

# Research and Application of Project Management Methodologies and Tools in Academic Environment

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## ABSTRACT

This paper is motivated to show the flow of research projects management in information technology. As information technology is one of the top spheres of business and develops too fast, it is very helpful to organize researchers, which will lead to desired place in markets. Actually researches are more important as without researches new methods and tools will not be found and the practice will stay on the same stage. Here, the project management can be described as a set of activities, which enables successful implementation of a project. In development projects the term “successful implementation” means that the projects achieved to required and planned result according to agreed time frame and budget. Project management in research projects has a lot of differences. In this paper we try to describe what the research methodology is, the steps, the principles and the tools of research project management, the difference between the development project management and the research project management. We try to present how research project management is being organized in different institutions and what common tools they are using in project management flow. Besides the general research management in university, it is very important to understand the research project management in each graduation degree. In this work we tried to represent research project management in PHD. Also with the help of the theory part we suggest to integrate JIRA in research project management.

## Keywords

Project management, research project management, JIRA, scientific computing

## 1. INTRODUCTION

Market leaders of different industries are looking for new technologies to improve their business. Remarkable innovations can be achieved only in a result of long research, experimentation and development phases. One of the most active industries in innovation is information technology. So the research process needs project management, which flow differs from development project management. In development projects the term “successful implementation” means that the projects achieved to required and planned result according to agreed time frame and budget. If to be more formal, the project management is process of planning and co-ordination of a project from inception to completion, which is aimed at meeting the client’s requirements, ensuring completion on time, of course within cost and required quality standards. Project management in research projects has a lot of differences. The start of research projects is the creation of framework based on the things that should be done. The start of development projects basically differs, here the customer requirements and expectations on outputs are discussed. The outposts of research projects and development projects differ as well. In research project the

sponsor or partner should be ready to a negative result of the research project, but worthwhile, such kind of example can be to produce a kind of evidence that something is not feasible. If the prototype is good enough it can progress towards a prototype for a development project, but not all prototypes are good and those bad prototypes will cost the company the same as the failed development product costs. It is very difficult to have “a positive negative” result from research projects. In business-oriented companies the applied research project is implied that the result of research project should be an input for development projects. The goals of development projects are related to current and future products and technologies. As a result other projects can depend on research results, such as planning, controlling and scheduling activities.

## 2. RESEARCH PROJECT MANAGEMENT

### 2.1. Research and its Methodology

Research itself differs from development. If the outcome were predictable, there would be no need to conduct an experiment or organize research. Observations are required in scientific method, which leads to the creation of hypothesis, which explains the phenomenon. The hypothesis may be used to predict phenomena. All this can be systematically tested through experimentation.

The scientific method has a conflict with basic principles of project management. In project management the start should be predictable, but in scientific method nothing is predictable. The result of research is either new knowledge or remarkable innovation. Research Project Management tries to minimize the risks of research projects and helps to involve not specified or excessively broad scope. The goal of research is to continually advance, contribute towards and increase the knowledge base of a selected area of interest. Researchers are selected on the basis of past accomplishments, successes and skills; but unlike customary project team members, the skills of researchers have been honed in a “publish or perish” world where reputation, status – and even continued employment – are dependent upon demonstrable contributions to the larger community. So, the following statements describe the research project stages and flow [1-7]:

1. Identify a research problem
2. Refine aim and objectives
3. Refine research questions
4. Conduct and document a literature review
5. Evaluate appropriate research methods
6. Design your research tools (survey, questionnaire, observations, etc.)
7. Do the corresponding experiments
8. Pilot test your data collection

9. Carry out your data collection
10. Compare and contrast data findings with the literature findings
11. Draw conclusions by evaluating your research questions, research objectives and research aim
12. Reflect on limitations and potential further studies in the area
13. Write your documentation

## 2.2. Research Project Management Steps

Here are the steps for research project management [1-7]

### 1. Research Protocol.

- An abstract;
- The statement of the problem;
- Heading theoretical framework;
- Objectives Methodology;
- Metrics;
- Anticipated resources.

