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APPLICATION OF PROJECT MANAGEMENT METHODS AND TOOLS WITH RESPECT TO THE PROJECT LIFE CYCLE AND THE PROJECT TYPE

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Abstract. The project management theory and standards offer a wide range of project management methods and tools. To ensure the maximum possible effectiveness of application of a particular methods or tools, it is necessary to assess suitability of their application within project life cycle stages, and also their suitability from the point of view of the type of the solved project. The paper authors aimed to identify suitable project management methods and tools, and assess their applicability from the point of view of individual project life cycle stages and from the point of view of the type of the solved projects.

Keywords: project, project management, project management standards, project management methods and tools, project life cycle, project type.

JEL Classification: O20, O22, O32.

1. Introduction

In the course of time, project management involves more and more methods and tools, both newly developed and taken over from other scientific branches, which aim to improve the procedures and increase the success rate of the implemented projects. The undoubtedly positive effect of application of project management methods and tools on the success and effectiveness of projects has been confirmed, e.g. by Patanakul *et al.* (2010), or Lappe and Spang (2014).

The basic overview of project management methods and tools is offered by the international project management standards (standards of International Project Management Association – IPMA, standard of Project Management Institute – PMI, PRojects IN Controlled Environments 2 – PRINCE 2), which recommend suitable project management procedures, competences, and activities, and also suitable methods and tools for their implementation. The primary prerequisite for successful project implementation is sufficient knowledge of available project management methods and tools. Then, when they are being applied, what is crucial is selection of suitable methods and tools with respect to the current project life cycle stage (Patanakul *et al.* 2010) and with respect to the type of the solved project. At the same time, a project refers to a temporary endeavour undertaken to create a unique product, service, or result, see more in PMI standard (Project Management Institute 2004), or a unique, transient endeavour undertaken to achieve a desired outcome, see more in PRINCE 2 (Association for Project Management 2012). This means that both standards mainly emphasize the temporary character of a project and uniqueness of the outcomes brought by implementation of the project. And it is the uniqueness of the outcomes of each project what leads to giving consideration to suitable project management methods and tools with respect to the type of the solved project, but it is also necessary, within the given context, not to disregard individual project life cycle stages.

The authors aim to identify suitable project management methods and tools, and assess their applicability from the point of view of individual project life cycle stages and from the point of view of the type of the solved projects.

2. Literature Review

2.1. Project life cycle and type of project

A project can be divided into several stages, whose succession is called a project life cycle. PMI standard (Project Management Institute 2004) represents division of a project into life stages as a result of a particular situation in a particular project. It defines the stages as unambiguously markable wholes, which are characterized by achievement of a measurable and verifiable project outcome (Project Management Institute 2004). The Czech standard

of IMPA (Pitas *et al.* 2012) defines a project stage as a group of activities that are logically mutually related from the point of view of project management, forming a separate time period within the sequence of project activities, having clear inputs and outputs, unambiguous objectives and assigned time period.

PRINCE 2 (Association for Project Management 2012) divides the project life cycle into five successive stages as follows: concept, definition, implementation, handover and closeout. PMI standard (Project Management Institute 2004) divides a project life cycle into the initial, intermediate and final stages. Dolezal *et al.* (2012) develop the above standards and divide a project life cycle stages in more detail into a pre-project stage (defining), a project stage (consisting of partial stages of commencement, preparation, implementation, and completion), and a post-project stage (including evaluation and operation of the project outcomes). Maylor (2003) defines the following four project life cycle stages: definition of the project, design of the project process, deliver the project and develop the process. Oellgaard (2013) divides a project life cycle into more stages as follows: scope, analysis, design, build, implementation and operation.

Division of a project into time-limited stages should result in improvements in the conditions for checking the processes and activities in individual stages. Particular procedures, methods, and tools that are suitable for application are defined for each stage. If necessary, it is possible to divide and structure individual stages further to achieve clearer arrangement.

To structure the methods and tools suitable for application within individual project life cycle stages, it seems to us purposeful to divide the project life cycle into the following stages:

- Concept, where the project intent is defined and assessed and the project objective is defined.
- Planning, where detailed partial plans are drawn up.
- Implementation, where the project is implemented on the basis of the detailed partial plans.
- Evaluation, where the project is completed and evaluated, and the project outputs are, as the case may be, utilized.

