

*Dorota Kuchta*  
Wrocław University of Technology  
Wrocław Military Academy of Land Forces

## PLANNING AND REALIZATION CONTROL OF RESEARCH PROJECTS

### Abstract

In the paper a new approach to research projects planning and management is proposed. It is substantially different from the traditional methods and resembles more the agile methods used in IT projects. It takes into account the much more greater dimension of uncertainty inherent to research projects as compared with other types of projects. It allows a project to be broken, if the analysis shows that the benefit/cost relation does no longer justify the project continuation. The focus of the method lies on an generalized tasks description, consisting of a comprehensive list of undetermined, unknown or uncertain task attributes and task dependencies, with an explanation clarifying the nature or the cause of the lack of information/uncertainty. The description should be updated in the course of the project. The proposed approach is applied to a real world research project where a lot of changes were necessary and traditional project management methods proved to be inefficient.

**Key words:** research project, project risk, project uncertainty

### Introduction

On the one hand, many authors [e.g. Turner, Cochrane, 1993; EFCG, 2010; Kuchta, 2011; Kuchta, Skowron, 2013] emphasise that research projects do differ from such projects as e.g. construction projects, organisational projects or new technologies implementation projects. On the other hand, their common features with IT or product development projects are emphasised. The problem with research projects is that many elements are unknown or little known in the project planning phase and many of them remain unknown for a very long time, sometimes almost even till the project end. This means that the classic project management methods, like project network techniques, Work Breakdown Structure (WBS) etc. [e.g. Haugan, 2002, p. 1–14] become almost useless. The lowest level of WBS should consist of work packages which are well defined, can be estimated with a reasonable accuracy and assigned to a responsible person. The network of a project requires a ready task list, their duration estimation and precedence relations. Now, in research projects,

it sometimes impossible to say which tasks will be performed, and even if some of the tasks can be named, we sometimes cannot say how they will look like, to which result they will lead and what changes or surprises they will bring during their realization. It is often difficult not only to estimate how much time they will take, but also to say how many times they will have to be repeated or what competences and for how much time will be needed during their realization. What is more, for some tasks we do not know in advance whether they will be executed at all and some task may have to be executed as a surprise, without having been planned. Of course, there are project network methods, where some of the mentioned uncertainties can be managed, like probabilistic networks (the GERT [Pritsker, 1966] or the VERT [Kidd, 2007] methods), methods assuming the possibility of a task insertion [Artigues, Michelon, Reusser, 2003], fuzzy approaches, where the task duration and the required resources quantity are assumed to be only approximately known (just to mention one of very many papers treating this subject [Kuchta, Janczura 2012]). However, all those methods, letting some space for uncertainty and the lack of information, do require other pieces of information in a too specific form for a research projects. E.g. even if they take into account the fact that it is not known whether a task will be executed or not, they require a complete list of possible tasks with the estimation of their duration and occurrence probability. Such a list in many research projects cannot be prepared, because the necessary information is not available. Or even if a method allows, a task to be repeated an unknown number of times, it still assumes that this task is rather well defined as to its execution way and possible outcomes. Again, such an assumption would be wrong in case of many research projects.

Many authors [e.g. Turner, Cochrane, 1993; Kuchta, Skowron, 2013] indicate that the management of research projects should be similar to the agile management used in IT projects [Wysocki, McGary, 2009, p. 383–488]. However, a direct transfer of the agile methods to research projects is not realistic, as in research projects the project results are often much more difficult to define than in IT projects. Also, the nature of the product is in both cases different. In IT projects the product is a software with several functionalities, which, even if not quite well defined at the beginning, do correspond somehow to a vision existing in the customer mind and it can be clarified step by step whether what it is being done does correspond to this vision or not. Also, which is by the way a fundamental assumption of one of the agile approaches called Scrum [Wysocki, McGary, 2009, p. 383–488], usually the final IT product can be delivered in already functioning parts, which often would not make sense in research projects.

It seems thus that research projects require a quite new and different management approach. A holistic methodology should be elaborated, taking into consideration the very special nature of most research projects. The author is conscious that the elaboration of such a holistic methodology needs a lot of time, several succeeded or failed and accepted or rejected attempts and the allied efforts of many researchers and practitioners from various research areas. It is the more so because research projects are not a homogenous group – there are significant differences among them [e.g. Jordan *et al.*, 2005].

