ABSTRACT

Universities implement a growing number of projects. We can indicate here: research projects (as a result of the fulfillment of the core processes of university), investment projects (modernization and expansion of university complexes in Europe is possible, among others, thanks to the funds coming from the European Union), as well as administrative projects (reorganization of the functioning of public universities is currently required by the ministerial regulations).

A large number of projects and their diversity requires universities to implement the appropriate project management system, which enables efficient project management, and thus results in the achievement of desired goals within a specified budget and time frame, in accordance with accepted quality standards; it also requires careful planning and control.

In the construction of an appropriate project management system in universities, account should be taken of three fundamental aspects of project management: the functional, the institutional (otherwise known as the organizational), and the personal aspect. The functional aspect is related to the fundamental processes of project management, which include initiation, planning, implementation, closure, and control of projects. The institutional aspects of project management raise concerns regarding the project location within a specified organizational structure. Personal aspects are related to problems regarding the selection and the direction of project personnel [Trocki, Grucza & Ogonek, 2004].

This paper is focused on the functional aspect of project management and has a structure as follows:
1. Functional aspect of the project management of universities,
2. Process approach in universities,
3. Traditional project management methodologies and agile methodologies (comparison of main characteristics),
4. Case study - proposed solutions for project management of university in functional aspect,
5. The next research steps necessary for the construction of project management system for universities.

1. FUNCTIONAL ASPECT OF THE PROJECT MANAGEMENT OF UNIVERSITIES

Discussion of the project management in universities in term of institutional aspect has been presented among others in the work: [Klaus-Rosinska, Zablocka-Kluczka, 2012]. It describes the proposed organizational (administrative) solutions in universities, including among others: location of project management department in the organizational structure of university, the list of tasks and responsibilities of it and identification of the processes that should be carried out for project management. The functional aspect of project management is a supplementation to the institutional aspect, because it focuses on project management processes. Proposals for construction of university’s project management system, in the functional aspect, should find answers to the following questions: what processes are executed in universities? which processes at the university will be linked to the projects area?, how should these processes be carried out, both in terms of administrative view (support for the contractors of the project), as well as in the executive terms of the project? should research projects / investment projects/ administrative projects be managed in the same way? what project management methodology should be applied in universities? The following parts of the article are supposed to give answers to these questions.

2. PROCESS APPROACH IN UNIVERSITIES

Currently one of the most popular trends in management is the use of a process approach. Today's universities, as well as commercial companies, should be process-oriented. They should also be flexible, characterized by the ability to adapt to new market conditions, effective, and have the appropriate technology (research equipment) and faculty.

Due to the complexity of universities a process approach to them is a very complicated issue. A multitude of entities operating at different levels of the hierarchy, and thus actions (processes) and the links between these
activities (processes), force the introduction of some assumptions defining the specific activities of the university. Assumptions set by the author were formulated as a result of the works on the construction of the Activity Based Costing for universities [Klaus, 2007]. Overall, in the universities it is possible to identify three main processes: "The Process of Teaching", "The Process of Scientific Research", "The Provision of Professional Services" [Cox, Downey, Smith, 1999] [Granof, Platt, Vaysman, 2000] [Australian Department of Education, Training and Youth Affairs, Ernst and Young, 2000]. As part of these processes activities are defined, for example the "Teaching process" will consist of activities related strictly to education (such as: preparation of classes, conducting classes, evaluate students), as well as activities related to the recruitment and graduating students. It should be remembered also for administrative actions without which the realization of the fundamental processes of the university would not be possible. In the "Administrative Process" can be isolated activities at the level of departments (like actions of dean's offices, libraries, departmental administration) and the activities at the university level (like actions of central administration, main library).

Philosophy of the process approach perceives a university as a series of interlinked processes running across the functional divisions. As a result of this approach, a process map has been formed, that is presented in Figure 1.

