

Project Management Methodologies as Main Tool for Current Challenges in Global Economy Driving Historical Changes

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Abstract—The project management methodologies have been improved over years. There have been utilized to model specific industrial situations, helping to change the course of world history. Today, more than ever, these methodologies are indispensable, not only in industry but in any organization. Never before the market have been so competitive, forcing organizations to adopt techniques in order to innovate their products and services. With these market demands, companies and universities are required to cooperate ever more. The connection between these two sectors of society is the main driver for innovative business success. However the success of this relationship is only possible, if there is a management methodology appropriate to the complexity of the projects which are developed in consortiums, multi- sectorial and are culturally so different. The methodology we are developing is now being tested in CROP (international and multicultural Project). This paper presents some of the improvements noted with the use of this methodology.

Index Terms—historical changes, innovation project management methodologies, RTD consortia, economy

I. INTRODUCTION

In the last millennium are known numerous cases of amazing personalities who put their knowledge into practice by performing highly innovative projects that have changed the course of history [1]-[2]. However, it was only in the past century that projects and methodologies for managing them have been considered more specifically [3]-[4].

The use of activity of project management has development greatly. The competitiveness necessary for today's business has forced companies to seek techniques to accelerate the launch of products and services, reduce costs and improve control of them [4]. The consumer market today requires products and better increasingly low-cost services, which causes a marathon between companies to win over the customer. A market with a huge variety of offers, in which the customer sets the

success of the company, has led organizations to live in a permanent state of change [4]. This need for constant innovation, creating new products and the continuous improvement of production processes, make it necessary for organizations to work together [4].

The executive branch of the organizations understands that their driving force has a rigid traditional structure, which performs repetitive activities routinely. These organizations are quite resistant to change, unless they are driven by new ideas by their directions. The development of new products is the driving force for organizations that are heavily investing in R&D. However, the costs increase significantly with the introduction of R&D activities, which is not a significant increase since the investment on R&D is mainly done by large company. This investment in R&D arises the necessity of new methodologies that are able to follow all the stages of the product creation from the R & D study to its introduction on the market [4]-[5].

The structure of most organizations is bureaucratic and slow, showing that old models are unable to provide a quick response to a constantly changing environment. Therefore, the traditional structure must be replaced by a structure of projects developed in plural consortia, or any other temporary management structure that is able to respond quickly to the created situations inside and outside of the organizations [6].

This paper presents a new methodology that is being used in a research unit that leads an innovative project in the field of aeronautics. This project is being developed in consortium composed of universities and companies. This methodology is turned to organizations in general, but its main focus will pass further for the implementation of the methodology in R&D projects rather than just company production. This methodology is supported by tools and models already known such as PERT diagrams and GANT maps used in connection with the application of CPM and TOC models [7-10].

II. PROJECT MANAGEMENT EVOLUTION

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A. History

The history of project management is very old. It has been practiced for Thousands of years since the Egyptian and Romans Era [11]. However the growth and acceptance of models of management projects, has changed significantly over the twentieth century and it is expected that these changes will multiply during this century, especially in the management of multinational projects. This growth is visible for example in the performance functions, organizational responsibility, organizational structures, authority delegation and decision making. Twenty years ago, many organizations chose not to have any model of management in their projects or processes. Today not only they have complex and unique project management systems, their survival depends on the success of implementation and execution of these project management models that were once not even an option [12]-[13].

During the 40s, the managers used the over-the-fence concept to manage projects. Each manager, assumed the role of general project management, did the best he knew, then when a bigger problem aroused, they tried to pass the work for a colleague who caught it.

One past the work to another colleague manager washes his hands of any responsibility for the project. If a project failed, the blame would be placed on another manager that he was at that time with the project in hand. A serious problem with over-the-fence model was that the manager who was in charge of the project had no contact with the client [4].

After World War II, the United States entered the Cold War. To win this war, they had to win the race of the development of army. The army race made it clear that the use of traditional project management model through the over-the-fence would not be acceptable for the Department of Defense (DoD) in projects as; the bomber B52, the Intercontinental Ballistic Missel or the Polaris submarine [4], [11].

In the final of 50s and early 60s, nearly every aerospace and defense industries were using project management models and they were forcing their suppliers to adopt similar models in their Businesses. Until this moment, project management models had been growing slowly except in the aerospace and defense industry. From the private sector the project management models began to be used by governments due the numerous works that were made with prices sometimes quite high. In the followed two decades, between 1970 and the mid-80s, most companies have left their craft project management models and adopted the new ones to be able to respond better to the increasing complexity of projects [4].

From the mid-80s the changes were fast and very varied, because there was already no doubt that the project management models had key role in organizations. Companies were the great engine of the application of these models, but behind them came the government agencies, universities, and all plural institutions [3]-[4].

