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Igor Gorshkov

Efficient Project Management Frameworks in Department of Nuclear Power Plant Design Institute

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The aim of the final year project was to analyse the overall approach to project management and resource management in the department of digital design development, the functions of which are very versatile and chaotic, and to implement a new framework for project management, which would suit the department's structure of projects and activities.

The case study featured in this thesis focuses on creating a flexible, user-friendly and well-structured information system which increases the effectiveness of planning the department's projects and resources significantly. The information system is developed on the basis of the project management methodology also developed in the case study.

The implementation of the project management frameworks and the information system for project management system showed an increase in data quality regarding resource management and a rise in the satisfaction level of top management and the workers of the department, whereas the percentage of key deadlines not completed on time decreased.

The results of the thesis can be used to further improve project management and resource management processes in the organization. The results can also be used as a reference for other organisations to improve their project management frameworks and using the experience of this thesis.

Keywords	project management, PM, resource management, Agile, Scrum, PMI, Redmine, PM methodology, PM frameworks

Contents

List of Abbreviations

PM	Project Management.
JSC ASE EC (ASE)	Joint Stock Company Atomstroyexport Engineering Company.
UDI	United Design Institute.
Department	Department of Digital Design Development.
PM	Project Manager (when related to the person).
IPMA	International Project Management Association.
PMI	Project Management Institute.
NPP	Nuclear Power Plant.
ICB	Individual Competence Baseline.
OCB	Organizational Competence Baseline.
PMBOK	Project Management Body of Knowledge.
PM2	A methodological document for Project Management developed by The Centre of Excellence in Project Management.
MS Project	Microsoft Project.
IT	Information Technology.

1 Introduction

In order to define what project management is, one must first define what a project is. According to the Project Management Institute, a project is defined as a temporary and unique set of activities, put together in order to reach a certain goal. The main features of a project are the certain times for its beginning and ending, its intended outcome, how costly it is and what resources it uses. Therefore, project management (PM) is the application of processes and knowledge areas, as well as instruments and techniques to the operations of a project in order to reach the project's goal. Reaching the goal also means doing it on time and without exceeding the budget. [1.]

The reason for the case study carried out in this thesis was an unsatisfying condition of project management processes in the case department, department of digital design development. Specifically, the resource management process of project management is analysed and developed in the thesis. It is important to comply with the features of the case company, JSC ASE EC, which is an engineering company specialised in designing, constructing and operating nuclear power plants both in domestic and foreign markets.

Overall, working in a big company means dealing with multiple activities and tasks simultaneously, as well as managing a great number of departments and workers. It gets especially complicated, when the company operates on both domestic and foreign markets, having various stakeholders and clients.

Furthermore, each department has to not only satisfy the project management requirements and guidelines of the company itself, but also to suit the domestic and foreign stakeholders, the clients, the top management of the company and all the accountants accumulating the data of project workflows and resource involvement in these projects.

Hence, it is essential for a project-oriented company to establish clear and transparent project management frameworks within each department in order to increase the efficiency of all processes occurring in the departments. Moreover, based on such frameworks, a flexible and user-friendly information system has to be created to comply with the frameworks and fulfil all project management data requirements. So, what kinds of

project management frameworks have to be implemented and how to organize the resource planning within the department of digital design development?

1.1 Background

The study focuses on analysing the current state of project management and specifically resource management in the JSC ASE EC. Then, based on a theoretical analysis of existing international best practices and project management frameworks, a solution is proposed and implemented. The solution optimizes the PM processes in the department of digital design development. It affects all the activities of the department positively. Special features of the company and existing guidelines are also taken into consideration.

1.1.1 Project Management and Resource Management as Key Processes

When a project is initiated in an organization, managing its various aspects efficiently must be the first priority of a project-oriented organization. It means not simply having a solid project team and a reliable and competent project manager; developing a set of standards and guidelines for project management is also highly important. The documents should thoroughly explain each step of the project, the functional roles of all project members and the processes of interaction between such members.

Without a properly organized project management, it is unlikely that a company would reach sufficient results even in a domestic market, and its reputation as a reliable partner for any other organizations is likely to suffer. Hence, developing the project management must be a high priority task for any company. Moreover, the development process is constant, meaning that there are no limits to developing the project management.

In addition, resource management is one of the most complicated yet important aspects of the project management as it is people completing the project, after all. Moreover, when a department carries out multiple projects simultaneously, managing the resources between these projects is even more challenging. [2,156.] Therefore, creating a transparent, honest and realistic system for managing the resources of a project is definitely

one of the most important tasks when developing the project management in an organization.

1.1.2 JSC ASE EC and United Design Institute

The case company, JSC ASE EC, is an engineering division of the State Atomic Energy Corporation ROSATOM, a governmental company, which focuses on designing, constructing and operating nuclear power plants both in Russia and in several foreign countries. The company provides the corporation with the design of the power plants, as well as IT support and solutions for design, construction and maintenance. JSC ASE EC also develops new digital products for design and information management and serves as a contractor on all nuclear power plant projects of the corporation. [3.]

Moreover, the company has three design institutes in Moscow, Saint-Petersburg and Nizhny Novgorod, all of which have a different approach towards design both in terms of information systems used for design and project management frameworks. All nuclear power plant projects are distributed evenly between three project institutes. Recently these project institutes were merged into a new structure – United Design Institute (UDI), and all the new projects of the company are completed by this new structure. [4.]

The final year project is not carried out for the whole company, but one of its departments. The case department is the department of digital design development. This thesis saw its main focus areas to be:

- Technical support for UDI in information systems for design.
- Development of information system architecture for design, including integration of systems.
- Development of design process frameworks for UDI, including methodology and standards.
- Interaction with foreign and domestic clients and stakeholders, including design data transfer.
- Other design development projects and operational activities within the department of digital design development.

It is clear from the list above that the scope of the activities of the department of digital design development is rather wide, so dealing with all of them requires solid project management frameworks.

