Project interactions in value based IT project portfolio management

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Abstract: Adequately considering interactions among IT projects in the process of constructing an IT project portfolio is a necessary condition in value-based IT project portfolio management (PPM). A lot of articles already deal with such interactions, but the literature lacks a common terminology and a structured perspective on the manifold types of interactions and their effects. In this article we present a framework that provides a structured perspective on interactions and thereby supports decision makers in the identification of possible interactions and the selection of appropriate methods for value-based IT PPM.

1 Introduction

For the value-based management of IT projects it is necessary that, along with other requirements [ZI08], IT project portfolio management (IT PPM) has to account for interactions among IT projects. We speak of an *interaction*, if resources consumed or outputs generated by a project influence the use of resources or outputs generated by one or several other projects. If, for example, the same piece of hardware is needed in more than one project and each project only temporarily needs this hardware, this certain piece of hardware may be shared between the projects and thus has to be procured only once. In the literature many state-of-the-art approaches can be found that consider interactions to some extent. Nevertheless, the literature lacks a framework that provides a structure to identify the manifold types of interactions and their effects on the value of the overall portfolio. In this article, based on a literature review and conceptual considerations, we identify possible types of interactions among IT projects and propose a framework to structure these types of interactions and the effects they inhere on the value of IT project portfolios. This framework can help decision makers to facilitate a more general understanding of project interactions and to identify appropriate approaches for value-based IT PPM from the literature.

2 Project interactions in the literature

While there seems to be consensus that the consideration of interactions is an important issue in the selection process of project portfolios, the perspective on project interactions and the degree of detail in which they are considered vary greatly in the literature. In a literature review, we examined the databases of Ebsco, Google Scholar, Science Direct, and Informs for journals featuring articles which contain the keywords "project selection" or "portfolio selection" in combination with "interaction" or "interdependency". We identified *Management Science*, *European Journal of Operational Research*, *Decision Sciences, Journal of Management Information Systems* and *International Journal of Project Management* to be highly relevant outlets for the addressed topic. Subsequently, we focused our literature review on these journals. From the resulting 230 articles of these journals we were able to exclude 159 by an abstract analysis, because they do not address the subject of our research sufficiently. In the following, we present an excerpt of 12 ([GE07], [FO84], [NE86], [DO06], [LI08], [SA96], [ME07], [BA04], [KL02], [MA94], [EI06], [LE01]) of – what we feel are – key-contributions from the remaining 71 articles. Many of the presented approaches consider certain types of project interactions in a detailed way, but it seems that there exists little consistency about the terminologies used and many of the interactions considered result from the special fields of applications for which the approaches have been developed. To our best knowledge no contribution exists, which classifies the types of interactions discussed in the literature and which provides a unified terminology and structure for project interactions. This will be the focus of the next section. To unify the terminology in this paper, in the following we will consistently refer to relationships or (inter-) dependencies among projects as *interactions*. We further denote the economic impact an interaction causes as *interaction effect*. If an interaction limits the space of candidate solutions for the portfolio we denote this impact *constraint effect*.

3 Structuring interactions in IT project portfolio management

IT projects can be seen as a transformation process in which certain inputs are transformed into outputs. The inputs – or resources (including e.g. technologies, workforce, and equipment) – needed to conduct a project in general induce monetary costs, whereas the outputs produced can be interpreted as services (e.g. infrastructure services, a webshop functionality, a new reporting system) that can deliver direct monetary benefits (by e.g. selling them), indirect benefits (by e.g. granting competitiveness or improving business process efficiency), or provide a basis and become resources for other projects. Therefore, we distinguish between the *transformation* level and the *economic effect* level (see figure 3.1).
In the following, we present a framework which provides a structured perspective on interactions among IT projects, and which classifies the types of interactions identified in the literature with respect to the transformation level and the economic effect level. Interactions and constraint effects can only occur on the transformation level, whereas interaction effects purely take effect on the economic effect level. Among resources and outputs, three types of interactions can occur.

