# Knowledge-Based Planning and Controlling with Methods of Artificial Intelligence to Increase Efficiency in IT Projects

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**Abstract** Because the success of IT projects in companies is increasingly becoming a competitive factor, this paper aims to analyze how knowledge-based tasks in an IT project can be supported with the help of artificial intelligence methods to carry out the IT project more efficiently. To answer the research question, a qualitative method in form of expert interviews will be used on the one hand and a discrete event simulation on the other hand to achieve quantitative results. In the simulation, it is intended to create a model without the use of AI elements. Under the same conditions, a project will be developed to support the knowledge-based tasks in the second step. The different constellations of the model can be adapted depending on the focus and the question. These models will be operationalized with parameters and will be compared under different constellations to measure the efficiency quantitatively. The findings of this study allow a statement whether it makes sense to support specific tasks in an IT project with the help of AI methods.

**Keywords:**
project management,
knowledge management,
efficiency,
controlling,
planning,
simulation

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# 1 Introduction

The ability to recognize and conduct transformations in the organization is one of the most important for companies nowadays. Knowing about the requests from their markets with their participants and the need to offer the right products to the right place, at the right time, and quality is essential for the survival of a company.

## 1.1 IT Project management

The pressure on IT departments to implement projects that contribute to the company's success remains high to reach their goals in the dimensions of time, quality, and effort. For the question what project management is about Reich describes it "as an area in which action is paramount and in which tasks, budgets, people and schedules must be managed and controlled to achieve expected results" (Reich, B.H., Gemino, A, Sauer, C., 2008a). Nevertheless, the achievement of the project objectives is not an end in itself. A research study in 2019 from Capgemini Germany figure out that only 15% of the interviewed companies will decrease their IT budget comparing the previous year. 50% of them will an increased budget, and nearly 35% will have the same budget level as last year. The main target of the IT budget with 72% will be the digitization of the processes and increasing the organization's efficiency (Dumslaff & Heimann, 2018). The main issue for these companies is that there are no sufficient human resources working in the IT and project departments to manage the upcoming demands. Also, the need to handle the knowledge of the employees is an increasingly severe topic where companies are fully aware of this circumstance. With these challenges, it is becoming increasingly challenging to achieve the stated goals of IT projects. This result is supported by The Standish Group International from 2015, which shows that only 6% of all grand projects were completed as planned, and only 11% of all large projects were completed as planned (The Standish Group International, Inc, 2015).

## 1.2 Knowledge management

An essential part of planning and conducting project management is the part of knowledge management (KM). That is also valuable to examine as already Gemino, Lee and Reich mentioned (Reich, B.H., Gemino, A, Sauer, C., 2008a) (Gemino et al., 2007) (Lee & Lee, 2000). As Wang et al. point out, projects are knowledge-intensive, but IT projects in a particular way (Wang, E., Lin, C., Jiang, J.J., Klein, G., 2007). This could be justified because IT projects often aim to develop new software, which is an imaginary product. On the other hand, the number of IT trends with knowledge-intensive skills and competence requirements is growing rapidly. Independent from the type of IT project or selected procedure model, often there are the following parameters given to hit the project goals. Lech uses the knowledge taxonomy of project knowledge to describe the parameters of resources, time, and cost to reach the target of a specific project, schedules, milestones, and other artifacts (Lech, 2014). In projects, all forms of knowledge are used in many places, and someone in projects must be aware of it. Hanisch also refers to the need that managing knowledge in projects is one of the most important tasks of a project manager, and the necessity to focus research in the field of project-based companies is growing (Hanisch et al., 2009).

Nevertheless, the project manager is responsible for many tasks, but two components must be distinguished in terms of knowledge management. Lech mentions that there are two types of knowledge that a project manager must have at his disposal. The one is the generic project management knowledge available in the PM body of knowledge guides also PM process models, and the other one is the product-related project management knowledge. This includes best practices for performing the projects involving implementing a specific system or topic (Lech, 2014). Judging by these facts, it should also be in the project manager's interest to manage knowledge as efficiently as possible in the projects.

## 2 Problem definition

The meaning of knowledge management is mentioned as a success factor in a large number of documentations. In general, there are some descriptions of how knowledge management is part of projects. One of them is the definition of Reich, Gemino and Sauer: "Knowledge management in the context of a project is the application of principles and processes designed to make relevant knowledge available to the project team. Effective knowledge management facilitates the creation and integration of knowledge, minimizes knowledge losses, and fills knowledge gaps throughout the duration of the project" (Reich, B.H., Gemino, A, Sauer, C., 2008b). Lech refers that identifying knowledge, mapping, and sourcing that does not take place in a structured manner (Lech, 2014). Gasik developed a model of project knowledge, which includes different views on knowledge within a project. He linked the micro-knowledge, which means the needed knowledge to perform one task, with the macro-knowledge view, which includes a complete knowledge possessed by a given person to increase efficiency (Gasik, 2011).