1.2 Aims

The aim of the thesis is to develop both the project management and, specifically, the resource management frameworks and an information system based on the frameworks to comply with the features of the department of the company and all the stakeholders of the activities of the department of digital design development. A development project is carried out after an in-depth analysis of the company's and the department's existing practices, standards, guidelines and features. Based on the current state analysis, best international practices in project management are taken into consideration in order to identify the most suitable solution for the department of digital design development.

Chapter 2 analyses the initial state of project management processes in the department of digital design development, focusing on the approach used currently, including the methodology, information systems in use and an overall structure of projects and resource management. Then, through an analysis of best practices that are introduced in chapter 3, a development project is carried out. The development project focuses on the same aspects as the current state analysis and its aim is to successfully integrate an upgraded methodology as well as a system for project management - based on the methodology - in the department of digital design development.

2 Initial State of Project Management Processes in Department

Analysing and properly assessing the current state of project management processes and frameworks in the department of digital design development was the first, and a highly important, step. Identifying the problematic spots, misunderstandings and contradictions between the overall structure of projects, the systems in use for project management and, specifically, for resource management, the methodological background and its reflection on the actions taken by the department are the main aspects to be taken into consideration in the analysis.

2.1 Project Management Approaches and Frameworks

Already in the first days of the current state analysis, a clear inconsistency in the department operations was discovered. Despite being a project-oriented organization whose main focus is on completing the projects on time and with high quality, the approach to project management in the department of digital design development was functional, meaning that the organizational structure was always above the project team structure.

All projects of the department of digital design development were dissipated randomly between various functional groups of the department. The reason for that was the wide range of tasks within each project, which covered the functions of various structural groups. Hence, the project team for each project contained several people from each group. But the Project Manager, who also belonged to one of the department's groups, did not have enough power to assign tasks to a certain person in the project team straight away. Instead, the Project Manager would have to ask the various heads of groups for resources in order to do his tasks and progress with his project. The structure of groups in the department is described in figure 1 below, as well as the way the project team was functioning.

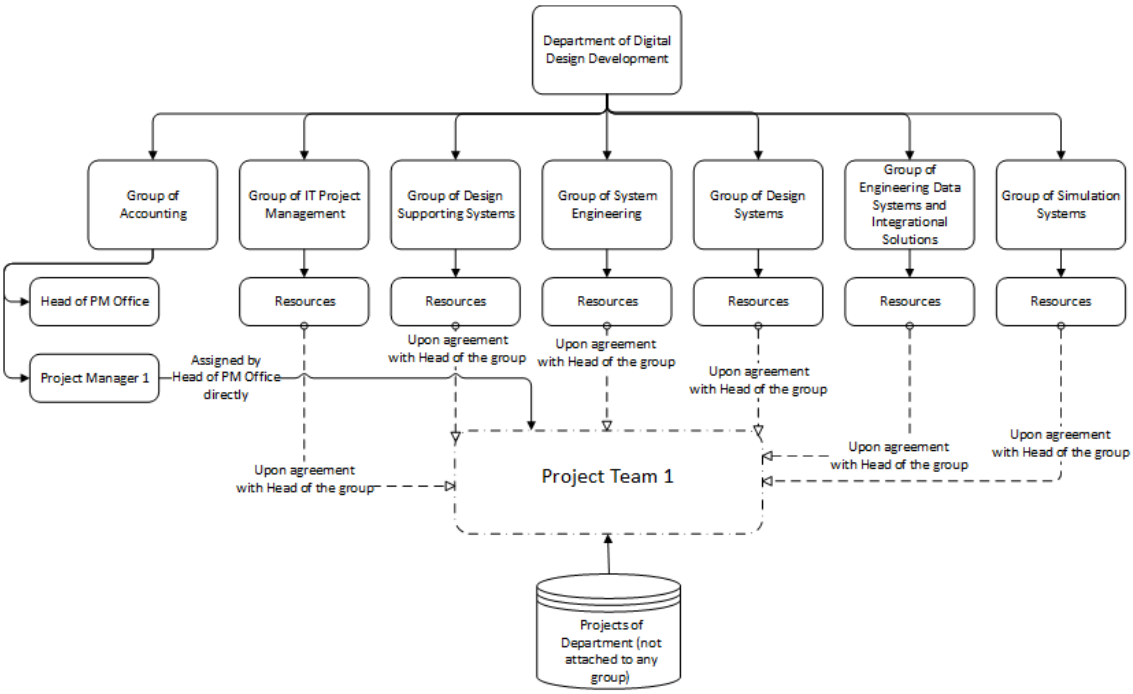


Figure 1. Structure of groups and projects of the department of digital design development.

As it can be observed in figure 1 above, the groups had more power to control resources than the project managers. Therefore, it is valid to state that there was no fixed project team, which, obviously, decreased the efficiency of the project and the overall motivation of Project Manager and the project team.

2.1.1 Project Management Methodology

Project management processes have to be described in a specific document called methodology. It had to be developed from scratch and implemented within the department of digital design development in order to define and clarify all PM processes taking the department's spectre of projects and tasks into account. However, the main focus of the department was on covering all operational activities within the group, with much less priority given to projects of the whole organization. That was a direct consequence of having a functional approach to PM, which is described in the previous chapter Therefore, no methodological documents were developed in the department. The PM processes were not clarified and the functions of the Project Manager were not defined.

Moreover, the department of digital design development used the higher-level standards and guidelines of the organization for project management as the core documentation for their project management processes. These standards and guidelines, in turn, mostly consisted of International Project Management Association (IPMA) and Project Management Institute (PMI) standards, with a few corrections and additions on top of them. It not only made such documents too common to be applied to a specific case, but also put a number of irrelevant obligations on the department. One such irrelevant obligation was the requirement to use certain information systems for demonstrating the current progress of a project, resources in use and other accurate information to truly demonstrate the real situation of the project workflow. However, as described in chapter 2.1.3 below, the information generated from such systems was of low quality, making the creation of a relevant methodological document essential for the case study.

2.1.2 Project Structure

When analysing an existing structure of projects in the department of digital design development, the first thing to consider is the types of projects the organization actually

carries out and how the department contributes to these projects, in other words, what role it plays.