### 2. Resources

- Money*. In different environment funding source is different. In research, the funding can come either from internal or external sources.
- Equipment/Facilities*. Equipment, facilities and expertise are expensive, that's why project manager needs to be resourceful.
- People*. Human are the key of the research. It must be reiterated that, while many scientists are very good at project management, it is the Research PM's primary job to enable them to *focus on their work*.
- Risk Mitigation*. Risk Mitigation is included under the heading "Resources" because failing to mitigate *squanders* a resource or results in loss.

### 3. Commencement.

At first research definitions and plans for implementation should be well established and included in the protocol. After the funding has been approved it is too late to begin what is known in some circles as "*forming* (constitution), *storming* (goal-setting) and *norming* (group and procedural cohesion)". In prior to the commencement of work, should be an "on-boarding" session. This meeting seeks to mitigate – if not eliminate – the issues surrounding collaboration by:

- Reviewing the protocol.
- Defining the "three R's": roles, rights and responsibilities of each member of the research team.
- Articulating ethical/legal considerations and how they must be addressed.
- Identifying how and when communications will occur. Work Breakdown Structures and Gantt diagram

### 4. Metrics and Reporting.

Research Project Management often requires multiple sets of metrics and redundant reporting. The research team will achieve the measures established in its protocol; the institution with which the PI is affiliated may impose metrics and a schedule on which progress is reported and balance sheets are reviewed.

### 5. Closing the Project.

Even concluding a research project is handled differently as compared to those managed in more traditional settings.

## 2.3. Research Project Management Tools

Here are the required tools of project management, which will help to achieve success [1-7]:

### 1. Resources

- a. Financial: Budget and monitoring costs of conducting research;
- b. Time: Create a timetable to plan dates and order of research activities;

- c. Data: Establish and maintain relationship with the key persons

### 2. Project Document

- a. Understand the project development flowchart;
- b. Understand the purpose and objective for each component of the Project Document.

### 3. Terms of Reference

- a. Describe objectives, expected roles and responsibilities of the researcher;
- b. Identify formal and informal qualifications;
- c. Distinguish between required and desirable qualifications;
- d. Prioritize qualifications;
- e. Consider effect of researcher's demographic characteristics in relation to target group.

### 4. Contract

- a. Outline rights and obligations of the researcher;
- b. Include contractual clauses to avoid problematic ambiguities

### 5. Training

Introduce researcher to the:

- a. Research context;
- b. Research objective;
- c. Population of interest;
- d. Methods of survey distribution, completion, processing;
- e. Interview and note-taking skills

## 3. SCIENTIFIC COMPUTING

### 3.1. Research Development on Scientific Computing

Computation is an essential element in every branch of science and technology over the next decade, driven by the vast amount of experimental data requiring analysis, and the need for increasingly realistic simulations of ever more complex systems. Scientific Computing is now being perceived as a core skill that is crucial to the construction of theories and models at a new conceptual level and therefore to the progress of many scientific agendas. The Institute for Informatics and Automation Problems (IIAP) is the scientific-research institute of the National Academy of Sciences of the Republic of Armenia (NAS RA) in the sphere of applied mathematics and informatics, as well as in the sphere of application of computing technologies in various fields of scientific computing.

Here are some requirements of research development process on scientific computing. Process for research development should support [1-7, 15]:

1. **Pre-development activities.** It is important to provide mechanisms which help to define the research subject, plan of research activities, train for novice members.
2. **Life cycle activities.** It's very important to provide mechanisms, which help to analysis, design, codification and test. Also must be regarded combination between elements of agile and traditional methods, iterative development, and prototyping paradigm.
3. **Management activities.** It's very important to provide mechanisms, which help to management of tasks, schedules, risks, costs, resources, configuration, infrastructure and knowledge.
4. **Quality assurance activities.** It's very important to provide **mechanisms**, which help to verify, validate, document, peer review, measure involving artifacts.
5. **Collaborative development**, which is important to provide mechanisms to help in communication among members of groups, coordination of groups, definition of roles, sharing the knowledge, integration of artifacts.