The issue regarding knowledge or rather the management of knowledge in projects is well-known, and there are many frameworks and modeling, e.g., from Gasik or the examinations from Lech. However, a quantitative simulation of a project management approach is still missing to prove that knowledge-based components with the support of artificial intelligence can run projects more efficiently.

This paper investigates to what extent the use of selected artificial intelligence or available services in knowledge-based tasks within an IT project leads to increased efficiency. The classic project management dimensions such as time, costs, and quality serve as variables, although other dimensions can also be used, e.g., quantity according to the functionalities in a software project.

## 3 Methodology

To ensure that both quantitative and qualitative questions are answered, two types of methods will be planned. For the questions of qualitative nature, the methodology of expert interviews is planned. The research project first provides for selecting relevant experts, e.g., CIOs., CEOs, heads of Project management, and high-level decision-makers. The interviews will be analyzed the answers by qualitative data analysis (QDA), according to Mayring. The interviews will be conducted as semi-structured interviews in order to be able to respond spontaneously to the development of the interview. To maintain a high degree of objectivity, reliability, and validity, each role is interviewed twice with different interviewees to obtain possible differences within a role. The results will use in the following discussion to underline similarities and deviations and try to explain these.

To answer quantitative questions, it will create and conduct a discrete event simulation model to evaluate the effects of using AI methods in IT projects' knowledge-based components. Adler, Mandelbaum, Nguyen, and Schwerer also used simulation to study processes. To identify weak points, bottlenecks, and performance losses, this methodology is preferable because the rapid modifiability of the simulation model allows new results and insights (Adler et al., 1995). Bassil also used a discrete simulation to evaluate software development life cycles, a software methodology for designing, building, and maintaining information and industrial systems (Bassil, 2012). This work shows that this type of simulation can investigate complex processes and make new findings visible.

MATLAB® Release 2020a software, a comprehensive numerical mathematics software package, is used to create and run the discrete simulation. The strengths lie in vector and matrix calculations, whereby the software is divided into an introductory module and numerous extension packages. Furthermore, in comparison to other simulation programs, MATLAB® offers the advantages of automated evaluation of larger data sets at high speed, the possibility of efficient multiple evaluations of the same data sets with programmed analysis routines, and integrated, flexibly applicable graphics and statistics functions. A particular position of the extensions takes Simulink, which provides a graphical interface for modeling and simulation of systems using signal flow graphs. Besides, the extension StateFlow is to be mentioned. It is a tool for modeling event-driven reactive systems with a finite number of states (Angermann et al., 2021).

The simulation structure represents the work breakdown structure of an IT project, which includes the classic phases of initialization, definition, planning, controlling, and finalization. Each of these phases, in turn, includes defined tasks that are primarily planned and carried out sequentially. Possible dependencies between the tasks are taken into account in the same way as possible returns to previous tasks if these are necessary. The individual tasks are provided with the classic parameters of project management quality, costs, and time (duration) and assigned corresponding values. After simulating the reference model, three values are calculated for each parameter, reflecting the project's total value. This model with the values mentioned above serves as a reference model with which all of the following models can be measured and compared, which is illustrated in figure 1.