The main activities of the organization were defined by this thesis as to design, construct and operate nuclear power plants, but, more importantly, also to develop the information systems used not only for the abovementioned activities, but also to improve the process of interaction with foreign owners as well. In addition, the study project defined the main focus of the organization as the development of new products. The result of such developments is the improvement of any processes within the organization, both design-related and non-design-related, and an efficiently support of the information systems in use.

From all the abovementioned activities, the department's functions were defined as:

- Providing an informational link, including engineering data and various building models (created by UDI's designers), between the owner and the contractor at all stages in all Nuclear Power Plant projects (NPP projects)
- Offer technical support of UDI in all information systems used in NPP projects
- Create new products for UDI and develop the existing ones in order to improve the digital design process of NPP.

Despite the clarity of the list of functions of the department of digital design development, the thesis found out that all the functions had, in reality, a lot of overlap. For example, each NPP project involves the technical support UDI to designers for the systems used for design and for sorting out the engineering data. Another example of overlap is that some system development is carried out simultaneously as a pilot in one or several NPP projects, meaning that such activity falls under two functions of the department at the same time.

As a result, even after defining the projects as NPP projects, technical support projects and design development projects, the thesis found out that most of the activities of the projects were often included in two or more projects at the same time, making it rather complicated to both form relevant and fixed project teams and to structure the tasks within a project. Moreover, the great number of significant deadlines and growing numbers of critical issues, which prevent UDI from completing their tasks according to the contract deadlines, created a chaotic and incomprehensible approach in the department.

All this means that the task structure in the projects was chaotic, with rapidly changing priorities, depending on what task was the most critical at a certain moment of time. Obviously, such chaos in task forming and prioritizing also brought chaos to resource planning and project team forming. The thesis did not discover any project team morale and team chemistry, as it was impossible to get a fixed the project team and people were reassigned to different tasks all the time, sometimes even working at multiple difficult tasks simultaneously. Hence, a clear problem in forming a proper project structure with unambiguous, transparent and well-prioritized list of tasks and activities was identified.

2.1.3 Information Management and Systems

One of the most important aspects of the initial state analysis is to inspect the information systems used for PM in the department, especially since the case study in this thesis is based on developing a unified system for project and resource management in the department of digital design development based on the methodology.

Because of the standards and guidelines that were used (see chapter 2.1.1), the department was obliged to use a variety of unintegrated and separated information systems for various aspects of project management. In addition, some systems were used for some activities for historical reasons, resulting in the use of a great amount of separated information systems used without a unified way of managing the projects. Therefore, in order to develop a comprehensive solution for the information system used for project management processes, it was vital to inspect what kinds of information each of the information systems used generated.

The first information system to be analysed was Microsoft Project – a project-planning software from Microsoft that is suitable for mid-term and long-term planning, but gets more complicated to dynamically control when considering operational activities, detailed short-term tasks and an in-depth resource management. Microsoft Project was mainly used for presenting and, sometimes, correcting the project schedules, although it did not have the actual resources showcased, only the main people responsible for the completion of tasks. The only integration with any other systems was a one-way import of tasks to Redmine via certain types of CSV-format tables, meaning that someone had to not only generate such tables from the system, but also to adapt them to the format suitable for import, making it a labour-intensive and inefficient integration, especially considering

the fact that changes in one system would not display in another. The main positive aspects and drawbacks of using Microsoft Project for project management are demonstrated in table 1 below.

Table 1. Positive and negative aspects of using Microsoft Project for PM.

Using Microsoft Project as the main system for project management	
Positive aspects	**Negative aspects**
Good for mid-term and long-term planning in a big scale	Poor effective integration possibilities (with other systems in use)
Automation of rescheduling (changing dates)	Ineffective for detailed planning (per person)
User-friendly interface for scheduling and planning	Ineffective dynamic resource management
	Poor quality of plan-fact analysis instrument
	Not upgradable (can only use what is in the box already)
	No functionality of communication within the task

The second information system used by the department studied in the thesis was Multi-D Docs&Resources – a web-application based on Liferay platform that was initially supposed to become the only system to be used for project management in the department, and was being developed intensively at the time of the analysis. The thesis saw its main functions to be:

- Resource planning (monthly planning without any attachment to the actual tasks of the project, only to its activities)
- Resource planning analytics (diagrams and charts showing the distribution of resources according to the entered planning data)
- Operational tasks (although the module had never been developed to the state where it could be properly used)
- Document storage (with the possibility of remote access and network disc function)
- Document approval procedure.

However, despite the versatile functionality of Multi-D Docs&Resources, each of its modules has a very incomprehensive and not user-friendly interface, making it complicated for the users to interact with the system and with the other users in the system, and for the administrators to control the system. Moreover, none of the actual resource load tasks of the workers of the department studied were entered in the system, meaning that there was no plan-fact analysis whatsoever, making the resource planning data useless and inapplicable for managing the resources of the projects dynamically. The list of the

positive and negative aspects of using Multi-D Docs&Resources as the main system for project management in the department can be seen in table 2 below.

Table 2. Positive and negative aspects of using Multi-D Docs&Resources for PM.

Using Multi-D Docs&Resources as the main system for project management	
Positive aspects	**Negative aspects**
Flexibility in upgrading (the system is a product of ASE)	Not user-friendly interface
Good variety of modules important for PM	Difficult integration with other systems, including the corporate systems of the company
Decent interface for communication on documents and tasks	No functions for actual resource load task data
	Poor quality of resource planning data (non-upgradable)
	Limits in upgrading (in terms of competences of specialists developing the system and in terms of Liferay platform possibilities)
	Poor project structure and interface of the structure

Another widely used information system used in the department studied in the thesis is Redmine which the thesis discovered to be an open-source web-application used to display the tasks distributed by projects, structured in the system. Redmine also serves as a support window for technical support requests from UDI to the department of digital design development. Redmine has a function for entering actual working hours for a certain task and the root of the task, including the project it belongs to. Redmine also has a user-friendly interface, an understandable and an upgradable structure of projects and tasks within the system, making it possible to create a tree of projects and tasks easily, including all operational activities and the IT support tasks of the department. Furthermore, Redmine has a statistics module, which, despite being at an early stage of development, has a potential of becoming a strong instrument for analysis both in terms of resources and scheduling.

