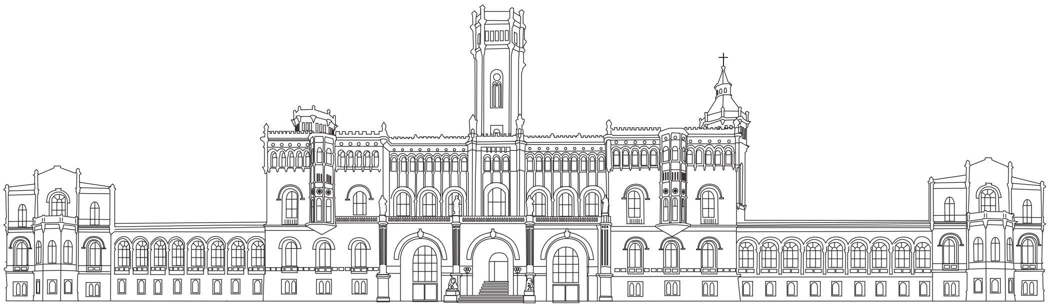

IT-Project Portfolio Management Optimization: Project Selection and Scheduling

Masterarbeit

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1 Introduction and Motivation

Information technology (IT) in companies has become indispensable (Alreemy et al., 2016, p. 907). A targeted use of it enables companies to continuously evolve strategically (Ruf and Fittkau, 2008, p. 4). In terms of IT-projects, for example, applications, software, and digital processes are developed, introduced, integrated, enhanced, and optimized (Tiemeyer, 2018a, pp. 1f.). Due to the importance of IT in companies, IT-projects and the associated management of these projects have a high priority in companies, since the IT-projects contribute to the success of the business and are even essential for it (Tiemeyer, 2018b, p. XVII; Alreemy et al., 2016, p. 907).

Companies usually have several IT-projects proposals to manage, although not all of them can be executed due mainly to limited budget and other resources (Tiemeyer and Zsifkovits, 2018, pp. 412-414). In addition, IT-projects are associated with risk and in many cases cannot be executed successfully (Tiemeyer, 2018a, p. 2; Alreemy et al., 2016, p. 907). In terms of business strategy, a combination of IT-projects has to be selected that add the most value to the company while making the best use of resources (Eckhardt and Bergmann, 2018, p. 59; Drews et al., 2014, pp. 25-27). Since the added value of an IT-project is not initially measurable, all possible IT-project proposals have to be evaluated in order to create comparability between the importance of them (Tiemeyer and Zsifkovits, 2018, p. 414). This evaluation should be based on criteria that are specifically tailored to IT-projects, and should also take into account its risks (Tiemeyer and Zsifkovits, 2018, p. 415). For the portfolio, which consists of the selected IT-projects, not only the composition itself is important, but also the scheduling of the IT-projects within the portfolio. In this process of portfolio composition and scheduling, various factors has to be taken into account. These factors include, for example, specific requirements of the company for the execution of IT-projects, as considered in the models of Abbassi et al. (2014) and Ghasemzadeh et al. (1999), dependencies between IT-projects, taken into account in the models of Karrenbauer and Breitner (2020), Carazo et al. (2012), Liu and Wang (2011), as well as Ghasemzadeh and Archer (2000), or scheduling constraints on IT-project execution, that are considered in the models of Zhang et al. (2019), Shou et al. (2014), and Carazo et al. (2010). This described problem motivates the following research question, which is being addressed in this thesis.

Research question: How can the decision making process of selecting and scheduling IT-projects for portfolios be optimized?

To answer the research question, this thesis is divided into nine sections. After the introduction and motivation, the thesis begins in Section 2 by explaining the theoretical foundations of the subject. Section 3 then continues to review the existing literature on the subject area. In Section 4, an already existing optimization model for IT-project portfolio selection and scheduling is presented and subsequently extended. The focus of this thesis is on the development of a decision support system (DSS) based on the extended optimization model. Its implementation is described in detail in Section 5. In addition, the usability of the application is checked and the usage is documented in Section 6. Subsequently, a benchmarking is performed in Section 7, to check the limits of the developed application. In the following Section 8, the results of the benchmarking are critically assessed. Limitations of the further developed optimization model as well as the developed application are pointed out and some recommendations for extension possibilities are presented. Finally, the conclusion section outlines the present thesis and suggests prospects for further research.