Similarly, as it is possible to see the project life cycle stages differently, it is also possible to divide project types from a number of points of view. Projects can be divided from the point of view of the volume of the project budget (Fotr, Soucek 2011), from the point of view of time (Dolezal *et al.* 2012), from the point of view of the project complexity (Fiala 2004), from the point of view of the character of the project outputs (Rosenau 2009; Pitas *et al.* 2012), from the point of view of the rate of the project risk (Svozilova 2011), from the point of view of the position of the project in relation to the project solver (Fiala 2008), or from the territorial point of view (Gareis 2005). Apart from the above points of view, we could also divide projects from the point of view of the sector or branch of business in which the projects are implemented, or from the point of view of the way of financing. The problems of project typology are more closely dealt with, e.g. by Archibald (2004) or Skalicky (2010).

The points of view taking account of the volume of the project budget, the time-intensity and complexity of the project seem to be the key points of view in relation to the character of the project. For clearer arrangement, it is possible to summarize the above points of view into the following omnibus classification:

- Small projects that can be characterized as projects with a smaller budget, with a lower time-intensity, with a low rate of complexity in planning and implementation of the project outputs.
- Medium projects that can be characterized as projects with a larger budget, more time-intensive, ensuring creation of a more robust project output with a more complex planning and implementation.
- Large projects that can be characterized as extensive projects with a large budget, time-intensive, whose aim is to ensure creation of an extensive output through application of complex procedures during planning and mainly during implementation.

Project differentiation on the basis of this classification is relative and always dependent on a particular situation. The budget volume has to be considered within the context of the solving organization, e.g. with respect to the annual turnover of the company, the annual balance sheet total, or the volume of the registered capital.

2.2. Project management methods and tools

Project management methods and tools have been developed gradually. Some of them were primarily intended for project management, while others were originally designed and used in different areas and later on they started to be applied in the area of project management like e.g. in the area of supply chain management (Vlckova *et al.* 2012). From

the point of view of the project management theory and practice, the below mentioned methods and tools, arranged from the point of view of their primary applicability within the project life cycle, can be considered as suitable project management methods and tools with respect to the project life cycle.

In the concept stage, it is first necessary to formulate the project intent and assess its impact on implementation of the strategic objectives of the organization. There, it is possible to apply Feasibility Study (Haponava, Al-jibouri 2009) and SWOT Analysis (Robbins, Coulter 2004). Subsequently, it is necessary to perform financial assessment of the project intent, where it is possible, with respect to the form of the project benefits, to choose between the classic methods for assessment of the effectiveness of investment projects with financial benefits e.g. in the form of Net Present Value (Mian 2011) or methods for assessment of the effectiveness of investment projects with non-financial benefits, e.g. in the form of Cost Benefit Analysis (Campbell, Brown 2003). If the project intent is evaluated positively, it is necessary to specify the project objective precisely enough. Methods and tools suitable for specifying the project objectives can include SMART Method (Maylor 2003) or Logical Framework (Couillard *et al.* 2009; Norwegian Agency for Development Cooperation 1999).

In the planning stage, it is suitable to apply project management methods and tools that help to draw up the project plan. First of all, they are methods based on the hierarchical structure, i.e. Product Breakdown Structure (Association for Project Management 2012), Work Breakdown Structure (Project Management Institute 2004), Resource Breakdown Structure (Rad, Cioffi 2004) and Risk Breakdown Structure (Project Management Institute 2004). It is also possible to apply network analysis methods (Critical Path Method, Program Evaluation and Review Technique, Metra Potential Method, Critical Path Method/Cost, Graphical Evaluation and Review Technique) (Hillier, Lieberman 2005; Ravindran 2008), Gantt Chart (Project Management Institute 2004), and Critical Chain Method (Goldratt 1997). For source planning, it is also possible to make use of Resource Levelling (Rad, Cioffi 2004), Responsibility Assignment Matrix (Melnic, Puiu 2011), and Stakeholders Analysis (Project Management Institute 2004). In this stage, it is also important to identify the risks and include measures leading to their mitigation in the project plan. To do so, it is possible to use risk management methods and tools in the form of RIsk PRoject Analysis (RIPRAN) (Lacko 2014), Ishikawa Diagram (Project Management Institute 2004), Determination of the Expected Value of the Risk (Dolezal *et al.* 2012), or Decision Tree Analysis (Fiala 2008). To draw up the project time schedule, but also to plan the risks, it is possible to apply Monte Carlo Method (Association for Project Management 2012; Project Management Institute 2004).