Nonetheless, Redmine does not have features such as resource planning, data diagrams and charts, and, more importantly, the department studied in the thesis had not issued any instructions and standards for using Redmine, so the data quality was relatively low, making it inoperable for project management at the time of the initial state analysis. The breakdown of benefits and drawbacks of Redmine as a system for project management is shown in table 3 below.

Table 3. Positive and negative aspects of using Redmine for PM.

Using Redmine as the main system for project management	
Positive aspects	**Negative aspects**
User-friendly interface	No resource planning function (upgradable)
Good interface for communication on tasks	No plan-fact analysis instrument (upgradable)
Good function of actual working hours data	Poor data quality both in task attributes and actual resource load
Possibility to upgrade the open-source system both internally (changing the code) and by inserting third party plugins for PM	Challenging integration with other system (mostly via Excel interface tables)
Decent and upgradable project structure and interface of such structure	

The rest of the data in the department studied was coming from various minor information systems which were only used because of the obligations the department had due to its outdated standards and guidelines for project management. For example, some of the technical support tickets were generated in a system called ServiceDesk, a web-application, which served as a link between UDI and the department for providing a service function. However, some of the tickets were also generated in Redmine, distributing that type of data between several information systems without any integration or link between them.

To summarize, the main problems identified in the information systems used by the department studied at the analysis stage were:

- Lack of a proper planning instrument in any of the systems
- Non-existence of any plan-fact analysis
- Double data entry issue (having to duplicate some of tasks or resource load data in several systems)
- No centralized data accumulation
- No integrations or information links between information systems.

However, none of these problems could be solved before developing a set of methodological documents and instructions on project management, because otherwise it would be impossible to identify the most suitable information system for the methodology.

2.1.4 Resource Planning

Since the main problem with the project management processes in the department studied in the thesis was resource management, identifying its current state and weaknesses was significant to plan how to improve it.

As stated in the previous chapters, the thesis did not find an adequate resource planning instrument in the department of digital design development. The reason for this was, firstly a chaotic approach to planning the tasks, activities and resources of projects in the department studied, and secondly, the functional structure approach towards PM in the department.

The main reason for the abovementioned problem is, again, because of using various information systems for different project management-related purposes: the thesis found out that while resource planning was conducted in Multi-D Docs&Resources, the actual resource load data was distributed between Redmine, ServiceDesk and other sources, which are not even information systems. For example, some groups were not familiar with Redmine and used MS Excel instead to generate time sheets of their workers' activities, making the data complicated to accumulate and sort out. Moreover, since Multi-D Docs&Resources did not focus on the tasks and only showcased how the human resources were distributed among the unified list of activities in the department of digital design development .Even though this list of activities was attached to projects, it was not showing the real picture, so it was nearly impossible to compare the resource plan data from this system to the actual resource load data collected from various other systems.

In addition, the thesis did not find any competence-based planning functions in the department of digital design development, and no competence database was discovered in the department, reducing the efficiency of planning even further. As a result, it was clear that the department did not know how to control its resources and had no proper instrument to do it, making every working day very chaotic and unstable for all of its workers, including Heads of Groups themselves.

2.2 Summary of Project Management Problems

To sum up, the project management processes in the department were of relatively low quality at the stage of initial state analysis. The main reasons for that were an overall chaotic approach to work, an unstable project structure, incomprehensive and irrelevant resource management and lack of a single source of information. Single source of information essentially means having one information system, an ultimate place for all project management processes. Simply put, the initial state analysis showed a great number of problems in the overall approach to managing the department's projects and resources. It reflects both in functional structure approach, described briefly in chapter 2.4, and the lack of relevant methodological background.

After the initial state analysis, described in chapter 2.1, was finished, the results were collected and presented at a round table meeting with the management of the department studied in the thesis. The department's management, especially the supervisor, were satisfied with the depth of analysis and took part in prioritizing the discovered problems. The main tasks to complete were defined as:

- Creating a set of methodological documents to replace the outdated standards and guidelines in the department.
- Selecting and implementing the most suitable approach to project management in order to replace the existing functional structure approach and give more power and control to Project Managers with their project teams.
- Re-defining and fixing the structure of projects and their activities and tasks in the department.
- Selecting and developing a single information system to accumulate all PM information, especially resource-related information.
- Creating a strong, reliable and high-quality resource planning instrument, which would include plan-fact analysis and be based on the competences of the workers.

Obviously, completing such tasks successfully would significantly increase the efficiency of project management in the department, potentially becoming a best practice for a number of other departments of the organization.

3 Overview and Analysis of Frameworks and International Practices

In order to complete such a great number of tasks as described in chapter 2.2, it is important to collect a sufficient theoretical background in order to select the best and most suitable path for development. When analysing the existing and internationally known and used frameworks, it is reasonable to consider not only the standards for project management, such as IPMA and PMI, but also some alternative frameworks and approaches, as well as some successful international practices, which could be suitable for the department.

3.1 Standards IPMA ICB and OCB

IPMA (International Project Management Association) is a professional European association focusing on creating various project management documents based on worldwide standards and guidelines. The documents include competence baselines for both organizations and individuals, standards for PM and more practical project management methodologies. The organization also certifies individuals who want to become Project Managers, or want to prove their competences in PM. IPMA also promotes successful European projects and project teams in order to showcase the best practices in project management. [3.]

Two documents released by IPMA were considered in the study: IPMA ICB (Individual Competence Baseline), and IPMA OCB (Organizational Competence Baseline). Both serve as guidelines for competences which should be used as key factors for assessing the organizations and the individuals working for them.

The IPMA ICB guidelines use a concept called the Eye of Competence. It indicates three areas of competences: Perspective, People and Practice. Together these areas of competences, or eyes of competences, serve as a solid base (a big eye). For an individual, it is important to have such competences in three domains: project, portfolio and programme management. [4,25-26.]

