A Functional and Conceptual Model of the Project Management Information System

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Abstract. Software products to support project management are very complex and expensive and for that reason small and medium enterprises (SME) lack the possibilities to use them. The paper presents our study on the project management information system (PMIS) that is appropriate for SME through aspects of architecture, functional model and conceptual model. PMIS architecture presents applications and integrations between them. A functional model presents phases and modules, separately for the project portfolio management and project management. A conceptual model in presented through sub-models for the project portfolio management, project management and reporting. The paper represents the first stage of our research on PMIS for SME where the goal is to evaluate the option for the development of PMIS that is suitable for SME.

Keywords: project management, project management information system, functional model, conceptual model, small and medium enterprises

Funkcionalni in konceptualni model informacijskega sistema za vodenje projektov

Programski produkti za podporo vodenju in izvajanju projektov so praviloma kompleksni in dragi, zato njihova uporaba med malimi in srednjimi podjetji (MSP) ni razširjena. Članek predstavlja študijo informacijskih sistemov za vodenje projektov (PMIS – project management information system), ki so primerni za MSP skozi vidike arhitekture, funkcionalnega modela in konceptualnega modela. Arhitektura PMIS predstavlja aplikacije in integracije med njimi. Funkcionalni model predstavlja faze in module, ločeno za vodenje projektnih portfeljev in vodenje projektov. Konceptualni model je predstavljen preko konceptualnih pod-modelov za vodenje projektnih portfeljev, vodenje projektov in poročanje. Študija predstavlja prvo fazo raziskave, katere cilj je evalvacija razvoja za MSP primernega PMIS.

Ključne besede: vodenje projektov, informacijski sistemi za vodenje projektov, funkcionalni model, konceptualni model, mala in srednja podjetja

1 INTRODUCTION

Small and medium enterprises (SME) often lack the possibility for software to support project management. The time and schedule management software products are in many cases complex and expensive. The same applies for PMIS (project management information system) software products. SMEs also rarely practice the project portfolio management since they do not possess the critical mass of the staff with appropriate competencies.

We explore project management information systems for SME. Our aim is to evaluate the development of PMIS which is not too complex and satisfies the needs of SMEs. In the first stage of our study where we define architecture of PMIS, its functional and conceptual model to support *project portfolio processes* as an option, because not all SMEs need it.

The paper is structured as follows. In Section 2 we define PMIS and its architecture. Section 3 presents the most important related works considered in our study. Section 4 presents the functional model of PMIS, its phases and modules separately for *project portfolio management* and *project management*. Section 5 presents the PMIS conceptual sub-models: *project portfolio management* sub-model, *project management* sub-model and *reporting* sub-model. Section 6 draws conclusions of our work.

2 PMIS

2.1 The PMIS definition

PMIS as an information system that supports the needs and activities of the project management. It also involves the *project portfolio management* (PPM) processes, what some authors consider as separate information system called *project portfolio management information system* (PPMIS). The term *project management* is broadly used, accepted, and understood by professionals in companies and organisations. We believe that the term *project portfolio management* confuses many people due to the word portfolio, which mostly associated with

investments. In our study PMIS supports the *project portfolio management processes* and *project management processes*.

2.2 PMIS architecture

Fig. 1 shows the PMIS architecture [7, 8, 9]. PMIS comprises the following applications: project portfolio management application (PPMa), project management application (PMa) and knowledge base application (KBa). They all share a common database and business logic level. The business logic level uses *application interface* (API) which integrates PMIS with *ERP system* (ERP) and *document system* (DS). PMIS uses DS as a storage space for various documents. ERP provides budgeting and financial data PMIS. The PPMa, PMa and KBa modules are shown below.
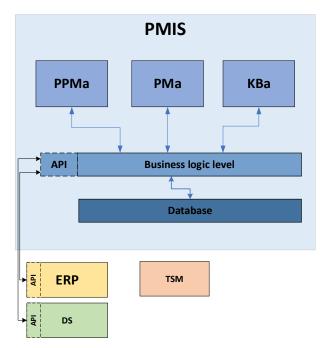

Figure 1: PMIS architecture.