In the implementation stage, it is possible to monitor the project progress through a number of specific methods and tools developed within project management, particularly Project Percent Complete Method (Dolezal *et al.* 2012; Maylor 2003), Structured Status Deviation (Lee-Kwang, Favrel 1988), Milestone Trend Analysis (Lester 2007), and Earned Value Management (Association for Project Management 2012; Solanki 2009; Storms 2008).

In the stage of evaluation and utilization of the project outputs, it is particularly suitable to apply Lessons Learned method, serving for a complex post-project evaluation (Carrilo *et al.* 2013; Jugdev 2012).

Apart from the methods and tools specific for particular project life cycle stages, it is also possible to specify methods and tools applicable across all project life cycle stages. They are mainly methods and tools affecting organizational aspects of project management in the form of Organizational Standards to Support Project Management (Zandhuis, Stellingwerf 2013) and Project Management Office (Project Management Institute 2004; Müller *et al.* 2013; Unger *et al.* 2012). Agile Methods (Beck *et al.* 2001; Koerner 2005) can also be considered as methods applicable in all project life cycle stages, as they bring a distinctive approach to project management from preparation of the project intent to its evaluation.

3. Results and Discussion - Applicability of Selected Project Management Methods and Tools in Individual Project Life Cycle Stages

The above mentioned project management methods and tools, which were specified with respect to their primary applicability within the project life cycle, can be applied in individual project life cycle stages in different ways. Some of them can only be applied in one of the stages, while some of the others are applied across more stages or can be applied for the whole project implementation period, or the outputs of these methods and tools are utilized in the following stages. In the event of significant changes in the project during project planning or implementation, it is possible to reapply

the methods and tools of the concept or planning stage to project the changes into the project plans. Tables 1–4 show applicability of selected project management methods and tools within individual project life cycle stages, identified by the paper authors on the basis of the literature research and their own experience with project management.

Table 1. Applicability of selected project management methods and tools in concept stage of project life cycle (Source: Authors)

Project Management Methods and Tools	Concept Stage
Feasibility Study	X
SWOT Analysis	X
Net Present Value	X
Cost Benefit Analysis	X
SMART Method	X
Logical Framework	X
PBS (Product Breakdown Structure)	
WBS (Work Breakdown Structure)	
RBS (Resource Breakdown Structure)	
RiBS (Risk Breakdown Structure)	
CPM (Critical Path Method)	
PERT (Program Evaluation and Review Technique)	
MPM (Metra Potential Method)	
CPM/COST (Critical Path Method/Cost)	
GERT (Graphical Evaluation and Review Technique)	
Gantt Chart	
Critical Chain Method	
Resource Levelling	
Responsibility Assignment Matrix	
Stakeholders Analysis	
RIPRAN (Risk Project Analysis)	
Ishikawa Diagram	
Determination of the Expected Value of the Risk	
Decision Tree Analysis	
Monte Carlo Method	X
Project Percent Complete Method	
SSD (Structure Status Deviation)	
MTA (Milestone Trend Analysis)	
EVM (Earned Value Management)	
Lessons Learned	
Organizational Standards to Support Project Management	X
Project Management Office	X
Agile Methods	X

Legend: X – the method or tool is applicable.

Table 1 shows project management methods and tools which can be applied in the concept stage.

Table 2 shows project management methods and tools which can be applied in the planning stage.

Table 2. Applicability of selected project management methods and tools in planning stage of project life cycle (Source: Authors)