The first competence or the perspective eye of competences is mainly about the competences of an individual to adequately react to the main drivers of a project. This area of competences defines the following key elements:

- Strategy – with clear goals and aims
- Governance, structures and processes – both external and internal, to establish the background of a project, a programme or a portfolio
- Compliance, standards and regulations – including regulations, standards, laws and tools that form the core of an entity
- Power and interest – focuses on the potential influence of organizational hierarchy on projects, portfolios and programmes
- Culture and value – organizational or social informal conventions, principles and practices, which contribute to the success of a project, programme or portfolio. [4,28-29.]

As seen from the list above, the elements of the perspective eye of competences focus on the big scale of projects, foreseeing and considering the factors affecting or driving the project, all of which is essential for making the project last, and last successfully.

Next, the elements of the people eye of competences focus on the soft skills of an individual:

- Self-reflection and self-management – to rationally organize and evaluate self
- Personal integrity and reliability – to complete the set tasks successfully and in a reliable way
- Personal communication – efficiently and correctly linking up with others
- Relationships and engagement – building up the connections with other people
- Leadership - putting everyone together to reach the goals
- Teamwork – involving every team member efficiently
- Conflict and crisis – how to deal with controversial situations
- Resourcefulness – the ability to combine techniques and approaches to create a proper team environment
- Negotiation – how to comply with the interests of all stakeholders and parties
- Results orientation – how an individual can affect the team to reach certain results. [4,29.]

The people eye of competences, as seen in the list above, focuses on the human factor rather than on instruments and tools. Soft skills are important, because the thesis found

out that the department of digital design development often neglects them, resulting in worse project efficiency.

Finally, the practice eye of competences is about the main factors influencing and demanded by the project. Being competent in this area means being an expert not only in understanding and affecting these factors, but also mastering the appropriate tools and methods to be efficient in project management. The main elements of the practice eye of competences are listed below:

- Design – translating demands into a project, a programme or a portfolio
- Goals, objectives and benefits – prioritizing and reaching the set aims and outcomes
- Scope – describing the boundaries
- Time – correctly planning the delivery of the product in the timeline
- Organization and information – controlling the information and communication within a project, a programme or a portfolio
- Quality – meeting the demands on quality and controlling the quality
- Finance – managing the money input
- Resources – controlling human resources
- Procurement – managing the acquisition of any resources
- Plan and control – integrating all of the activities and distributing them
- Risk and opportunity – identifying and correctly managing the risks and possible scenarios
- Stakeholders – interacting with stakeholders
- Change and transformation – rotating the structure of the organization in order to increase the efficiency
- Select and balance – prioritizing the components of a programme or a portfolio. [4,29-30.]

All in all, IPMA ICB gives guidelines on the set of competences, divided into three logical categories as shown in figure 2 below (three eyes). The competence elements within each eye form together a generic model of competences which could be adapted and applied in various organizations. [4,35]

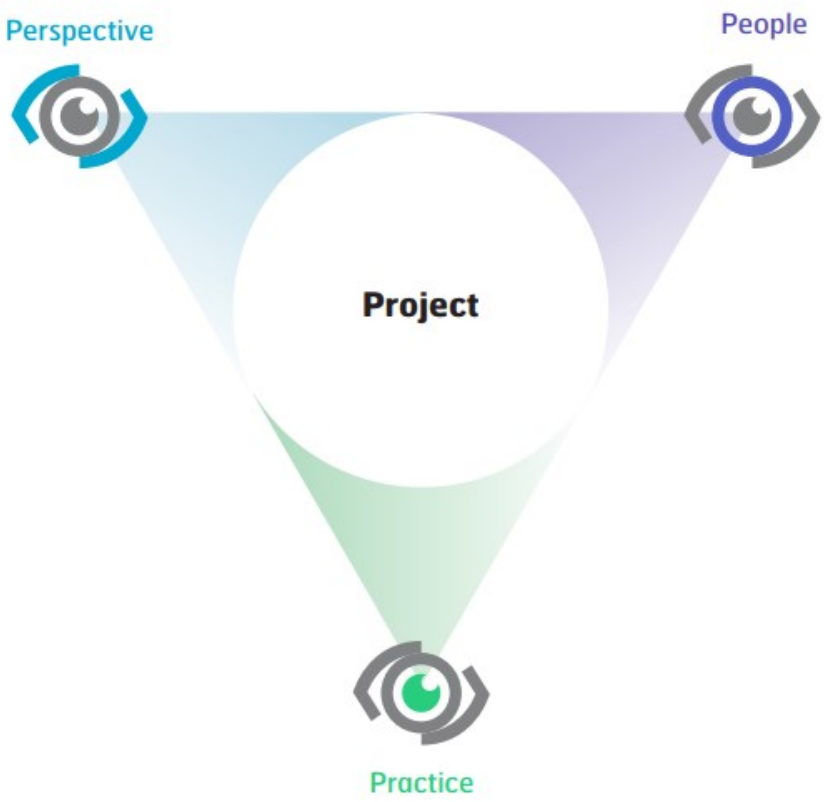


Figure 2. The three eyes of competences according to IPMA ICB [4,37].

The IPMA OCB, in turn, takes a bigger picture approach to analysing project management as a knowledge area and focuses on organizational competences. It also takes the people's competences showed in figure 2 above into consideration, and provides a strong link between the organizational strategy and the projects of the organization. In addition, IPMA OCB links corporate governance, as well as management systems with project-oriented systems. [5,19.] The competences are divided in the following categories:

- Governance – corporate strategy, governance and development that concerns projects, programmes and portfolios
- Management – systems and functions of managing projects, programmes and portfolios
- Organizational Alignment – adjustment of processes, frameworks and approaches with internal and external parties

- Resources – setting up the requirements for resources, defining their current state and acquiring the new ones
- People's Competences – organizational aims and expectations for people competences, including interactions, execution and recognition. [5,49-51.]

An overview of all organizational competences and their elements is demonstrated in figure 3 below. The elements are grouped and shown in the context of an organization, both internally and externally. [5,49.]