The software which supports *time management and scheduling management* (TSM) is an important component of PMIS. TSM is a rather complex system where besides the visualisation elements, complex algorithms for the time management and scheduling management are implemented. For that reason, the TSM software in not appropriate for the custom development and is therefore purchased as a commercial-off-the-shelf (COTS) program [3]. An example of such program is the widely used Microsoft Project. To the best of our knowledge, such programs do not have API and therefore do not enable integrations.

3 RELATED WORKS

Texiera et.al. [2] analysed PMIS designed for a consulting company. PMIS is used for managing projects in order to assure the project success. They find that many companies, especially SMEs, do not use PMIS for two reasons. First, they are very expensive. Second, they are a generic solution which are in many cases do not support specific needs of projects and companies. According to them, only PMIS dedicated and adapted to the needs of a company brings a significant advantage.

Abrantes and Figueiredo [3] have introduced the implementation of Microsoft Enterprise Project Management solution in a company. They emphasize the importance of integration of PMIS with other applications, such as the ERP system. Authors also state that PMIS alone without project management processes defined does not assure success.

Kock et.al. [4] investigated the impact of project portfolio management information system on the project performance. They find out, first, that only 20% of companies use PPMIS, 83% of them use software for the time management and scheduling of a single project. Second, companies must reach a certain maturity level of project organisation and formalisation of project management processes to gain value from using PPMIS. Third, they confirmed the hypothesis that the use of PPMIS is positively related to the project success within portfolios and the quality of project management. Because of this finding the scope of PMIS is in our study defined broader than that of PPMIS.

Raymond and Bergeron [5] explore the impact of the use of PMIS on the project manager and project success. They make a survey and analyse the statistical data. They find that using PMIS increases productivity, effectiveness, efficiency, and decision making of project managers. They argue that it is not PMIS directly that affects the project success, but a hight quality of information and an extensive use of PMIS.

4 THE FUNCTIONAL PMIS MODEL

In this section we present the functional PMIS model, its phases, modules, and matrix to show relations between them, i.e. which phases are supported by which modules. We do it separately for the *project management* and *project portfolio management*.

4.1 Project Portfolio Management Phases and Project Portfolio Management Modules

Our definition of phases is based on PMI [1], studies [4, 5, 6, 10] and our own experience. The phases and their key activities in the *project portfolio management* are:

- **Portfolio structuring**: defining projects (project initiation), prioritizing projects, selecting and approving projects, identifying synergetic effects of projects within a portfolio,
- **Human resource management**: detection of bottlenecks, competence management, identification of new hirings needed, identification of needs for education types,

- **Portfolio steering**: establishing an external steering committee, monitoring the project performance, identifying projects with a bad performance, monitoring the realization of synergetic effects,
- **Risk management**: identifying the portfolio risks, identifying the cluster risks, defining the risk responses,
- **Portfolio learning and the KB maintenance**: documenting the lessons learned, communicating the lessons learned, inserting the lessons learned entries into KBa, performing analyses with KBa,
- **Governance of financials**: defining the project portfolio budget, defining the budget for each project, monitoring the projects spending vs. the budget, performing a financial analysis,
- **Reporting**: defining the structure of the reports needed, creating reports and distributing them to stakeholders.

We identify the following PPMa (project portfolio management application) modules within PMIS: portfolio management, human resource management, portfolio steering and risk management, portfolio analyses and reporting [8, 11, 12].

The matrix in Table 1 shows how the modules are used to support the PPM phases.

Table 1. Relations between the modules and phases in PPMa.

Phase\Module	Portfolio management	Human resource management	Portfolio steering and risk management	Portfolio analyses and reporting
Portfolio structuring	X			X
Human resource management		X		X
Portfolio steering			X	X
Risk management			X	
Portfolio learning and KB maintenance				X
Governance of financials	X			X
Reporting				X

The matrix requires some comments. First, PPMa is much wider in terms of the activity's distribution through time since the projects are in different stages of project life cycle in a particular moment. Second, in the portfolio structuring phase projects are added over time, although the majority of them are added to the project portfolio and evaluated in the time of the company's strategic planning. Consequently, the intersection of the names and content of phases of modules is "higher" than in case of the project management.