![Figure 1 Process map of universities](image)

Source: own work based on documentation of Quality Committee of Wroclaw University of Technology

Sub-processes covered by a gray box are groups of actions taken to train students, the relationships between these sub-processes result of a sequence of specific events and the flow of information. Highlighted are also two other main processes of universities: scientific research and professional services. In addition, supportive and management activities are indicated.

### 3. TRADITIONAL PROJECT MANAGEMENT METHODOLOGIES AND AGILE METHODOLOGIES

The purpose of this chapter is to present some basic information about selected methodologies of project management which will constitute the basis for project management solutions of universities in functional aspect presented in chapter 4. There will be presented and compared 4 project management methodologies: ICB methodology, PMBoK, PRINCE2 and agile methodologies. Methodology applied by an organization is chosen by it, while the selection is affected by many factors: type of conducted operations (e.g. public administration bodies prefer methodologies with a more formalized documentation), type of conducted projects (e.g. at IT projects agile
methodologies are preferred), preferences and competencies of projects management staff. The purpose of applying a given methodology in project management is maintenance of balance in a triangle time-costs-quality. Each methodology describes differently the way the issue is understood, which does not change the fact that each of them applies to the same matter, and an attempt to indicate a better or worse methodology currently does not bring an unambiguous answer. Methodology is, as indicated in the definition itself, a set of principles concerning methods of performing some work. An action compliant with principles and standards when managing a project is a facilitation for operation, methodology is thus necessary because: it facilitates communication through common, well-identified notions, ensures repeatability, provides verified methods, tools and patterns, makes it possible to learn from the mistakes of others, warns about possible problems, organizes knowledge.

ICB methodology (IPMA Competence Baseline) was created by International Project Management Association (IPMA). It is a non-profit organization registered in Switzerland, with a secretary's office and operational headquarters in the Netherlands. Project management according to ICP is: "planning, organization, monitoring and management of all aspects of the project and motivating all participants, leading to achieve goals of the project within the agreed time, cost and criteria of performance" [IPMA, 2002]. ICB defines 28 major knowledge areas concerning project management.

PMBoK Methodology (Project Management Body of Knowledge) was developed by Project Management Institute (PMI), an American institution. PMBoK consists of five process groups and nine areas of knowledge. The projects are directed by Project Management Office (PMO), a unit that supports project managers and administers the projects. Examples of such support are: identification and development of project management methodology, supervision function in order to comply with the standards, procedures and templates in project management using a projects audit, development and administration of projects progress, procedures, templates and other jointly used documents (organizational work measures), communication coordination at the level of all projects, optimum processes (best practices) and standards, instructing, mentor function, trainings. Project Manager, according to PMBoK, is a person to whom the task of achieving the goal of the project was entrusted. Mastering knowledge, tools and methods which operate as checked practices are not sufficient to effectively manage projects. Three levels are required: knowledge, achievements and person.

PRINCE2 methodology (Project In a Controlled Environment) defines the project as: “a temporary organization that is created for the purpose of delivering one or more business products according to an agreed Business Case” [Office of Government Commerce - OGC, 2009]. As in the case of PMBoK the authors of PRINCE2 manual explain why methodology in project management is necessary: "Considering that projects are a method to introduce changes in business and that project works carry greater risk than other business operations, it is logical that implementation of safe, consistent, verified approach to project management is a valuable business investment." [Office of Government Commerce - OGC, 2009]. PRINCE2 is a non-legally guarded methodology, based on the principles (rules), may be applied in many spheres business opportunities. Project management according to PRINCE2 are four integrated elements: principles (rules), issues, processes and environment. Principles are: continuous business relevance, using experience, defined roles and responsibilities, gradual management, management with the use of tolerance, concentration on products, adjustment to conditions of the project. Issues are: Business Justification – why?, Organization – who?, Quality – what?, Plans – how?, for how much? when?, Risk – what if?, Change – what is the impact?, Progress – where are we now?, where are we going? should we continue? Processes are: before the project – ordering project preparation, namely order delivered by an organization intending to start the project, project initiating stage, subsequent realization stages, last project implementation stage. Roles in project management according to PRINCE2: steering committee (chairman, main user, main supplier), project manager, team manager, project supervision, service of changes, project support.