Figure 3. Overview of IPMA OCB competence elements of an organization. [5,49.]

As can be seen in figure 3 above, the application of organizational competences to the PM standards of an organization not only provides a transition from having a planned-through idea to the certain results, but also enables the so-called lessons learned cycle process on the level of organization, which is something the department studied in this thesis always emphasized, but rarely executed.

3.2 PMI PMBOK Standard

PMI (Project Management Institute) is a worldwide association which not only focuses on creating standards for project management, but also serves as a community which certifies people, provides them with resources and tools for PM development and serves

as a platform for networking [6]. Its main standard, PMBOK (Project Management Body of Knowledge) is a thorough foundation for project management, a collection of a number of various practices in PM, both classic ones and ones that involve an innovative approach. PMBOK also serves as a rulebook for project management, containing a broad glossary of terms, processes and approaches. [7,1-2.]

Overall, PMBOK understands the processes of a project as a summary of ten Knowledge Areas, which are all interconnected, but serve as separate sets of processes. In addition, the project timeline is divided into five chronological stages, called Process Groups, which essentially form the lifecycle of the project. [7,23-24.] The way these Knowledge Areas are mapped with Process Groups is shown in table 4 below.

Table 4. Mapping of Project Management Process Groups and Knowledge Areas. [7,25.]

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work 4.4 Manage Project Knowledge	4.5 Monitor and Control Project Work 4.6 Perform Integrated Change Control	4.7 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Schedule Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Manage Quality	8.3 Control Quality	
9. Project Resource Management		9.1 Plan Resource Management 9.2 Estimate Activity Resources	9.3 Acquire Resources 9.4 Develop Team 9.5 Manage Team	9.6 Control Resources	
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Monitor Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses	11.6 Implement Risk Responses	11.7 Monitor Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Engagement	13.3 Manage Stakeholder Engagement	13.4 Monitor Stakeholder Engagement	

However, while being a fairly good and all-round summary of the overall knowledge in project management, PMBOK is still only a standard, which means it cannot be directly used to create a methodology which would describe the project management processes. In addition, PMBOK's weakness is a rather brief description of project roles and their responsibilities. It further proves the point that the guidelines of PMI should be used as reference material. [8.] All in all, PMBOK is more of a background document to refer to when defining some terms or processes of project management, but not a main source to consider and start from.

3.3 Agile and Scrum

Agile is a recently developed methodology for PM, which was initially presented by a group of software developers around the world. It stresses an iterative, cycle-based approach, using frequent sprints in order to increase the efficiency of the project and the involvement of the project team members as well as stakeholders in the process. The main focus of Agile is continuous, sustainable development, transparency to all project members, high pace of the project and increased flexibility to the changing environments. In addition, Agile creates space for making some changes in the working process through intervals between the sprints, or cycles of development. [9.] A basic scheme of Agile framework for progressing in a project is demonstrated in figure 4 below.

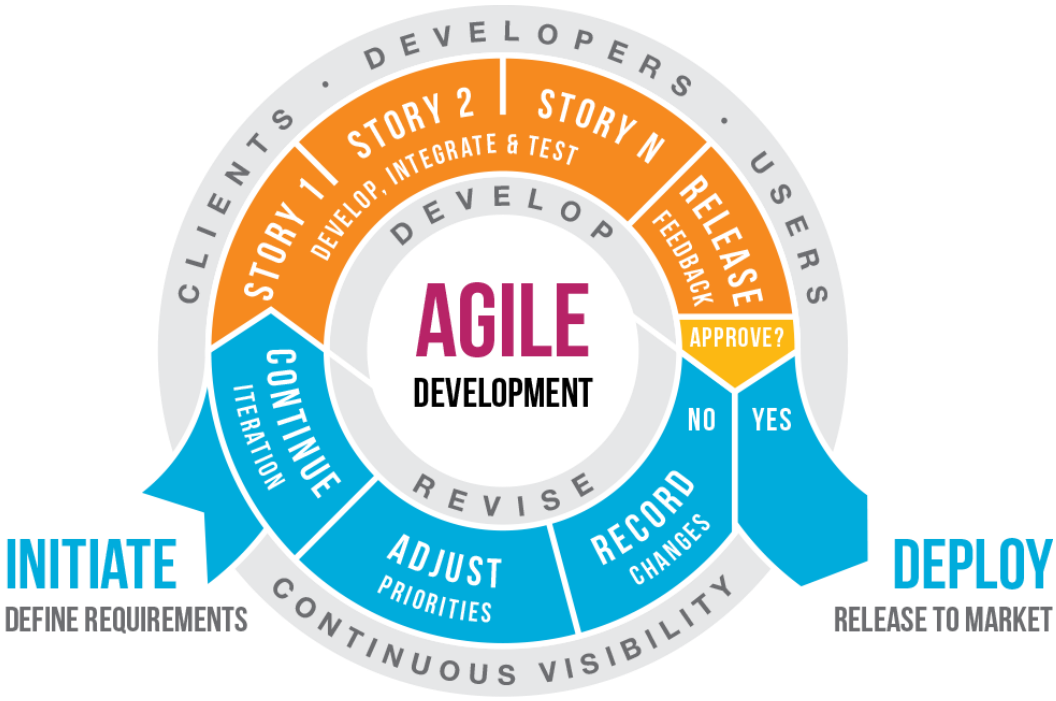


Figure 4. Schematic description of Agile Project Management methodology. [10.]

As it can be seen in figure 4 above, Agile development not only uses sprints to develop in an iterative way, but also involves users, developers and clients to transparently monitor the progress of the project, together. Nonetheless, Agile requires all project members and clients to be not only acquainted with the methodology, but to also have a set of skills to successfully perform the methodology. The most important skills are flexibility

and adaptability to the changes in the environment, prioritization abilities, quick critical thinking and ability to focus on vital tasks only. [9.]

Agile is implemented worldwide in various industries, the most popular being software industry, as shown in table 5 below [9]. This is another strong argument for considering Agile as a suitable methodology for the department studied in this thesis, as the majority of its activities are based on developing design software.