6. **Distributed development**, which is important to provide mechanisms to help in distributed coordination, management, artifacts control and problem resolutions.
7. **Activities promoting research development**, which is important to provide mechanisms to help in systematic review, experimentation, writing technical documents, preparing didactic materials.
8. **Transference of knowledge from academy to industry**, which is important to provide mechanisms to help in definition of academy-industry cooperation plan, preparation of material for training in industry, preparation for receipting and monitoring trainee researchers in industry and transferring of ideas, solutions, prototypes, infrastructure.
9. **Partnership formation between academy and industry**, which is important to provide mechanisms to help in definition of partnership, communication among researchers and professionals, elaboration of contracts, within information about patents, copyrights, confidentiality, financial support, etc.

### **3.2. Description of Processes for Research Development on Scientific Computing**

Here are the methods of research, which should be chosen before the start of the research:

1. **eXtreme Researching-XR**. Here an agile methodology is used. Here are XR practices; frequent integration, remote pair programming, on-site customer, collective knowledge, planning game, metaphor, 40h week on average, coding standards, controlled software spikes, testing, refactoring, object-oriented component-based modeling
  2. **R & D Standard Process**. Hwang and Park defined this process, which is based on international standards of systems and software engineering and on their past experience. The proposal
    - a. Included traditional work methods
    - b. Covered many areas
    - c. Included a process tailoring guideline
    - d. Focused on an efficient configuration management process
    - e. Provide several templates.
- R&D has the following categories
1. Life cycle /system, devices, basic technology, standardization, policy, strategy/
  2. Supporting
  3. Project management
  4. Organizational processes
3. **Higher Degree Process-HDG**. Researchers of Software Engineering Application Laboratory, in South Africa, define HDG. This model helps to evaluate processes, which are carried out in software research laboratories. The main goal is to develop human resource with competence, which will help in independent research. HDB consists of 10 practices; define the research project goal, plan the investigation, determine key technical inputs, execute the research project, review and approve technical outputs, validate the research outputs against proposal, disseminate research results, assemble the dissertation, independently assess the outcomes of the research project against evaluation requirements.
  4. **The YAO's Proposal**. It is a framework of web-based research support systems, which is centralized on research activities, phases and technology support needed.
- There are 7 basic phases:
1. Idea-generating phase;
  2. Problem-definition phase;
  3. Procedure-design/planning phase;

4. Observation/experimentation phase;
5. Data-analysis phase;
6. Results-interpretation phase;
7. Communication phase.

## **4. Research Management in National Science Foundation of US /NSF/ and European Science Foundation /ESF/**

### **4.1 The Research Management in NSF**

NSF is a US government agency, which supports research and education in all fields of science and engineering except medicine. The annual budget of NFA is near to US\$ 7.0 billion. For about 20% of US universities and colleges is covered by NSF [12]. Each year NSF funds 10000 proposals from 40000. Proposals may be submitted in response to the various funding opportunities that are announced on the NSF website. These funding opportunities fall into three categories-program descriptions; program announcements and program solicitations-and are the mechanisms NSF uses to generate funding requests. To have an honest selection NSF developed "merit review" mechanism. Merit review is organized by NSF, which chooses independent scientists, engineers and educators who are experts in the relevant fields of study. 3-4 independent experts are reviewing each proposal. After the reviewers choose the best proposals NSF program officer tries to analyze the external reviewers' feedback. As soon as review is done, the program officer makes an "award" or "decline" recommendation to the division director. Final programmatic approval is being completed at NSF's division level. A principal investigator whose proposal for NSF support, the one, which is declined, gets explanation. If that explanation does not satisfy he may request additional information from the NSF program officer or division director. If the program officer makes an award recommendation and the division director concurs, the recommendation is submitted to NSF's Division of Grants and Agreements (DGA) for award processing.