4.2 Project Management Phases and Project Management Modules

Based on PMBoK [1] there are the following phases and their major activities in the *project management* (see also Table 2): project planning, project execution, project monitoring and project closing. The initiation phase is not listed, because it is part of *portfolio structuring phase* in *project portfolio management*. The PPMa modules within PMIS are: scheduling and time management, human resource management, change management, procurement management, project steering and risk management, budget and finance management, reporting.

The matrix in Table 2 shows how modules are used to support the project management phases.

Table 2. Relations between modules and phases in PMa.

Module\Phase	Project planning	Project execution	Project monitoring	Project closing
Scheduling and time management	X	X	X	
Human resource management	X		X	
Change management	X		X	X
Procurement management	X		X	X
Project steering and risk management			X	X
Budget and finance management	X		X	X
Reporting	X		X	X

Figure 2: Relations

The matrix requires some comments. First, phases are defined based on the PMBoK standard and consequently modules to a considerable extent reflect knowledge areas of PMBoK. It is therefore not surprising that some phases are supported by quite a high number of modules. Second, the reporting module covers reporting as part of communication management knowledge area in PMBoK.

5 THE CONCEPTUAL PMIS MODEL

In this section we present the conceptual PMIS model by introducing several conceptual sub-models to improve the transparency and clarity. The following sub-models are introduced: *project portfolio management* sub-model, *project management* sub-model and *reporting* sub-model. The conceptual model is therefore introduced through sub-model, the union of sub-models represents the conceptual model.

A simple rectangle and arrow technique is used for the conceptual model where the rectangle represents the concept and the line with arrows the relation between the two concepts. Arrow types are used in conceptual sub-models are shown in Figure 3. Each type shows a type of the cardinality between the two concepts.
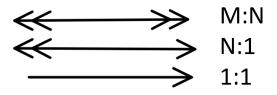

Figure 3: Types of arrows showing cardinality.

5.1 Project portfolio management conceptual sub-model

When defining a *portfolio* in portfolio management, various *portfolio evaluation data* must be introduced and analysed. There are also several *portfolio budget elements* which altogether form a *portfolio budget*. Also, the *portfolio risks* are identified when defining a *portfolio* and *portfolio risk responses* are defined additionally. One *portfolio risk response* can back more than one *portfolio risk*. A particular project is rarely isolated from other projects. *Synergy effects* are almost always a result of the set of goals and deliverables of two or more projects in a portfolio.

When *portfolio* and its projects are executing, there comes to several changes either in the portfolio definition or significant changes in the portfolio's projects. Such changes affect the scope of the portfolio budget, timeframe, risks, synergy effects and others. Such changes are logged in the portfolio change log. Project portfolio management conceptual sub-model is shown in Figure 4.
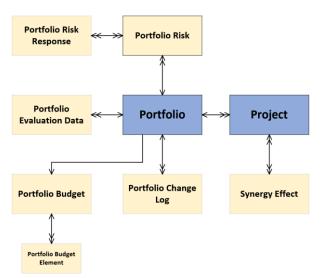

Figure 4: Project portfolio management conceptual sub-model.

5.2 Project management conceptual sub-model

The project is in many ways conceptually similar to the portfolio. When initiating and defining a *project* in the project management, various *project evaluation data* must be introduced and analysed. There are also several *project budget elements* which altogether form a *project budget*. Also, *project risks* are identified when initiating and defining the project and *project risk responses* are defined additionally. One *project risk response* can back more than one *project risk*. Forming a project team and selecting project manager and project team members with proper *competences* is also part of defining project.

When projects are in progress there comes to several changes in the project definition. Such changes affect the scope of the project, project budget, project timeframe,

project risks, synergy effects and others. Such changes are logged in the *project change log*. Project conceptual sub-model is introduced in picture.