Table 5. Agile adoption rate in different industries. [9.]

Industry	**Agile adoption rate**
Software (ISV)	23%
Financial services	14%
Professional services	12%
Insurance	6%
Healthcare	6%
Government	5%
Telecoms	4%
Transportation	4%
Manufacturing	4%

Also one of the branches of the Agile methodology, Scrum, is important to consider. Scrum is a PM framework, which is based on Agile, yet focuses on an even faster, more intensive and, thus, efficient development, which suits best for creating new products and innovative solutions. It has its own structure of roles and sprints, intensifying the process of development as well as the adaptivity of a project and its members to the changing circumstances. A basic concept of the Scrum framework is shown in figure 5 below. [11.]

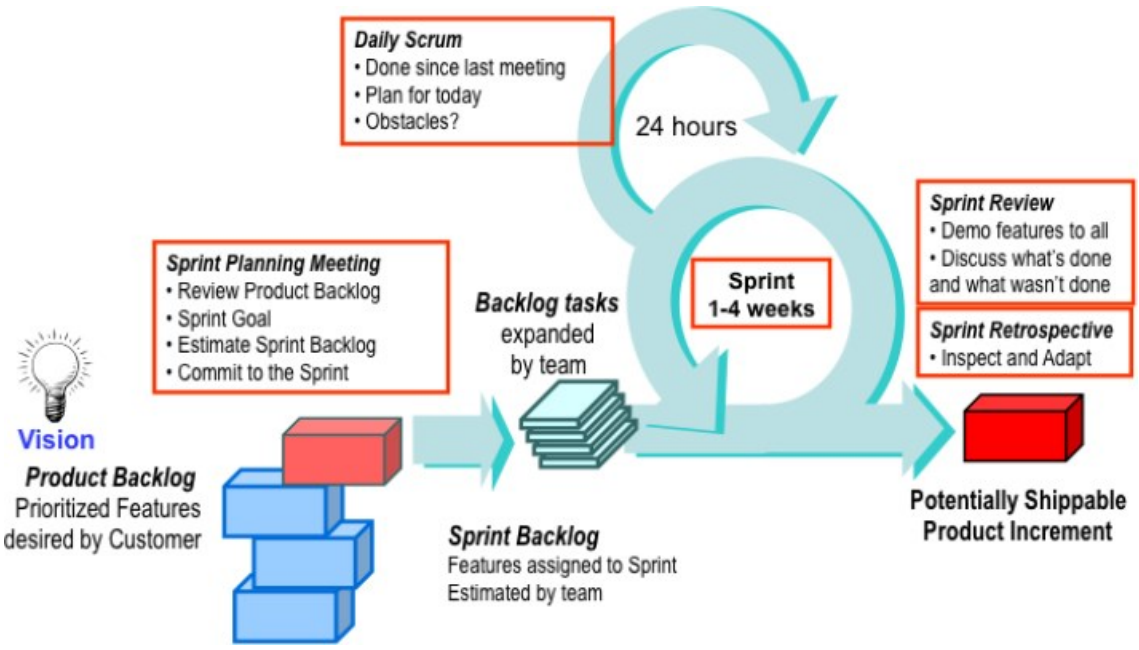


Figure 5. The concept of Scrum framework. [11.]

From figure 5 above, it is clear that the frequency of sprints, the background and the outcomes are all crucial elements of the framework, forming its core along with the idea of daily Scrum meetings. A Scrum meeting is a concept of brief, yet very informative meetings of all project members. It answers such questions as what was done, what is planned for today and what are the barriers slowing down the project workflow. By answering these questions, everyone involved in the project gets a transparent vision of everything happening in it, which is a powerful aspect of the framework. [11.]

Further on, Scrum only introduces three roles in the project: the team itself, the owner of the product and the Scrum master. While the project team has to be self-organizing, the Scrum master sets up the communication within the team, deals with all external issues and tackles all problems related to any aspects of the project. The product owner, in turn, is the holder of the product backlog shown in figure 5 above in the beginning of the project. The product owner sets the priorities and showcases his vision of what the product should be, so that a sprint backlog can be formed. After each sprint, an analysis is conducted by the team and the master, and a retrospective is formed in order to develop the workflow and make the next sprint more efficient. [11.]

To summarize, both Scrum and Agile are progressive frameworks of project management, but it is clear that they should be used wisely as frameworks mostly for the projects

where the aim is to deliver a product or develop a new solution for software. Moreover, it is also important to notice that the rigidity of an organization has a negative effect on the workflow of projects adopting Scrum or Agile. It means that big scale projects, which are heavily controlled by the top management and have a set of fixed deadlines of top priority, will not be efficiently executed using such frameworks. [12.]

3.4 PM2 Project Management Methodology

PM2 is a methodological document for project management developed by The Centre of Excellence in project management, which is a part of the European Commission. This document is an actual guide to PM, based on existing best practices. It covers such aspects of project management as the lifecycles of a project, PM processes, roles and their functions, communication and soft skills. PM2 also explains several techniques and tools to use in order to increase the efficiency of project workflow. [13] One important topic that PM2 covers is different project organizing approaches, the main three being the functional structure, the projectized structure and the matrix structure, each discussed below.

The Functional Structure describes projects as integrated in the organizational structure. In this case, a Project Manager does not have the full power to bring in the resources to complete the project tasks. Instead, he involves senior management to acquire resources, and the projects tend to progress slower. [14,9.]

The Projectized Structure is a situation where the resources are put in one pool. Then, Project Managers agree between themselves to borrow them for project tasks, forming their projects team. The organizational structure has less importance than the project structure, and projects are given the highest priority. [14,9.]

The Matrix Structure is a combination of two abovementioned approaches. The main idea is to combine the project organizations with the organizational structure of the company in order to successfully complete both project tasks and the operational tasks of the structural groups. A Project Manager has enough power to bring the resources into the project team as long as it does not significantly affect their operational activities. [14,9.]