### **4.2 The Research Management in ESF**

The European Science Foundation (ESF) is an association, which is based on 72 member organizations, which are specified in scientific research. These organizations are spread over 30 European countries. ESF is an independent, non-governmental, non-profit organization that facilitates cooperation and collaboration in European research and development, European science policy and science strategy. The mission of ESF provides a common platform for members in order to: raise European research; find out new directions for research. ESF has three directions; ESF Science Strategy, ESF Science Synergy, ESF Programmed Management [13]. The structure of the European Science Foundation supports the on-going commitments that are performed for Member Organizations, which involve the coordination of international research programs. Also in ESF is very important high level of quality assurance and resources to execute the contracts that currently are held with the European Commission. ESF tries to manage different types of research instruments. They range from 5-year programs, which involve potentially hundreds of researchers, to more concentrated 3-day events, which find innovative ideas and future perspectives. The main purpose is to keep activities in a high level of care and attention to detail. The staff should provide excellence and ensure that the results of activities are published in high-quality journals and circulated to the relevant audiences through the developed communication channels.

## 5. PHD RESEARCH MANAGEMENT

### 5.1. PHD Research Management for Candidates

For realizing any big project, whether it will be writing a grant proposal or PHD thesis, working on a journal publication, one needs analytical skills, research abilities but all this will not help to achieve success.

In most fields the trainings of increasing project management skills are not developed, however, universities and funds supports researchers in project management development in fields like writing a PHD thesis.

Here are the main steps, which lead to effective results for PHD:

1. **Write a quick outline.** It is very important to have a plan. Before estimations one should write down in a few words the main steps of his project.
2. **Plan the parts of your outline.** As soon as general outline with tasks is ready, researcher should try to plan the timing for implementation. Usually people who study PDF are very busy. It is very difficult for them to follow due dates. So for PhD candidates, the other responsibilities can be limited
3. **Assemble your toolkit.** Before starting a work, researcher should stop again for a moment and ask himself
  - a. What is really required?
  - b. Does he have the required books?
  - c. Does he know where the available required books are?
  - d. Does he have access to the right journals and software licenses?
  - e. Does he have the required material in the lab?

Try to have positive answers for all those questions.

4. **Checkpoints.** Planning helps to check the progress of project and make necessary corrections. Checkpoint can be meetings with supervisor, who checks ones work regularly to find out, if researcher is on right direction. Researcher should find positive and negative points of the done work.
5. **Document your assumptions and process.** It is very important to have documentation about the process. Here are the main points that researcher should keep:
  - a. What changes have been done?
  - b. When the changes have been done?
  - c. Why the changes have been done?
6. **Project diary.** Researcher should have something like a diary for not losing the direction of thesis.

Candidate can expect from supervisor:

- A proper reading shared work
- Feedback, which should be in time
- A willingness to listen and support
- Administrative responsibilities

Supervisor can expect from candidate:

- Keeping appointments
- Try to use supervisor's advice
- In case of disagreement prepare arguments
- Ask for explanation if material is unclear
- Not to overburden with similar drafts
- Properly addressed administrative responsibilities

### 5.2. PHD Research Management for Institution

PHD is one of the most important steps in the life of candidates. It is very important for both candidates and institutions to understand the importance of PHD. PHD

research requires management from both sides - candidates and institution.

Each institution, which provides PHD, should organize the process and should be responsible for candidates. Each institution consists of independent departments, which have own fields and education degrees. This means that the administration is responsible for managing researches in each graduation degree.

One of the main requirements of PHD is writing thesis. Here are the main responsibilities:

- The candidate is responsible for writing and researching.
- The supervisor is responsible for managing.
- The administration is responsible for general management.

Administration should provide with relevant information. To manage their work administration should:

- Plan-prepare available fields and themes of thesis, update scholarships, etc.
- Manage timing- they should think about due dates. There are 3 types of due date:
  - Due date of choosing field and supervisor
  - Due date of theory part of thesis
  - Due date of research part /depends on how many years candidate is studying/
- Support- Administration should support candidates with required documentation and books.
- Control- There are 3 level of controlling:
  - Administration- administration controls through supervisor and through candidates.
  - Supervisor- supervisor manages candidates workflow
  - Self-control- candidate should control himself as well;
- Release - If all the above-mentioned steps are succeeding, it means that the candidate is ready to complete his thesis and represent it.