9 Conclusions and Future Prospects

To answer the research question, how the decision process of selection and scheduling of IT-projects for portfolios can be optimized, first an existing scoring method for IT-project evaluation and priorization has been presented in this thesis. In the further course, an existing optimization model for simultaneous selection and scheduling of IT-projects for portfolios has been extended. Afterwards and as focus of this thesis, a DSS with the integration of the extended optimization model has been developed, which is based on an already existing DSS.

For the compilation of a portfolio regarding the selection of IT-projects as well as their scheduling, various inputs can be made in the DSS. First, the main parameters, the number of IT-project proposals and the period of the planning horizon, can be defined. For each IT-project, scheduling restrictions can be defined in terms of project duration, the earliest possible project launch and the latest possible project completion. In addition, a resource consumption can be defined for each IT-project, depending on the individual periods of the project duration. Here, a distinction is made between different types of resources. With regard to the evaluation of the individual IT-projects, the number of sub-criteria and the weighting of the main criteria predefined by Karrenbauer and Breitner (2020) can be defined. Furthermore, it can be defined whether an IT-project should be included in the portfolio on a mandatory basis or not under any circumstances. Between the individual IT-projects, predecessor and successor relationships can also be defined, whereby an IT-project can have several predecessor and successor IT-projects and chain relationships are also possible. The individual IT-projects can also be assigned to different groups, between which relationships of mutual exclusion can be defined. If no specific group assignment is made, each IT-project is initially assigned to its own group. Consequently, the mutual exclusion relationship can also be defined between individual IT-projects. Several such relationships can be defined for a group. In addition, the definitions of the mutual exclusion and precedence relationships are directly linked to the definitions of the IT-projects that are to be mandatory included in the portfolio and those that are to be excluded from the portfolio. Finally, for each individual period of the defined planning horizon, the resource availabilities of the individual resource types can be defined in the DSS. All these definitions are stored in a database file.

After these individual inputs have been entered in the DSS, the optimization can be performed, which determines the optimal portfolio composition with regard to IT-project selection and scheduling on the basis of this initial situation. As an optimization solution, the DSS displays the optimal portfolio score, the number of selected IT-projects, the scheduling of the portfolio and the actual resource consumption. This solution is also stored in the database.

In order to obtain a comparison, each of the described input values, but especially the number of IT-projects and the number of periods of the planning horizon, can be adjusted and then a new optimization can be performed. Finally, effects can be determined, e.g. how the portfolio score or the selection and scheduling of the IT-projects changed when the initial situation changed.

The benchmarking aimed to show the limits of the developed DSS. It could be shown that an increase in the number of IT-projects leads to a new initial situation for the optimization, which strongly influences the solution finding. It was also determined that the available resources are a decisive factor for the portfolio composition. Thus, if this limitation is abolished, all available IT-project proposals are selected into the portfolio, taking into account the remaining restrictions. In order to find out the real limits of the developed DSS, further benchmark tests have to be carried out with a higher number of available resources or periods of the planning horizon.

With a view to future work, the model presented in this thesis could be extended to include synergies, mutually binding inclusion relationships, and a further use of the group allocation. Furthermore, an extension could taken multiple versions of IT-projects, a deeper subdivision of resource types, and a transfer of unused resources to the following period into account. In order to ensure that resources are not fully utilized, the inclusion of IT-projects in the portfolio could be limited by requiring them to achieve a minimum project score. In addition, uncertainties could also be included in the model, whereby, for example, resource consumption or availability is not entirely clear and therefore an appropriate interval has to be defined. For these model extension ideas, further research could be helpful.

The implementation of the DSS could also take the optimization of computation times into account by using less computationally intense functions and loops. In addition, the DSS could be expanded by authentication options for different roles.

Regarding the applicability check, only fictitious data has been used in the present thesis. This check could be extended in a further proposal regarding a practical implementation in an environment with real data. Furthermore, expert interviews could reveal further restrictions that are useful and important for decision making regarding IT-project portfolios in an applied industrial usage.