Resource-Resource interactions arise solely between the resources, whereas *Output-Output* interactions occur just between the projects outputs. *Output-Resource* interactions occur among outputs and resources. To keep it simple in a first step, on the economic effect level we distinguish just between (monetary) costs and (monetary) benefits. Further, we assume that all parameters of interest (e.g. benefits resulting from a project's output) are deterministic and known at the time the portfolio is planned. So called *intertemporal* interactions – interactions that may influence the decision-making today based on potential follow-up projects in future phases of project portfolio planning – are not considered in the first step. Thus, in this article we focus on interactions that just affect the planning decision of the actual portfolio, which are referred to as *intratemporal* interactions. The consideration of uncertainties in resource availability, project outputs, benefits, costs, and interaction effects are as well subject to further research.

In the following, along with a description for each of the different types of interactions, we provide a short example and discuss the specific forms this particular type of interaction can adopt, as well as the effect this interaction is expected to have. Further, we provide an assignment of the contributions found in the literature to the different types of interactions, if the considered interaction in a contribution in substance corresponds to our definition.

3.1 Resource-Resource interactions

a. *Competitive resource utilization interactions*
   Description: Projects require the same resource and therefore the amount of resource required for the joint implementation of the related projects is *greater* than the sum of the resources required if the projects would have been implemented separately.
   Example: A staff member shared among different projects may need some time to mentally switch between the projects. This may result in set-up costs which could have been saved if the staff member would only be employed in one project at a time.
   Forms of appearance: This interaction affects all related projects in some way, which we denote as *symmetric*.
   Interaction effect: Costs increase. Due to diseconomies of scale in the resource utilization, additional resources may have to be procured to conduct the related projects.
   Considered by: [FO84], [GE07], [SA96].

b. *Complementary resource utilization interactions*
   Description: Projects require the same resource and therefore the amount of resource required for the joint implementation of the related projects is *less* than the sum of the resources required if the projects would have been implemented separately.
   Example: A staff member shared among different projects may benefit from his knowledge of a specific programming language required in more than one project. This may reduce the effort and working time (e.g. due to learning effects) needed by this member.
   Forms of appearance: This interaction affects all related projects in some way, which we denote as *symmetric*.

Interaction effect: Costs decrease due to economies of scale.
Considered by: [FO84], [KL02], [SA96], [ME07], [MA94], [NE86], [EI06], [LE01] .

Apparently, the types of interaction presented above result in similar interaction effects, merely affecting the costs in different directions (positive and negative). For further modeling purposes they can be subsumed by the term *resource utilization interactions*.

3.2 Output-Output interactions

a. *Competitive output interactions*
Description: The benefit of the outputs generated through the joint implementation of related projects is *smaller* than the benefit of the outputs generated if the projects would have been implemented separately.
Example: The benefit of the implementation of an Enterprise Resource Planning (ERP) system will be substantially diminished by the parallel implementation of a second ERP system.
Forms of appearance: Can be either *symmetric*, so that all projects in this relationship are affected, or *asymmetric*, so that a project influences other projects, but is not influenced by the other projects itself. As a special symmetric form of this interaction, projects can become *mutual exclusive*[1] (as in the example above).
Interaction effect: Benefits decrease (in the symmetric or asymmetric case).
Constraint effect: Restricts the solution space (for the mutual exclusive case)
Considered by: [ME07], [DO06], [LI07], [FO84], [SA96], [ME07], [NE86], [EI06].

b. *Complementary output interactions*
Description: The benefit of the outputs generated through the joint implementation of related projects is *greater* than the benefit of the outputs generated if the projects would have been implemented separately.
Example: The joint development of a portable multimedia player and a compatible software-tool to administrate and arrange music and playlists for that device can have synergetic effects on sales of both of the products.
Forms of appearance: Can be either *symmetric*, so that all projects in this relationship are affected (as in the example above), or *asymmetric*, so that a project influences other projects, but is not influenced by other projects itself.
Interaction effect: Benefits increase due to economies of scope.
Considered by: [ME07], [KL02], [DO06], [FO84], [SA96], [NE86], [EI06], [LE01].