Both PMBoK and PRINCE2 are complex methodologies, consisting of many areas of knowledge, issues, principles or groups of processes. Both methodologies can be adjusted to the needs of an organization, within which they are to be used, they are not limited to IT projects but are applied in any sphere of business. The situation is different in the case of agile methodology of project management (like SCRUM), applied first of all when developing software. Within SCRUM three roles are included: Product Owner, Team Members and Scrum Master, the so-called backlog is used for products and parts of products are created in short time during the so-called sprints. SCRUM may be used to create any kind of software as an independent product and software as part of another product. SCRUM is a methodology with Agile manifesto (declaration of principles of agile software creation). This manifesto puts a human being at the heart of software because it is created through cooperation and collaboration of people. In SCRUM emphasis is put not on technologies or tools but on all persons taking part in creating software.
Agile manifesto also formulates optimization of customers' satisfaction and creation of value added as the purpose of creating software. In the case of commercial software projects what matters is only whether economic objectives of the project were achieved. In SCRUM the person responsible for achieving economic purposes of the project is the Product Owner who controls backlog of the product as well as the plan of software/part of software publishing. SCRUM does not specify hard frames of the project, does not impose templates and processes, and thus it is not a set of solutions. It does not impose what to do but requires creativity from employees. If the project and organization require some documentation, it must be created by the organization implementing the project.

Table 1 presents comparison of the described methodologies. The comparison was made according to the following criteria: project definition, structure, parameters for management, areas of knowledge/issues and processes. PMBoK and PRINCE2 methodologies are similar in many points. SCRUM methodology is definitely different. One of the greatest differences is the use of SCRUM to create software, while PMBoK and PRINCE2 are used for projects of each size and for any industry.

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<td>Comparison of methodologies</td>
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Moving on to similarities in PMBoK and PRINCE2 it should be mentioned that both methodologies define project as a temporary activity or organization with a well-known date of commencement and completion of the project. The same thing applies to basic parameters of project management, e.g. quality. Both methodologies clearly determine that in order for the project to be completed, it is necessary to define what the result, the outcome or the product of the project be. Many common points are also in the areas of knowledge/issues of both methodologies. Both methodologies also pay great attention to processes, within which input elements are converted into output elements.

One of the main differences between PMBoK and PRINCE2 according to PRINCE2 is the need to define a business reason that presents an optimum set of information used in order to formulate opinions whether the project is (and remains) beneficial, feasible and necessary, and therefore whether it is worth investing in its implementation. Business case "should not be used only to acquire initial funds for the project but should be actively maintained throughout the whole duration of the project and continuously updated with current information concerning costs, risk and benefits" [Office of Government Commerce – OGC, 2009]. In PMBoK methodology there is no need to deliver business case and maintain it during all project phases. There is, as a matter of fact, a need to determine in the order the project, goal of the project, what we want to achieve in it and what is supposed to be generated, however, continuous sustaining of the purpose during the project is not assumed. It does not mean, however, that purpose during project implementation may be changed. Its achievement is as important as in PRINCE2 methodology.
Analyzing the described methodologies and practice of their use in organizations of various types, project management at universities at the level of the whole university could proceed with the use of traditional methodologies of project management. For instance PRINCE2 methodology is obligatorily used in public administration in Great Britain, also some universities in Poland (e.g., Wrocław University of Technology) plan to support the area of project management with traditional methodologies taking solutions of PRINCE2 methodology (with regard to identification and implementation of project management processes) and PMBoK (with regard to the concept of PMO application).

Another issue is project management at the level of the project itself. A problematic issue seems to be above all projects planning process which assumes introduction of rigid schedule and budget for the project. A question arises with regard to research projects: whether their specific character, uncertainty about obtaining results enables correct planning with traditional methodologies? Wouldn't it be better to use agile methodologies?

