Communication

The **aim** of this paper is to support portfolio decisions by balancing existing projects and new project applications into a portfolio mix that has the greatest potential to achieve strategic objectives and create value. To achieve this aim, a central research question was addressed: How can existing portfolio management processes be expanded to improve decision quality through simulations using value driver trees?. In this regard, the development and evaluation of a process model for the integration of VDTs into a PMIS was sought as a possible answer. This process model was developed following the principles of situational method engineering, comprising process steps, activities, roles, and responsibilities. An illustrative application scenario was conducted to demonstrate the use of VDT in simulating the impact of portfolio decisions and to obtain detailed and valid insights for an initial evaluation. The results support the assumption that VDTs can practically support the tasks of project evaluation and portfolio balancing by providing holistic, calculable, and objective simulations that accurately represent the impact of portfolio decisions on strategic objectives. Critically, the modelling of the VDT involves a large amount of effort with statistical tests [29].

However, there are **limitations**. Firstly, human judgment was required to determine which literature was considered relevant in the systematic literature review. Secondly, the data used in the illustrative application scenario was artificially generated to serve the purpose of an initial proof of concept. However, it is important to note that VDTs are company and domain-specific, making it difficult to create generalizable case studies. For future research, the approach should be applied to further real-world case studies, preferably in various industries. This could further investigate the utility of the approach and the supporting process model.

Overall, the **contribution** of this study is twofold. Firstly, it extends research on project portfolio decisions by using VDT-based simulations, which enables practitioners to reduce the risk of poor decision-making, avoidable costs, and excessively long assessments of portfolio scenarios. Secondly, it provides practitioners with a process model to support the organisational implementation of the approach, thereby increasing the probability of successful deployment. In addition, the integration of the VDT method into project management opens up a new and promising research path.

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