Project Management Methods and Tools	Planning Stage
Feasibility Study	X
SWOT Analysis	X
Net Present Value	X
Cost Benefit Analysis	X
SMART Method	
Logical Framework	X
PBS (Product Breakdown Structure)	X
WBS (Work Breakdown Structure)	X
RBS (Resource Breakdown Structure)	X
RiBS (Risk Breakdown Structure)	X
CPM (Critical Path Method)	X
PERT (Program Evaluation and Review Technique)	X
MPM (Metra Potential Method)	X
CPM/COST (Critical Path Method/Cost)	X
GERT (Graphical Evaluation and Review Technique)	X
Gantt Chart	X
Critical Chain Method	X
Resource Levelling	X
Responsibility Assignment Matrix	X
Stakeholders Analysis	X
RIPRAN (Risk Project Analysis)	X
Ishikawa Diagram	X
Determination of the Expected Value of the Risk	X
Decision Tree Analysis	X
Monte Carlo Method	X
Project Percent Complete Method	
SSD (Structure Status Deviation)	
MTA (Milestone Trend Analysis)	
EVM (Earned Value Management)	
Lessons Learned	
Organizational Standards to Support Project Management	X
Project Management Office	X
Agile Methods	X

Legend: X – the method or tool is applicable.

Table 3 shows project management methods and tools which can be applied in the implementation stage.

Table 3. Applicability of selected project management methods and tools in implementation stage of project life cycle (Source: Authors)

Project Management Methods and Tools	Implementation Stage
Feasibility Study	
SWOT Analysis	
Net Present Value	
Cost Benefit Analysis	
SMART Method	
Logical Framework	
PBS (Product Breakdown Structure)	X
WBS (Work Breakdown Structure)	X
RBS (Resource Breakdown Structure)	X
RiBS (Risk Breakdown Structure)	X
CPM (Critical Path Method)	X
PERT (Program Evaluation and Review Technique)	X
MPM (Metra Potential Method)	X
CPM/COST (Critical Path Method/Cost)	X
GERT (Graphical Evaluation and Review Technique)	X
Gantt Chart	X
Critical Chain Method	X
Resource Levelling	X
Responsibility Assignment Matrix	X
Stakeholders Analysis	X
RIPRAN (Risk Project Analysis)	X
Ishikawa Diagram	X
Determination of the Expected Value of the Risk	X
Decision Tree Analysis	X
Monte Carlo Method	
Project Percent Complete Method	X
SSD (Structure Status Deviation)	X
MTA (Milestone Trend Analysis)	X
EVM (Earned Value Management)	X
Lessons Learned	
Organizational Standards to Support Project Management	X
Project Management Office	X
Agile Methods	X

Legend: X – the method or tool is applicable.

Table 4 shows project management methods and tools which can be applied in the evaluation stage.

Table 4. Applicability of selected project management methods and tools in evaluation stage of project life cycle (Source: Authors)

Project Management Methods and Tools	Evaluation Stage
Feasibility Study	X*
SWOT Analysis	X*
Net Present Value	X*
Cost Benefit Analysis	X*
SMART Method	X*
Logical Framework	X*
PBS (Product Breakdown Structure)	X*
WBS (Work Breakdown Structure)	X*
RBS (Resource Breakdown Structure)	X*
RiBS (Risk Breakdown Structure)	X*
CPM (Critical Path Method)	X*
PERT (Program Evaluation and Review Technique)	X*
MPM (Metra Potential Method)	X*
CPM/COST (Critical Path Method/Cost)	X*
GERT (Graphical Evaluation and Review Technique)	X*
Gantt Chart	X*
Critical Chain Method	X*
Resource Levelling	X*
Responsibility Assignment Matrix	X*
Stakeholders Analysis	X*
RIPRAN (Risk Project Analysis)	X*
Ishikawa Diagram	X*
Determination of the Expected Value of the Risk	X*
Decision Tree Analysis	X*
Monte Carlo Method	X*
Project Percent Complete Method	X*
SSD (Structure Status Deviation)	X*
MTA (Milestone Trend Analysis)	X*
EVM (Earned Value Management)	X*
Lessons Learned	X
Organizational Standards to Support Project Management	X
Project Management Office	X
Agile Methods	X

Legend: X – the method or tool is applicable; X* – particularly the method or tool outputs acquired in the previous project life cycle stages are utilized.

The effectiveness of utilization of project management methods and tools is then affected by the project type. The suitability of application of

the selected project management methods and tools was also specified on the basis of the literature research and the authors' own experience and with respect to the project type, see more in Table 5.