4. CASE STUDY - SOLUTIONS FOR PROJECT MANAGEMENT AREA FROM A FUNCTIONAL POINT OF VIEW

Solutions concerning functional aspect of project management of universities will be presented using the example of a real university which is the Wrocław University of Technology (Poland) [Grzech, Klaus-Rosińska, Pawelczak, Zablocka-Kluczka, 2011]. Currently, works related to improvement in the area of projects management are ongoing.

The transfer of process approach to project management area requires process map detailing. Process map for the area of project management has been signed in the Figure 2. It distinguishes three basic phases of project management:

- Project planning phase (A),
- Phase of implementation and closure of projects (B),
- Phase of supervision and sustainability of projects (C).

![Figure 5 Process map for the area of project management](source)

Projects planning phase (A) will cover any actions involving preparation and initiating the project (this division is consistent with project management methodology PRINCE2).

**Subprocess: Project Preparation**

According to PRINCE2 methodology the purpose of project preparation is implementation of all actions aiming at initiating the project. Transferring assumptions of the methodology to the ground of a university, the subprocess of project preparation will start from reporting the willingness to undertake the project, the so-called
reporting project initiative, which may be the effect of the performed review of needs of the scientific – research environment or internal needs of the University (investment projects ordered by the Rector). In the case of some research projects reporting project initiative starts from the scientific – teaching employee. Within this subprocess Projects Management Centre should serve information – advisory functions with regard to:

- possibilities to obtain funds for specific research /investments (both due to the possibilities of projects financing and the adopted strategic assumptions of the University),
- determination of project implementation formula (project preparation with own effort, project preparation as part of cooperation with another unit, subcontracting project execution),
- setting up project team (appointing Coordinator and/or Manager or the project, procedure of acquiring project employees, employment),
- preparation of basic project assumptions.

Subprocess: Initiating the Project

According to PRINCE2 methodology the purpose of project initiating is to develop a project initiation document. It defines e.g. purpose of project implementation, its key products, method, time and costs of their delivery. There is also information about scope of the project, its limitations, way of quality assurance, identified risks and flow of information in the project. Transferring such a document to realities of research project, Project Implementation Document will have the character of an application for project’s financial support.

From the point of view of initiating projects Projects Management Centre should serve information – advisory functions with regard to:

- preparation of applications for financial support (assistance in filling the application, developing the schedule and project budget, result indicators and durability of projects in the case of structural projects),
- preparation of project initiation document (of a different type than application for financial support),
- negotiations of signing project contracts (including the issue of intellectual property protection).

At this stage information on the project should be included by the Centre in projects management system (records of projects).

Implementing And Closing Projects (B)

The implemented projects are divided into specific management stages, and actions taken are repeated, usually in periods that can be determined (e.g. every month, every quarter, every year). The number and the length of these periods are variable and depend both on the kind /type of the project and its specific nature.

From the moment of launching the project fundamental responsibility for its success rests on the Project Coordinator. His/her primary task is checking whether the project brings intended benefits and the planned objectives are achieved both in its particular stages and in the scale of the whole project. In the event of observing irregularities in the course of the project implementation, his task is to suggest and implement (with prior approval of the financing institution) appropriate corrective actions.

The process of project implementation can be divided into subprocesses:

- implementation of substantive and administrative tasks at particular stages of project implementation (according to PRINCE2 nomenclature: implementation of substantive tasks is called managing product delivery),
- current management of stage of the project (according to PRINCE2 nomenclature: controlling a stage of the project),
- verification of results obtained within a given stage (according to PRINCE2 nomenclature: managing a stage of the project),
- monitoring the project,
- handling external and internal control and project audits,
- closing the project.