## 6. RESEARCH IN INSTITUTES

During this work we investigate how research is being organized in Cambridge, Oxford, MIT, Princeton, Stanford, and Harvard [8-11]. And we can summarize that for successful research in institute you need to have a right organized management flow. Here are the main things that are needed in research management: creative team, which consists of undergraduate, postgraduate students and professors, flexible communication, available research material, fund /sponsor, grand, field of research, goal.

To have desired results the institution needs to: identify what is success for the research project, manage and plan stakeholder, define timelines, manage risks, projects, project budget, finding time to manage project

Each institute has its own method of research project management. Before starting research the manager and team should understand what management method should be used during research planning and research development.

## 7. SUGGESTION: JIRA as a tool of Research Project Management

After investigating research project management we came into conclusion that, the management will be easier and more flexible if we use JIRA Atlassian [15,16] as a research project management tool. JIRA is one of the most widely used issue tracking and agile management methods. It is used worldwide especially in IT. Developers like JIRA, because it is integrated with IDEs and source code management systems such as GIT and SVN. Atlassian has additional add-ons, which make developers and managers life easier and more comfortable. Besides issue tracking and project management, JIRA allows implementing resource

management. More often JIRA is used in development projects and not in research, but it is very useful to use JIRA in research project management. In general the phases of projects are the same and as we presented above there is a little difference between the areas of PM knowledge and RPM knowledge. As Jira is very flexible and has various tools and add-ons, the tools that should be used for management depend on research type and sphere. There are no special add-ons or tools for research, but current tools are so flexible that they are useful. Thus, if all research funds and processing institutions use JIRA, it will be easier to communicate and share results. JIRA will provide transparency in countries. Also by using JIRA students from different countries will be able to organize research together. So let's see on example how to use JIRA for research project management. As our main example of research project management sphere is PHD, so let's see how candidate and supervisor can use JIRA to manage their work.

## 7.1. Writing PHD Thesis Management in JIRA

After investigating research project management and JIRA management, we came to conclusion to use Agile board and JIRA confluence for PHD management. So let's summarize how candidate should write PHD thesis to accept PHD degree. Candidate should investigate the sphere, find an interesting and actual topic, create a plan and consultate with supervisor.

So, above mentioned is the first level, if these steps are successfully completed, candidate can begin to work on next level, where supervisor has a very important role. He should provide with books, help to find organizations, which will give information for practical part, monitor candidate's work.

Here is how JIRA can help to save time:

- Create an Agile Project and Confluence space.
- Agile board is being created automatically.
- They can use JIRA Project for their planning.
- Supervisor can create weekly sprint /task list/ for candidate and communicate with him once a week,
- Confluence will be used instead of word, the advantage of confluence is that supervisor can watch the progress anytime he wishes, can add some comments or intermediate tasks. Supervisor will receive an email and will be able to check the work and add comments.
- JIRA will help both the candidate and the supervisor to prove their trailer. JIRA keeps the whole history and with the help of Agile add-on (Tempo) can create a report.

## 7. CONCLUSION

Research is a complex task which has a bit prescribed structure. In research team it is important to share plans with others, which can help to estimate and allocate time. Research project management helps to organize work, to see the progress of work, shorten risk of forgetting tasks or losing information. It also contributes reflections on the research process. Here are the important points of research project management: quality, time, cost, scope

The process of research projects consists of standard activities in research projects, creating a GANTT Chart, risk management and project tracking. The outputs of research projects are documentation – classic structure, basic writing skills, Harvard referencing, Plagiarism.

So based on chapter 6 we have the following suggestions to set up JIRA in universities, create specific research plugins for JIRA and share JIRA knowledge with others, to have fast results.

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