Thus, the aim of the paper is to propose a first approach to the methodology of research projects management. This first attempt consists in a proposal of a special description of tasks of research projects which takes into account the specific attributes of research tasks. Thus, the main result proposed in the paper is a generalized way of describing project tasks, taking into account what is actually know and what is unknown or partially know, or uncertain about the task in question. The list (open to changes or modifications) of attributes to be included in the description will also be proposed. The proposal has been inspired by the procedure used in Renault and described by Courtot [1998, p. 210–215].

The outline of the paper is as follows. In the first section we will describe the procedure used in Renault and our proposal of its generalization. In the second section we will present a research project in which the author played the role of project manager. In the third section we will apply the proposed approach to the selected project. The paper will close with conclusions and an outline of further research.

## I. Proposal of research project tasks description

One of the main problems linked to research project planning is the fact that the tasks to be potentially performed are often very poorly determined. There are many factors and circumstances which may influence almost all their attributes. Thus, elaborating networks, schedules and time-based budgets according to the traditional rules for the whole project is often an activity which either cannot be done or if it is done, it produces a fictive result, which will usually have little to do with reality.

Courtot [1998, p. 195–280] describes procedures used for risk management in several big companies, among other in Renault (p. 210–215). Their projects are usually development projects – they develop new types of cars or of their equipment pieces. So their projects are based on a vision in somebody mind, thus in our opinion are less undetermined than many pure research projects. And yet one element of the Renault project risk management procedure is the preparation, for each project, of a list of tasks “with imprecise content.” Tasks included in the list are presented with several attributes or statements. The attribute or statement has to be marked if it is relevant for the given task.

Table 1

Description of a task from the list of tasks “with imprecise content” used in Renault

<p>Task n</p> <ul style="list-style-type: none"> <li>• task content will be determined by its predecessors which have not been executed yet</li> <li>• task content has not been defined because of lack of time</li> <li>• for the task content there exist several possible scenarios</li> <li>• there is no way of controlling whether the task will be performed correctly before it is finished</li> <li>• task content will be determined by the available resources</li> <li>• the person responsible for the execution of the task is unknown</li> </ul>
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Source: based on: Courtot H. (1998), *La gestion de risques das les projets*, Economica, Paris, p. 218.

As mentioned before, the uncertainty inherent in many research projects is most probably much greater than in the projects realized in Renault. In our opinion, for most research projects the task attributes from Table 1 should of course be taken into account, but there should be many more attributes added to them.

In some books [Turner, Cochrane, 1993; EFC, 2010; Kuchta, Skowron, 2013] we can read that in research projects the goal or the method or both may be not well defined. Also for research project tasks not only the content may be not well defined, but also many other elements (attributes), and their list is not fixed, and should be determined in each case afresh. In fact, in Table 1 also at least two other attributes occur, although categorized under the “content” aspect: the resources and the possibility of controlling the realization of the task. In our opinion it would be more logical to isolate them as separate attributes, and indicate a dependency between them and the content. In this way it would be more visible if resources and controlling procedures, which are very important for each task execution, may be a cause of problems.

Thus, in our opinion, for a research project task there should exist a flexible and comprehensive list of undetermined, unknown or uncertain attributes, with a description clarifying the nature or the cause of the lack of information (like it is done for attribute “task content” in Table 1). Additionally, it should be possible to indicate dependencies between tasks or their attributes, because, exactly as it was the case in Table 1, the quality, completeness and clearness of information about one attribute may influence another one.

What is more, in our opinion, during the project realization, the period between “now” and the planned tasks start should be taken into account, like it is done in the agile approach in IT projects. For the tasks which will start very soon or soon, the financing has to be ensured, thus they should be estimated as good as it is possible, for the medium scenario, with a certain reserve. The tasks which would start later should not be financed “now.” In each moment of time a break of the project should be possible without other consequences, in case the tasks which have already been started/completed indicate that the financial means had better been directed to other projects. This would optimize the usage of financial means and researchers working time, so that the both are used as effectively as possible.

A proposed framework of the task description is given in Table 2.

Such an approach would permit to avoid financing research tasks without any relevance to their actual, current scope and usefulness.