In the 90s, companies began to realize that the implementation of management models was no longer a choice but a necessity [3]-[4].

B. Actual Base Model

The Project management is a complex and ongoing activity, which can provide competitive advantage to an organization, but on the other hand, can bring you many problems if not managed in a proper and professional way. Therefore having an appropriate project methodology helps the project to achieve its objectives.

When we talk about standardization of project management models, we must speak about PMI - Project Management Institute. This institute was created with the aim to standardize project management models, and for that purpose it created the PMBOK - Project Management Body of Knowledge - which uses a standard methodology that underpins many other methodologies that are emerged in organizations depending on their needs. Thus the PMBOK methodology is divided into 9 main features: a) Management Integration; b) Stress Management; c) Time management and deadlines d) Cost Management; e) Quality Management; f) Human Resource Management; g) Management of Communications; h) Risk Management; i) Procurement and Supplies Management [4].

C. Past and Present View of PMM

TABLE I. CHARACTERISTICS OF PROJECT MANAGEMENT METHODOLOGIES

Models of Project Management	
Past view	Present View
<ul style="list-style-type: none"> It will require more people and additional overheads. Can reduce the profitability of the project It will increase the value of the unrealized changes in the organization Create Organizational instability and conflicts increase Decrease the benefits of customers It will create more problems in overall Only major projects need to have management methodology. It will create quality problem Will create problems of authority and unnecessary energy outgoing Its focus is only on the sub-optimization of the project The cost may turn the prices of products uncompetitive 	<ul style="list-style-type: none"> It allows us to accomplish more work in less time, with fewer people. Increase Profit It will provide greater control over changes to establish The organization become more efficient and effective by improvement of principles of behavior in the organization. Had allowed us to work more closely to our customers. Provides the means for solving the problems. All projects benefited from the introduction of these methodologies Increased quality Reduces the effort required to employ a certain function Allows employees to make better decisions. It will increase our business

In this new millennium, it has been found that despite all adopted methodologies for project management in the organizations, there are some barriers that often still hinder the implementation of some models. Hence, some authors make a clear distinction and say that between 60s-90s we had traditional business models and now we have a new generation of methodologies over the 90s up to today emerged as a new generation which we call modern project management methodologies [4].

Management models of modern projects are now used in all organizations to manage all kinds of projects or services.

Through literature, we can draw some small conclusions (Table I) from the change in thinking that has been happening in recent years with regard to the acceptance of design methodologies for organizations [3]-[12], [26]-[32].

III. C-MAST METHODOLOGY FOR RTD PROJECT

The models most commonly used in the management of scientific and technological projects are the models used for project management in industry. Models as the theoretical constraints of TOC, critical path method CPM, application diagrams as PERT or GANT, are some of the models globally accepted to be used in project management [7]-[10]. When we seek project methodologies that apply to innovation or research projects we have traditional resources to the formulation of hypotheses that will generate the questionnaires to implement a given target audience. Then the data from these questionnaires will be treated, which will give us some idea about next steps.

As we saw earlier, we have methods that accompany the industrial and business development projects and we have methods that support researchers in the development of the initial studies of a particular project. However we found some deficiencies with regard to methodologies that are implemented at an early design stage of the project idea to follow us on the issues of research planning, attracting and selecting the best lines of financing, and then follow us in connection finalization phase of scientific research to the startup of the production phase of the project [14]-[19].

In this chapter we present three RTD projects (CROP MAAT and ACHEON) being developed in C-MAST (Center for Mechanical and Aerospace Science and Technologies), University of Beira Interior Unit. Those projects are product of the European strategy for the development of new products that will revolutionize the market. The C-MAST has already in course several European projects with consortium composed of companies and universities, i.e., projects that join both types of methodologies that we propose to study.

A. Research Objectives

This methodology developed in C-MAST will be based on already existing models that were used in industry and universities. Through the study of traditional models of management of industrial projects that were used substantially until mid 90s, we intend to understand

the needs that they had, and realize what made these systems give rise to the so-called Modern Project Management.

Then we went to analyze thoroughly programs of RTD project management that were already exist in the past, to define whether these were only implemented in research of a particular technology, or these models were implemented at an early stage of project development and accompany for all phases up to output of the product commercialization..

B. Project CROP

The CROP project introduces an innovative propulsion system based on the concept of cycloidal rotor aircraft, using an integrated approach that includes an electric drive, integrated in a structure fed by a source of environmentally friendly energy. The propulsion concept of CROP is revolutionary and will introduce the new aircraft concept, overcoming traditional limitations of takeoff and landing, including the ability to hover in the air [17].

Projects as CROP are projects requiring more complex and efficient execution than those currently used methods. The relationship between science and commerce still has some gaps and this relationship is not always easy to control as not to affect the development of the project. Cultural differences and different ways of work in international consortia are other obstacles to projects like this [23]-[25].