3.3 Output-Resource interactions

a. *Binary contingency interaction*
Description: A project cannot stand alone and requires the outputs of other projects as mandatory resources.
Example: The implementation of an ERP system may require the installation of computer hardware to be completed, whereas the hardware can be installed without the ERP system.

[1] The simultaneous conduction of two or more interrelated projects may lead to a situation where the projects technically could be conducted in parallel, but become "economically" mutual exclusive. For modeling purposes it still seems favorable to consider this being a constraint effect.

Forms of appearance: Is *asymmetric*, so that a project's output is required as a mandatory resource by other projects, but is not influenced by other projects itself.
Constraint effect: Necessitates the selection of distinct projects if related projects are selected.
Considered by: [KL02],[SA96].

b. *Continuous competitive contingency interactions*
Description: An influenced project may stand alone, but the outputs of related projects deteriorate the resource requirements/utilization of the influenced project.
Example: A project implements new reporting guidelines for projects resulting in increased reporting efforts per project and thereby reduced available working time for project team members.
Forms of appearance: Is *asymmetric*, so that a project influences other projects, but is not influenced by the other projects itself.
Interaction effect: Costs increase.
Considered by: [BA04], [FO84], [NE86], [LE01].

c. *Continuous complementary contingency interaction*
Description: An influenced project may stand alone, but the outputs of projects with interactions to the influenced project improve the resource requirements/utilization of the influenced project.
Example: A project implements new reporting guidelines for projects that provide more transparency in the staffing of projects. This results in a more cost efficient assignment of team members to projects.
Forms of appearance: Is *asymmetric*, so that a project influences other projects, but is not influenced by the other projects itself.
Interaction effect: Costs decrease.
Considered by: [BA04], [FO84], [NE86], [LE01].

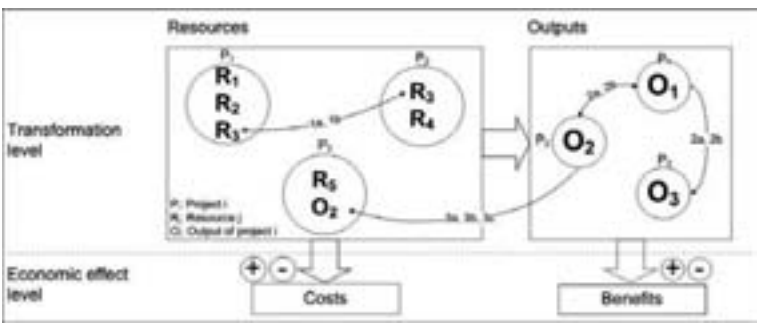

Fig. 3.1: Interactions and their effects in IT portfolios

3.4 Degree of considered interactions

For the assessment of the different types of interactions in our framework, the number of involved projects has to be considered. Each type of interaction basically can be assessed in a "bottom-up" approach for two projects at a time and for subsets of more than two projects up to the whole number of project proposals. Here, an appropriate trade-off between estimation effort and the desired degree of accuracy has to be found.

4. Summary and Outlook

Based on a literature review we identified the need for a unified terminology and structure of interactions among IT projects. We presented a framework that structures these interactions and thereby provides valuable insights for the decision makers to select appropriate approaches for value-based IT PPM from the literature. At this time the framework only accounts for deterministic parameters and does not consider uncertainty and the potential for risk diversification, which will be the subject of further research. In addition, the detailed assessment of each of the identified interactions can become very expensive. Therefore, the question of which interactions have to be assessed in greater detail and which can be neglected for specific project portfolio selection problems should be also addressed in prospective research. Finally, temporal considerations have to be included into the framework.

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