Subprocess: Implementation of Substantive and Administrative Tasks at Particular Stages of Project Implementation

This subprocess includes contracting by Project Coordinator performance of a given group of substantive and administrative tasks, their fulfillment by members of project teams, giving a completed group of tasks and confirming this fact. Projects Management Centre will not take direct part in this subprocesses.
Subprocess: Current Management of Stage of a Project

In this subprocess will current project management by Project Coordinator be implemented, reduced in fact, to the detailed planning of tasks and resources necessary for their implementation (human, financial, etc.), determination of method of operation organization, motivating personnel, control over implementation of partial tasks, undertaking corrective actions and receipt of a completed group of tasks.

With regard to the concerned subprocess Projects Management Centre should perform, above all, information and advisory functions with regard to procedures implementation:

- purchase,
- acquiring additional employees (experts) for the execution of works design,
- information and promoting projects (especially in structural projects),
- settlement (payment of invoices, employee issues, etc.), and solving problems emerging in these areas.

Consulting should also include the scope of systematic of keeping and arrangement of project documents as required by the University.

Subprocess: Verification of Results obtained Within a Given Stage

According to PRINCE2 methodology each stage must be completed and accepted before moving to the next stage. In this subprocess it is verified whether the stage provided all required products and whether all (substantive, financial) goals and indicators planned for a particular stage were reached. In this context is also drawn up a detailed plan of the next stage, taking into account possible revisions and possible corrective plan.

In this subprocess, tasks of the Projects Management Centre should consist in verification of key parameters of implementation of a given stage of a project. On the basis of reports submitted by project Coordinator employees of the Centre should make formal and financial assessment of implementation of a given stage of the project in terms of compliance with application documents and organizational standards. In the event of determination of possible irregularities, they should be added to the system and – if they exceed the adopted boundaries of tolerance or the Coordinator does not see any possibility of their independent correction – the University's authorities should be informed thereof. The centre should also supervise removal of any observed irregularities and annexing project documents (contracts along with schedules and budgets), if it is accepted to remove observed irregularities.

Subprocess: Project Monitoring

Within its duration the project is subjected to continuous monitoring. From the point of view of projects implementation process Projects Management Centre – apart from verification of key parameters of implementation of a given stage of the project – should serve a function monitoring their progress (both in substantive scope and resulting from the signed project contract). Monitoring will therefore cover: schedules, projects budgets as well as procedures conducted within projects: purchasing, hiring, publishing, promotional operations etc. As in the case of the previous subprocess, employees of the Centre should make formal and financial evaluation regarding the investment project implementation regarding compliance with application documents and organizational standards and prepare information on project advancement in and progress. In the event of determining possible irregularities – include them in the system and – if they exceed the adopted boundaries of tolerance or the Coordinator does not see any possibility of their unassisted correction – inform about them University's Authorities. The role of the Centre should be also determination of the need to issue opinions about any observed irregularities by independent experts and applying to the Rector to undertake significant decisions regarding the conducted project (e.g. revocation of power of attorney of the Coordinator, change of the Coordinator, appointment of project supervisor, prior termination of the contract for financial support, etc.) Within monitoring of the project tasks of Projects Management Centre also include registration and verification (from the formal point of view) of payment applications and submitted periodical reports. Periodically Project Management Centre should prepare collective information about projects for the use of the University Authorities.

Subprocess: Handling External and Internal Control and Project Audits

All projects in the period of their implementation and after their completion may be subject to control, both external and internal. Substantive liability for preparation and giving information on project implementation, project documentation, obtained results and progress in project implementation rests on its Coordinator. The tasks of Project Management Centre, on the other hand, include transferring information about the scope and time of control and
coordinating control actions and external and internal audits. Employees of the Centre can also be included in internal teams controlling the project. The tasks of the Centre should also include review of post-control information and its archiving, and transferring information about the result of the control to the University's Authorities. In the event of observing irregularities in project implementation by a controlling institution, the role of the Centre is calling Project Coordinator to explain reasons of discrepancies and supervision over their possible later elimination and performance of post-control recommendations.