It has to be emphasized that the proposed approach differs from what is called project risk identification. Project risk is defined in many ways, but one of definitions is the following one [Courtot, 1998, p. 41]: “project risk is an event which may occur, and if it does, it may have a negative impact on the project plan in terms of completion time, cost or product quality, and the deviation from the plan will be difficult or impossible to accept.” The key word in this definition is “deviation from the plan.” In research projects there is no hard plan, with respect to

Table 2

## Proposed description of tasks of research projects

<p><b>Task n – uncertainties</b></p> <ul style="list-style-type: none"> <li>• Content <ul style="list-style-type: none"> <li>– (see Table 1)</li> <li>– ...</li> </ul> </li> <li>• Research objects <ul style="list-style-type: none"> <li>– Are the research objects guaranteed, of high quality, of a fixed price?</li> <li>– ...</li> </ul> </li> <li>• Methods <ul style="list-style-type: none"> <li>– Are the methods to be used well determined?</li> <li>– Are the methods of a known difficulty degree?</li> <li>– ...</li> </ul> </li> <li>• Competences <ul style="list-style-type: none"> <li>– Is it exactly known what competencies will be needed?</li> <li>– ...</li> </ul> </li> <li>• Results <ul style="list-style-type: none"> <li>– Is it know what kind of results can be expected?</li> <li>– ...</li> </ul> </li> <li>• Resources <ul style="list-style-type: none"> <li>– Is it known who will be needed for the task execution?</li> <li>– ...</li> </ul> </li> <li>• Controlling whether the task is be performed correctly before it is finished impossible <ul style="list-style-type: none"> <li>– ...</li> <li>– ...</li> <li>– ...</li> </ul> </li> </ul>
<p><b>Task n – dependencies</b></p> <ul style="list-style-type: none"> <li>• Dependencies on other tasks <ul style="list-style-type: none"> <li>– ...</li> </ul> </li> <li>• Dependencies on the attributes on other tasks <ul style="list-style-type: none"> <li>– ...</li> <li>– ...</li> </ul> </li> </ul>
<p>To be updated continuously (date...):</p> <ul style="list-style-type: none"> <li>• Tasks planned execution <ul style="list-style-type: none"> <li>– very soon</li> <li>– soon</li> <li>– rather late</li> <li>– late</li> <li>– very late</li> </ul> </li> <li>• Tasks overall evaluation (workload, time, budget) <ul style="list-style-type: none"> <li>– optimistic case</li> <li>– medium case</li> <li>– pessimistic case</li> </ul> </li> </ul>

Source: own elaboration.

which deviations might be measured. Other definition of project risk use terms like “identified event with a known probability and consequences,” which again does not suit the discussed case of research projects.

## 2. Description of the selected research project

The goal of the research project, as it was formulated, was to work out a costing system for universities, with an implementation attempt in selected areas of Wrocław University of Technology.

The problem with costing systems in any organization is that, although their aim is to determine the true cost of products, services, customers etc. (thus in a university the cost of courses, projects, students etc.), they may give numbers which are just numbers, with little relevance to reality. Companies, whose aim is to generate a profit, do try do elaborate good costing systems which deliver high quality information, but universities are far behind in this respect. It is usually not known what the actual cost of a student education or a research project is, even if there are numbers which are claimed to give this information. A few years ago it became clear that universities do need the same high quality cost information as profit oriented organizations and since then it has been searched for good university costing systems, which has proven to be rather difficult [Estermann, Claeys-Kulik, 2013]. The project in question was meant to be a part of this common effort.

Wrocław University of Technology is one of the largest universities in Poland, with over 35 000 students, 12 faculties, the Department of Fundamental Studies in Wrocław and 3 regional branches in Jelenia Góra, Legnica and Walbrzych (<http://www.portal.pwr.wroc.pl/fakty,242.dhtml>, retrieved: 23.03.2013). The faculties represent different areas: technology and engineering, pure science, but they include also the faculty which represents the author of this paper, which is not very engineering and technology oriented: Faculty of Computer Science and Management. It is obvious that the cost of research projects or student education in the field of management differs from that in the area of empirical chemistry, biology or in the area of construction, where expensive equipment and materials are necessary. Thus it was clear that various areas of the university needed various costing methods.

The project consisted of the following activities – the description below is almost identical to that given in the formal description of the project in the application for financial means to the Polish National Center of Research and Development. As far as precedence relations are concerned, the activities were to be executed in a sequence – the project network in the planning phase consisted of just one path formed by the activities listed below.



Table 3

Activities of the selected research project – the original description  
in the project plan

1. Review of the literature regarding costing methods relevant for universities.
2. Review of practices at various universities.
3. Review and a critical evaluation of the current costing methods at Wroclaw University of Technology: at the highest level of the whole university and at the level of various faculties, selected in such a way that they represent different faculty types.
4. Elaboration of a new or modified costing method for the whole university and for the selected faculties.
5. First implementation attempt, results analysis.
6. Modification of the method based on the verification results.
7. Second implementation attempt, results analysis.

Source: own elaboration.