Table 5. Suitability of application of selected project management methods and tools from the point of view of the project type (Source: Authors)

Project Management Methods and Tools	Type of Project		
	Small	Medium	Large
Feasibility Study	X*)	X	X
SWOT Analysis	X*)	X	X
Net Present Value	X	X	X
Cost Benefit Analysis	X	X	X
SMART Method	X	X	X
Logical Framework	X	X	X
PBS (Product Breakdown Structure)		X	X
WBS (Work Breakdown Structure)	X	X	X
RBS (Resource Breakdown Structure)	X	X	X
RiBS (Risk Breakdown Structure)	X	X	X
CPM (Critical Path Method)	X	X	X
PERT (Program Evaluation and Review Technique)		X	X
MPM (Metra Potential Method)	X	X	X
CPM/COST (Critical Path Method/Cost)		X	X
GERT (Graphical Evaluation and Review Technique)		X	X
Gantt Chart	X	X	X
Critical Chain Method	X	X	X
Resource Levelling	X	X	X
Responsibility Assignment Matrix	X	X	X
Stakeholders Analysis	X	X	X
RIPRAN (Risk Project Analysis)	X	X	X
Ishikawa Diagram		X	X
Determination of the Expected Value of the Risk	X	X	X
Decision Tree Analysis		X	X
Monte Carlo Method		X	X
Project Percent Complete Method	X	X	X
SSD (Structure Status Deviation)	X	X	X
MTA (Milestone Trend Analysis)	X	X	X
EVM (Earned Value Management)		X	X
Lessons Learned	X	X	X
Organizational Standards to Support Project Management	X	X	X
Project Management Office	X**)	X	X
Agile Methods	X	X	X

Legend: X – the method or tool is recommended for application; X*) – methods and tools also applicable to a small project; with respect to the size of project, it is suitable to apply them in a simplified form; X**) – if only small projects are solved, a Project Management Office is a too costly tool.

In the concept stage of the project life cycle, it seems to be purposeful to make use of Feasibility Study, SWOT Analysis, Net Present Value (in the case of private projects), or alternatively of Cost Benefit Analysis (in the case of public projects), SMART Method, Logical Framework, Monte Carlo Method, Organization Standards to Support Project Management, Project Management Office and Agile Methods. In the planning stage of the project life cycle, it is possible to apply almost all the assessed methods, with the exception of SMART Method, Project Percent Complete Method, Structure Status Deviation, Milestone Trend Analysis, Earned Value Management, and Lessons Learned. Most of the assessed methods and tools are also applicable in the implementation stage of the project life cycle, with the exception of methods and tools considered by the professional literature as the planning stage instruments (Feasibility Study, SWOT Analysis, Net Present Value, Cost Benefit Analysis, SMART Method and Logical Framework), and also Monte Carlo Method and Lessons Learned. In the evaluation stage of the project life cycle, it is possible to apply all the assessed methods and tools, either in the form of the outpputs of the previous project life cycle stages, or their application itself.

As for the type of projects that were cumulatively assessed from the point of view of the volume of the project budget, the time-intensity and complexity of the project, the following recommendations for their application have emerged. For implementation of medium and large projects, it is possible to recommend application of all the assessed project management methods and tools. However, some of them are not suitable for small projects, as the method or tool is too robust in proportion to the project size. Therefore, it is not advisable to recommend, for this type of projects, application particularly of Product Breakdown Structure, Program Evaluation and Review Technique, Critical Path Method/Cost, Graphical Evaluation and Review Technique, Ishikawa diagram, Decision Tree Analysis, Method Monte Carlo, and Earned Value Management, and, apart from these, also of Project Management Office.

In addition, it is necessary to state that application of project management methods and tools in individual project life cycle stages in individual project types must always be based on assessment of a particular project, its scope and character. Also, it is necessary to take account of the range of knowledge of particular project management methods and tools and the experience, relating to their application, of the project team members.

4. Conclusions

The project management theory offers a number of methods and tools applicable to different extents within individual project life cycle stages. When deciding what project management method or tool to apply in practice, it is essential to consider, with respect to the type of the solved project, the benefits of particular methods and tools and to choose such methods and tools that have unambiguously positive benefits with respect to the finance, time, or organization demands placed on their processing. It is also necessary to give careful consideration to application of project management methods and tools not only in the life cycle stage for which they have been intended primarily, but also in other stages, or also to reutilization of the outputs of the methods and tools in the following project life cycle stages.

A limiting factor of the presented paper is its focus on the selected key project management methods and tools, and on the selected types of projects. Next research should thus be focused on assessment of the applicability of alternative project management methods and tools and other project types.

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