Various *project issues* arise during any project realisation. In our experience it is very important for the project manager to note them and analyse them. On the other hand, *project manager* and other *project team members* often get fast ideas or thoughts about the project and it is important that they record them right away as (audio) *note* on the mobile phone. Project portfolio management conceptual sub-model is shown in Figure 5.
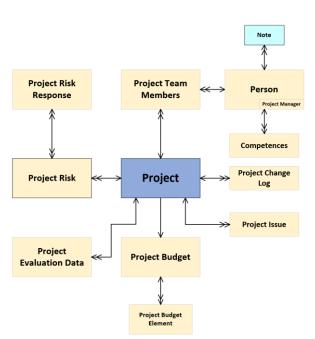

Figure 5: Project management conceptual sub-model

5.3 Reporting conceptual sub-model

Reporting on projects and portfolios is an important part of the communications knowledge area [1, 8]. Reporting is the responsibility of project managers, portfolio managers and project office. In many cases, the management of companies establishes steering committees (*portfolio steering committee* and *project steering committee*) with external independent consultants as committee members.

The mission of such bodies is to provide monthly quality assurance reports (*portfolio quality assurance report*, *project quality assurance report*) which represents their view on the progress of projects or portfolio. In such reports, typically risks are identified and analysed. Besides that, recommendations for the risk mitigation and other recommendations are provided. The project office creates monthly status reports for the portfolio and projects: *portfolio report* and *project report*. The data for the reports (*portfolio report data* and *project report data*) are automatically gathered by PMIS or inserted manually by project managers, portfolio manager and project office staff.

PMIS represents an important role in reporting because it represents a hub for data gathering and central channel of communications. Through the integration of PMIS with ERP financial data is gathered to be included in reports.
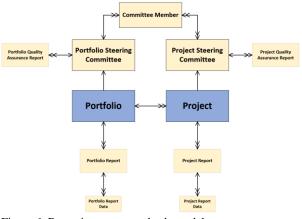

Figure 6: Reporting conceptual sub-model

6 DISCUSSION

Conceptual sub-models for the project portfolio management and project management reveal quite a high level of conceptual similarities. There are some comments which should be provided regarding this. First, the portfolio represents a group of interrelated projects. It is therefore unjustified to expect many differences between the sub-models. Key principles of the project portfolio management and project management are the almost the same or quite similar. Second, the conceptual model introduced in the paper provides a basis for the creation of a conceptual data model for the PMIS development. Only the key concepts are introduced in the paper and no attributes are defined. Later, in the conceptual data model the similarities between both sub-models will be smaller. Third, a high level of similarities between both models was expected at the beginning of our study. As already mentioned above, our goal is to develop PMIS where the PPMa application will not be required, thus enabling SME's to use only PMa.

6.1 Limitations of the study and plans for the next stage of our study

This study is implemented based on a literature review and our 20 years of experience. The limitation of our study is: we analysed only one PMIS product (Microsoft Project Server - MPS) and one TSM product (Microsoft Project). In our experience MPS is a complex product with quite high limitations for implementing adaptions to the company's needs. In the next stage of our research, we will first provide detailed functional specifications based on the findings of this study and our experience. Then we will develop a PMIS prototype to show its functionalities and represent various scenarios of use.

Some of the functionalities will not be actual and in many cases the data will be randomly created.

7 CONCLUSION

Our defines the PMIS architecture, the functional model of PMIS and the conceptual model of PMIS. Two major fields were considered: the *project portfolio management* and the *project management* separately. Our definition of the PMIS architecture comprises PPMA and PMa applications for *project portfolio management* and *project management*. *Lessons learned* is the category relevant to both major fields and for that reason *knowledge base application* (KBa) is also included in the architecture. Namely, our aim is to design PMIS where only PMa can be used, because most of SME's do not practice the *project portfolio management*. In our functional model there are phases for both major fields. We also defined PPMA and PMa modules for *project portfolio management application* and *project management application*. In the last part of our study, we presented a PMIS conceptual model using three conceptual sub-models: *project portfolio management* sub-model, *project management* sub-model and *reporting* sub-model.

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