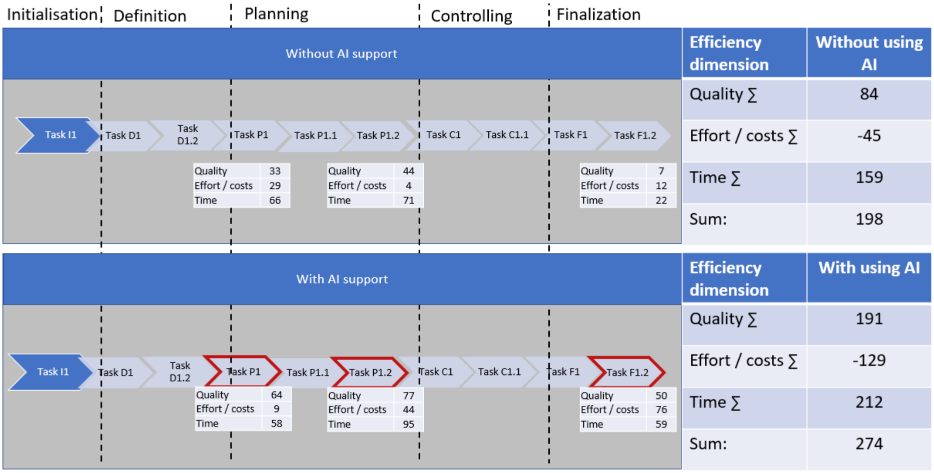


**Figure 1: Reference model vs. AI supported KM model**

Source: own illustration

In the second step, the same model structure is used to identify the tasks related to knowledge management outlined in red in figure 1. Every task related to knowledge management is examined to determine which artificial intelligence methods are suitable for performing this task more efficiently. Once a method has been found, the values of the parameters in quality, costs, and time (duration) also change. Objectively it can only be said that the use of AI in knowledge-based tasks leads to either "no improvement", "medium improvement," or "great improvement" in the individual parameters. However, these three categories cannot be compared quantitatively. To make this possible, predefined ranges are defined in the three categories, and the values are determined using random variables. This procedure is carried out with all knowledge-based tasks. For tasks with no relation to knowledge management, the parameters quality, costs, and time (duration) remain identical to the reference model. With the comparison between the reference model and the new knowledge management-optimized model, a sufficient number of simulations runs with statistical methods can now be used to investigate the extent to which efficiency can be increased using AI methods for knowledge-based tasks within IT projects, which is shown as an example in figure 2.

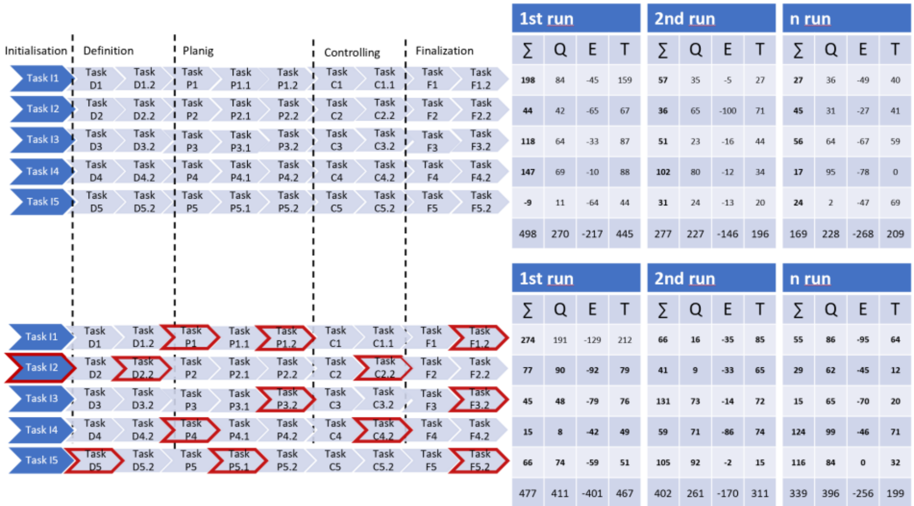


**Figure 2: Simulation result**

Source: own illustration

With a combination of the results by expert interviews and simulation will the research question be answered.

## 4 Preliminary/Expected results

The expectations in terms of answering the research question are divided into two forms of methods. On the one hand, results are obtained from expert interviews and quantitative content analysis. According to Kuckartz, the quality of the information depends on selecting the interview participants, who take part in the expert interviews, and whose answers are subsequently evaluated (Kuckartz, 2018). A basic breakdown of experts can be divided into three areas. On the one hand, there are those experts who have the technical know-how. Secondly, the experts have process knowledge, which goes hand in hand with informal or hidden knowledge. The third group of experts consists of interpretive knowledge, which has ideas, ideologies, and explanatory patterns (Kruse et al., 2015). To conduct an open-ended study on the one hand and to validate the results, on the other hand, at least two experts of the same role are interviewed from each role. This constellation should ensure the quality of the statements. In the case of significant deviations within the same role, an attempt is made to find explanatory approaches, which represents a gain in knowledge.

The expected results of the simulation essentially depend on the identification of the knowledge-based tasks in the IT project, which can be supported with AI methods. With the classic parameters of quality, cost, and time (duration), the cost parameter is probably the only negative evaluation parameter since AI methods will cause an initial effort in the company before they are used. Therefore, the simulation remains to be seen whether AI methods can form a significant added value. On the other hand, the effort could be reduced to a certain extent through cost degression.

## 5 Future development

Future research fields concerning the current topic can be, on the one hand, the change management process in the planning and implementation of IT projects. In particular, the skills of project managers about artificial intelligence methods would be worth mentioning. Likewise, the training and development of project staff should also be investigated in more detail. Here, there is the possibility of searching for and finding suitable candidates within the own company or relying on externally purchased specialists. However, the introduction and ongoing operation of AI methods for IT projects are not enough. After the processes around project planning and project execution with AI methods have been implemented in knowledge management-relevant areas, it is essential to set oneself apart from the competition by safeguarding innovations in this area and secure the technological lead for as long as possible. The standardization of these processes should then be made as efficient as possible before they are commoditized, and the optimization of IT projects begins anew with new innovative approaches in this area (Moore, 2002).

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