Then comes the need for a new methodology to look at the project as a whole, encompassing all phases of development on the same methodology, adapting the most sensitive details and not as general as the current project management models [15]-[16].

C. Problems Encountered

Previous projects of research unit had faced with numerous obstacles as regards with the management of the various steps in the project submission. Among the many difficulties which made more delays in the new projects was the lack of a methodology applied in the initial phase of the project, particularly with regard to the search of a specific funding line, when it comes to staging of a draft description of the different stages of the project, and particularly in the selection and contact of different partners to be members of the consortium. We can say that there was no application of any management methodology project until then [15].

In the past we were using GANT diagrams of the tasks execution, the completion of the reports of the deliverables, without any ongoing assessment of the state of development of the project. At this time there was not a strict and permanent control to the costs in the project, nor any analysis of relative performance and communication within the consortium, which inevitably created attrition, hampering the normal functioning of the work which is reflected in not achieving the deadlines for applying project [16].

D. New Methodology

To better specify these steps, we can say that the new methodology should note the following: a) Preliminary

Assessment of ideas and focus on detail; b) Study of appropriate funding sources; c) develop a general draft of the project; d) Programming Resources, tasks, costs, risks and technical control; e) Preliminary analysis of the risks and impact of the results; f) formats standardized reporting and documentation; g) Monitoring the process and preliminary theoretical, technical and scientific studies; h) Collection and processing of data and characteristics that may affect the project; i) The use of planning models; j) Flexibility to apply to all projects; k) Flexibility for rapid improvements when applied to the

middle of the project; l) Focus on the end customer / target market; m) Readily accepted and used throughout the organization; n) The use of life cycle phases standardized [19]-[21];

Based on all these features mentioned above and the detailed study of the rules and lines of European orientation, C-MAST created its own methodology to apply their new RTD projects [16].

The following diagram below is an example of applying this methodology to a project, in this case the CROP project [17].