**Subprocess: Closing A Project**

Regardless of the mode of project closing (planned, after completion of the last group of tasks or premature as a result of special circumstances) according to PRINCE2 methodology projects must be finished in an ordered and controlled manner. This subprocess is started by actions preparing for closing the project (making sure whether goals of the project have been achieved and specific results have been achieved, preparation of the list of all actions that will have to be undertaken in order to close the project, e.g. submission and acceptance of the last request for payment, closing the order, closing bank account, etc.). One year before closing the project plan of implementation of project result indicators should be submitted and maintenance of durability of the project along with financial forecast of possible revenues and expenses of durability of the project (as mentioned in the part concerning durability), while already after the termination of the project, it is required to prepare and transfer the documentation to the archive. These are responsibilities of the Project Coordinator. At the same time it should be ensured that all experiences acquired during project are registered.

The tasks of Project Management Centre in this subprocesses should include coordination of support of university units regarding closing the project as well as organization and conducting review evaluating the project. Report from this review should be archived by PMC and constitute the basis for actions undertaken by the Centre within the period of supervision over projects durability.

**Supervision Over Projects Durability (C)**

After closing the project and its final settlement, both financial and substantive, stage of durability of the project take place. At this stage process of supervision over durability is conducted in which sub-processes can be distinguished:

- supervision over archiving project documentation,
- supervision over result indicators implementation (in the case of structural projects),
- supervision over durability of projects results.

**Subprocess: Supervision Over Archiving Project Documentation**

The person directly responsible for archiving project documentation (its completeness, correctness of ordering and timely delivery to the right archive) is the Project Coordinator. The role of Project Management Centre in this process should be to check whether the documentation was transferred to the archive in due time.

**Subprocess: Supervision Over Result Indicators Implementation**

The person responsible for result indicators implementation is Project Coordinator. The role of Project Management Centre in this subprocess should be verification of project result indicators on the basis of submitted six-months statement in relation to submitted a year before closing the draft plan of result indicators implementation. If the reported values of indicators differ from the planned, Projects Management Centre should return with request to the Project Coordinator for explanation and possible updating of indicators implementation plan. In the case of irregularities in the implementation of indicators with possible financial – legal consequences, the Projects Management Centre should inform the University's Authorities about this fact.

**Subprocess: Supervision Over Durability Of Projects Results**

Supervision over durability of project results includes supervision over active use of equipment purchased in the project and supervision over actions aiming at commercializing research results. Active use of equipment is the responsibility of its users, the role of Project Management Centre should be periodical checking whether the equipment is still in use. Similarly, in the case of test results commercialization, the role of Project Management Centre should be periodical checking whether research results are commercialised. Project Management Centre should give to Project Coordinators information on the possibility of commercialization of project results, directing them to Technology Transfer Centre. At the same time it should inform TTC about arising research results. Project Management Centre should also perform the role of an information centre for the environment and in the event of
inquries from outside, give information about completed projects, results achieved within projects, current condition of indicators implementation, any opportunities of using research results etc.

5. NEXT RESEARCH STEPS NECESSARY FOR THE CONSTRUCTION OF PROJECT MANAGEMENT SYSTEM FOR UNIVERSITIES

A complete projects management system of universities requires examination of issues of personal aspect and particularization of each of the mentioned aspects: institutional, functional, personal. Taking into account functional aspect (which is the subject of this study) it is necessary to:

1. Decide (on the basis of recognition on a greater sample) whether division of roles for Project Coordinator and Manager is legitimate, and, if so, determine their functions division at each project management process,
2. Examine solutions at the level of the project, especially with regard to project planning process and using in it assumptions of agile methodologies of project management,
3. Check universality of solutions described in case study (division and importance of processes in research project management according to PRINCE2 methodology),
4. Check and possibly supplement proposed solutions with case study on solutions of other traditional methodologies (e.g. PMBoK, ICB).

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