The financial means were given for the above scope.<sup>1</sup> The actual schedule, which was realized in reality, is as follows:

Table 4

Activities of the selected research projects – the description of their actual form

1. Review of the literature regarding costing methods relevant for universities.
2. Review of very general remarks about what is done at 3 other universities, with no details which would make possible any deeper analysis, conclusions or any imitation in the context of Wroclaw University of Technology.
3. Review and a critical evaluation of the costing system at just two faculties, no access to the university level, and the analysis at the faculties **level did not bring much information, as most costing figures simply come there from the university level and the employees at the faculty level do not have any influence or any deeper knowledge about them.**
4. Elaboration of a **costing method limited to teaching cost for the two faculties.**
5. First implementation attempt, **no results analysis with the participation of responsible employees.**
6. **Not carried out.**
7. **Not carried out.**

Source: own elaboration.

Without entering into details and reasons of this situation, it is clear that the actual realization differed deeply from the desired one. In fact, the actual scope was significantly smaller than the planned one, for which the financial means were granted. As project manager, the author of this paper can only say with full responsibility that the project team were deeply involved and did everything they

<sup>1</sup> We are not discussing here the budget in detail. It was also elaborated for the planned scope, although it was very difficult to estimate the effort needed.

could both in the project planning phase and in the project realization phase, but it was simply impossible to get more information, more involvement on the part of university employees or to work out a more comprehensive costing system, better verified and implemented in practice.

In the planning phase the project team performed a risk analysis, and in fact some of the obstacles we encountered in the actual realization were foreseen. However, the financing institution required a schedule consisting of conventionally described tasks, thus the tasks from Table 3 were formulated. In fact, any other conventional formulation would have been as little certain as this one. Without actually performing some of the tasks, we were not able to describe them precisely. Without asking different universities for information, we could not know that they were not willing or able to give it or that most of them did not have anything important to say about high quality costing (Task 2). Without having the project started and having the permission of the university president, we could not start gathering costing information at the university, thus we could not know that it is for certain reasons inaccessible or nor readable or that the persons dealing with costing were not ready or not able (because of lack of time) to cooperate (Task 3). The failure to complete properly the other tasks was a logical and unavoidable consequence of the problems in Task 2 and 3.

In fact, to make up for the reduced scope actually realized, a new task was included in the project – the analysis of the costing system at a smaller university, where above all the teaching process is realized (and very little research). For this university a teaching costing system was elaborated, but it was not fully verified nor put into practice.

In the next section we will show how the approach proposed in Section 1 would have made the description of the tasks in the project plan more realistic. The financing institution would have had a better picture of the project and could have made the financing dependent on the actual evolvement of the situation. For us, as project team, and above all for the author as project manager, such an approach would have spared all the stress linked to the fact of not being able to fulfill the scope we got the financing for. We would have ended the project earlier, seeing that it was impossible to do it well, and would have consecrated our efforts to other projects. With the present system, we had to continue no matter what, having to search for another university, which was not really very interested in the project, but was simply kind enough to help us. This is not a sufficient reason to continue a project, each project should have a justification and an interested customer. The present research project planning system made us continue a project without a *raison d'être*.



### 3. Application of the proposed approach to the selected project

Here we will present Tasks 1–4 from the project presented in the previous section in the way we think they should be presented in the project plan (in a shortened form however, showing only the most important examples of attributes and aspects which should be considered). The lower part of the proposed task table (Table 2), which has to be updated continuously, will be omitted here.

Table 5

Excerpt from Task 1 proposed description in the studied project planning phase

<p>1. Review of the literature regarding costing methods relevant for universities – <b>uncertainties</b></p> <ul style="list-style-type: none"> <li>• Workload:                     <ul style="list-style-type: none"> <li>– It is unknown how many relevant literature items there exist, how different different papers are (do they simply present the same method in several variants or substantially different methods)</li> <li>– It is unknown how difficult to understand the papers will be and how much time will be needed to analyze them</li> </ul> </li> <li>• Competencies:                     <ul style="list-style-type: none"> <li>– It is unknown whether we would need the help of a university cost expert to fully understand and then imitate in our model the models described in the literature</li> </ul> </li> </ul>
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Source: own elaboration.

Table 6

Excerpt from Task 2 proposed description in the studied project planning phase

<p>2. Review of practices at various universities – <b>uncertainties</b></p> <ul style="list-style-type: none"> <li>• Research objects:                     <ul style="list-style-type: none"> <li>– It is unknown how many universities in Poland and in the world have any significant achievements in the field of high quality costing ad how many of them have described their systems or will be willing to present it to us in detail</li> </ul> </li> <li>• Workload:                     <ul style="list-style-type: none"> <li>– It is unknown how much time and money it will take to get to know another university costing system</li> </ul> </li> </ul>
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Source: own elaboration.