Global Diagram for RTD Projects - CROP

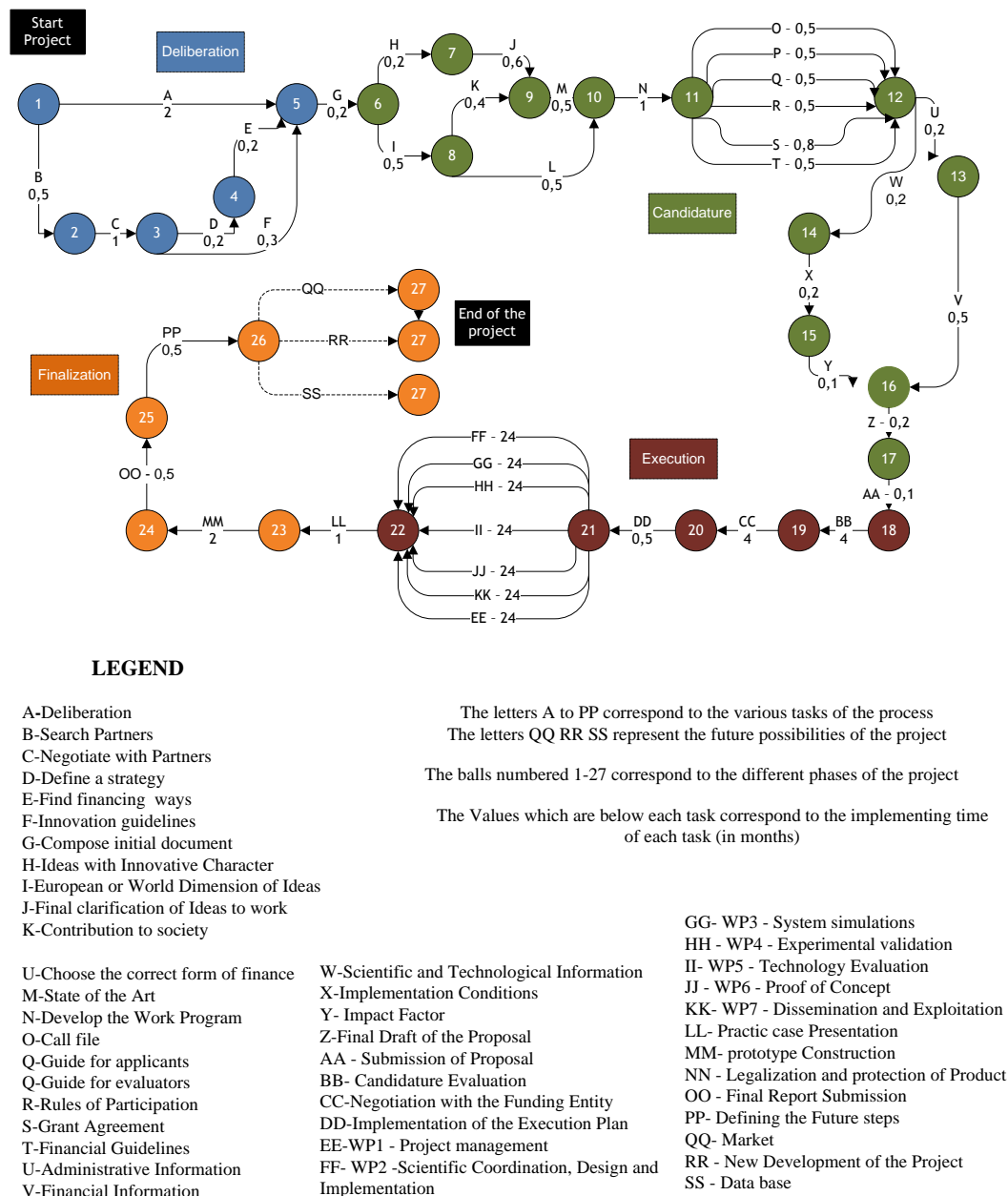


Figure 1. Global Diagram for RTD Projects-CROP

E. Application of the Methodology

After previous projects experiences, the C-MAST decided to invest in a new design methodology that could

trace the main ideas of all the steps that we have to implement on the project. the first step was to create the figure of a project manager within the unit so that besides

creating a methodology there was someone responsible for managing it [16].

The first step is to know the research group, its resources, human and material, its main areas of work and the specificities of their projects. Another important point before the implementation of the methodology was to understand the group's strategy, which is based on organizational cooperation strategy that is defined by European Commission for the next six years. Regarding the investigation involves a strong focus on cooperation between companies and universities in order to do more research supported with a defined target market [16].

With the clear methodological basis has gone up to the creation of the project methodology, which is supported most of all in the segmentation of phases and duration times of them in the product life cycle. This methodology is also supported by tools such as PERT and CPM, at certain stages of development works in consortium because it is there that Project life is more complex [26].

Thus, the methodology was applied from the beginning of the project by considering different options for the first draft of the project, taking into account the financing options, presenting the first draft of the CROP project (Fig. 1), starting to search for key partners who fit in the previously created profiles. After deliberation phase went up to the stage of submission of the candidature, all contracts were signed after approval of the funding line. At this point, the project is near the end of the execution phase and the methodology has been critical to avoid delays and unnecessary expenses in the project. The methodology will monitor the project to its final stage, this stage is already being worked on and before the end of the execution phase the guidelines are already part of finalization, all outlined in a way that no extra costs or delays in final phase of the project [4].

The application of the methodology has been applied rigorously, preventing that the problems which have arisen had affected the overall implementation of the project by being corrected immediately. Thus financial performance and execution times have not changed, not being necessary redefinition of funds and prolongation of time.

This methodology is already being applied in MAAT and ACHEON projects where the C-MAST is a partner. In these two projects the methodology is applied in a partial way since the overall management of projects is made by the University of Modena Reggio Emilia, Italy [18]-[19].

IV. METHODOLOGY CONTRIBUTION

With analysis of the methodology applied, we understand that this methodology is formed based on the general phases of the project and did not explore in detail other details such as the segmentation of work performed in a particular Work Package. This is due the fact that this is being aided by these phase Gant diagrams to planning and implementation task and for CPM models in runtimes controller. The methodology created, it was important during the initial brainstorming executed during the first

drafts of the project. It was also important in the choice and definition of partners and selection of call for funding from the FP7 program.

However the real test of the methodology was verified in solving problems in the execution phase. Cultural components are the major challenge to the implementation of a project methodology because each organization has its own working methods, and when we work in a plural consortium we have to do adjustments and make minor adaptations of our methodologies to work in relation to the methodology used by principal project manager. It happened in CROP where the methodology was predominant, to prevent cultural and work methodologies differences from affecting the execution of the project. Moreover, it was essential monitoring and supervision of intermediate financial reports, it was still very effective in overcoming certain delays of the implementation of certain Deliverables, adjusting times and causing those delays were quickly recovered.

This methodology has also been important in the activities of dissemination of project results.

V. CONCLUSIONS

This work was based on a strong literature review about the history of project management, including its evolution over the years.

With the tool here presented it will be easier to set guidelines when it needs to select the best sources of finance, the best partners and the best way of implementing the project.

This model will be applied mainly in RTD projects, with international and multicultural consortium. It was still detected some flaws when it comes to autonomy in the management of very specific problems such as control of the execution times of the projects or in the extremely high spending in some parts of the projects.

Regarding this the methodology needs the support of other tools that could help it to cover all the kind of possible failures that may occur in the project during its most critical period.

As future work we intend to develop our methodology in order we don't need other models and helper methods in the management of our projects.

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