Table 7

Excerpt from Task 3 proposed description in the studied project planning phase

3. Review and a critical evaluation of the current costing methods at Wroclaw University of Technology: at the highest level of the whole university and at the level of various faculties, selected in such a way that they represent different faculty types – <b>uncertainties</b>
<ul style="list-style-type: none"> <li>• Research objects:           <ul style="list-style-type: none"> <li>– It is unknown how many faculties will be willing to cooperate</li> </ul> </li> <li>• Workload:           <ul style="list-style-type: none"> <li>– It is unknown how much time it will take to get to know the costing system at the given faculty or at the university level</li> </ul> </li> <li>• Results:           <ul style="list-style-type: none"> <li>– It is not known whether the current costing system is very bad, bad, good, thus it is not known whether the result of the analysis will be an identified need for the elaboration of a completely new system or for a modification of the current system</li> </ul> </li> </ul>

Source: own elaboration

Table 8

Excerpt from Task 4 proposed description in the studied project planning phase

4. Elaboration of a new or modified costing method for the whole university and for the selected faculties – <b>uncertainties</b>
<ul style="list-style-type: none"> <li>• Research objects:           <ul style="list-style-type: none"> <li>– It is unknown how many faculties will be willing to cooperate</li> </ul> </li> <li>• Workload:           <ul style="list-style-type: none"> <li>– It is unknown how complex the work to do will be, as it is not known what the present system looks like</li> </ul> </li> <li>• Results:           <ul style="list-style-type: none"> <li>– It is not known whether the elaborated method will be one method with slight variations for individual faculty types and for the university level or a set of completely different methods</li> </ul> </li> </ul>
4. Elaboration of a new or modified costing method for the whole university and for the selected faculties – <b>dependencies</b>
<ul style="list-style-type: none"> <li>• Task 3:           <ul style="list-style-type: none"> <li>– Task 4 is totally dependent on the outcome of Task 3</li> <li>– Task 4 is dependent on Tasks 1 and 2 (the more work in university costing systems has already been done, the easier and less time consuming the work in Task 4 will be)</li> </ul> </li> </ul>

Source: own elaboration.

The corresponding descriptions for Tasks 5, 6, 7 would have been done analogously.

As for financing, we would have proposed to finance first Task 1 and Task 2. Their poor outcome, the lack of willingness to cooperate on the part of other uni-

versities, the difficulty to get information, the fact that the literature is very general and the necessary details remain unknown, would have given us an alert that Task 3 might be difficult. We would have asked for its financing, but we would have reduced its maximal expected scope and have asked for much less financial means than we did in the real case. And having done some progress in Task 3, we would have ended the whole project or drastically limited its scope. The attained result would have been more or less the same as it was in reality, but it would have been much cheaper. The saved financial means could have been used for other, more justified research goals.

## Conclusions

In the paper we have proposed a new approach to research project planning and controlling. The approach would require more time spent on project planning, as well as its control. Moreover, the decision about project financing would have to be remade and updated at regular periods, as the method does not pretend that in research projects it is possible to estimate the project duration and cost with a reasonable accuracy. In our opinion it is not, even allowing a rather high margin. The currently used methods do not take the fact into account, they treat research projects like other types of projects, which in our opinion often result in big amounts of money spent on activities of which it is already known that they will not lead to the desired goal, and at the same time there is no money for other, more promising research projects.

The advantage of the proposed method consists in our opinion in the fact that it will force research project planners to give for each project task the information about what about is known, what is known only partially and what is unknown, which pieces of information are still needed to plan the task in a more comprehensive and concrete way, how to get them and when they might be expected. The advantage for the research financing institutions would be to be able to see which project tasks can be planned in a reasonable way in the given moment and thus their financing is justified and in case of which project tasks it is better to wait with the financing decisions till the uncertainty level is reduced. Research projects planned and financed using such an approach can be broken without greater problems for any party involved the moment they prove not to lead to expected results.

The disadvantage of the approach is a higher workload it would impose on research project planners. However, as in research projects often huge amounts of money, and quite frequently of public money are spent, in our opinion it is important to plan and evaluate them on the basis of rigorous and true data, while true data in case of research projects often mean vagueness or uncertainty statements.

Of course, the proposed method has to be verified in practice and further elaborated. We have tried it out only post factum on a few research projects known to

the author (one of those cases is presented here), but the opinion and evaluation of other researchers is needed. It will be gathered in our further research.

The way to a complete project research planning method, being able to be used in practice, is still long. However, we hope that our paper provides a first step towards it.

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