Moreover, the PM2 methodology also covers the lifecycle of the project. It defines the key project phases and describes the processes happening in the phases, including the responsibilities of each role in the project. A brief timeline of the project phases with respect to the level of effort each of them requires is demonstrated in figure 6 below. [14,13.]

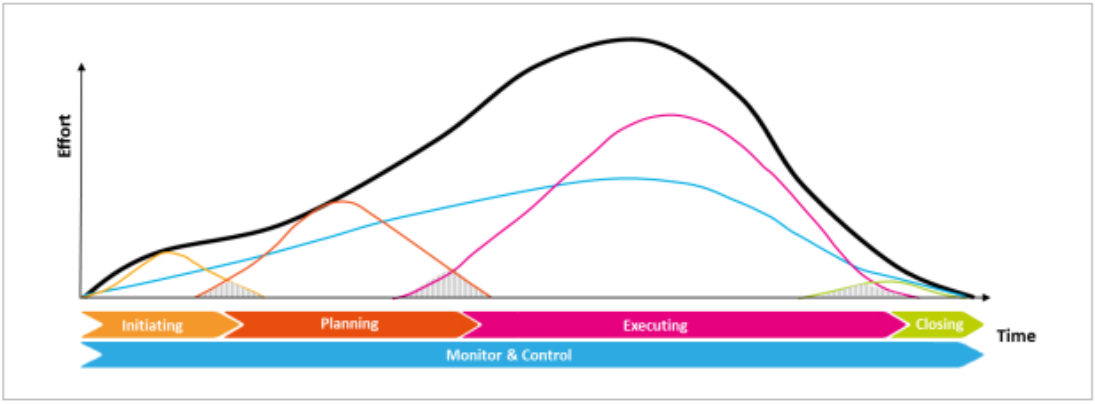


Figure 6. Project lifecycle according to PM2: a timeline of phases with respect to cumulative effort. [14,13.]

The PM2 methodology outlines the drivers and key inputs and outputs of each phase, emphasizing the importance of certain project roles at each stage. A smooth sequence of actions presented in figure 7 below forms the project workflow. Despite being a simple scheme, it can significantly increase the progress of the project, if applied correctly. [14,17.]

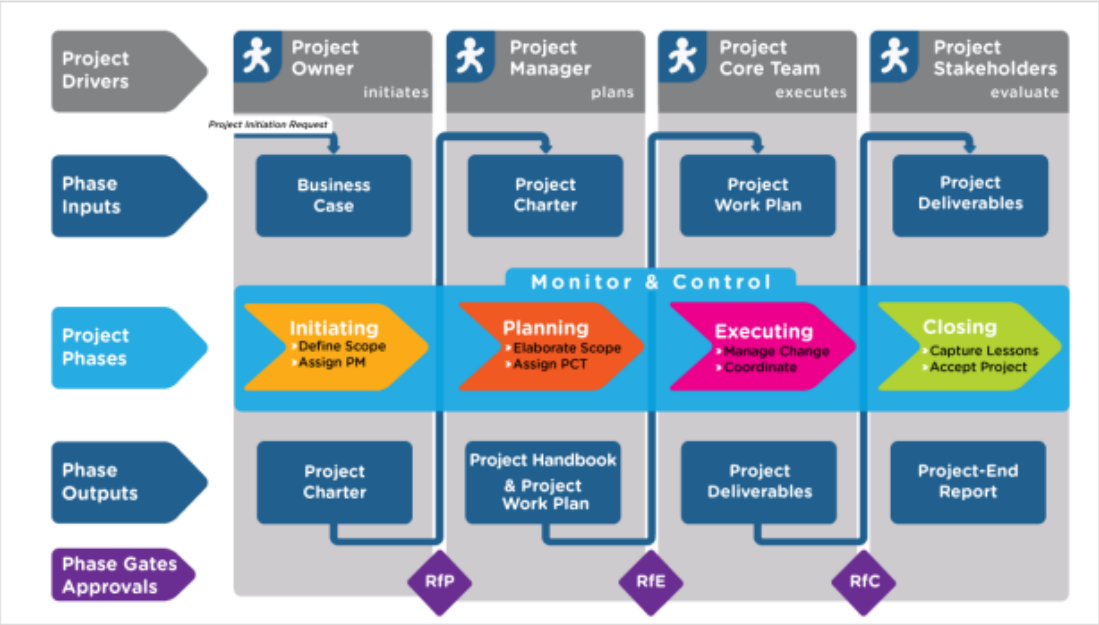


Figure 7. Swimlane diagram of a project according to the PM2 methodology. [14,18.]

Finally, PM2 methodology can be successfully used together with Agile frameworks, including Scrum. It is mainly because the methodology is flexible and presents various scenarios of managing projects, as well as various tools, instruments and techniques for it. PM2 creates the possibility to combine a strict control of the requirements of a project, a structured approach to project management and a desirable level of agility within the tasks of a project. [14,20-21] Overall, PM2 Project Management Methodology is a flexible, yet insightful document, which gives the organization a possibility to smoothly implement it, combining it with modern Agile frameworks and providing strong guidelines like those of IPMA or PMI on top of it.

3.5 International practices

When building up a theoretical background, it is also important to look into some of the best international practices. The organizations can either directly apply project management frameworks, or adapt them to suit the circumstances and the environment in the organization. Analysing such practices made a solid impact on the decision-making part of the study.

First, a good example of successfully applying Scrum framework can be observed in a venture capital company, Openview Venture Partners. Scrum was applied to both internal projects of the company and portfolio companies of Openview. The areas of the projects had a wide range: management, finance, customer support and others. The main features of Scrum – intensity and visibility – helped the company to eliminate 30 percent of the projects, which were considered not worth focusing on. In addition, conducting one-week sprints helped the Scrum teams increase their productivity, being dedicated to less projects simultaneously. As a result, the overall productivity of the company doubled, and was growing ever further. [11.]

A fresh perspective on innovational competences was presented by Laura-Maija Hero in a development project called TeenMINNO. The aim of the project was to promote the innovation competence for students seeking for a job in the field of innovation, where heterogeneous competencies and multidisciplinary thinking are required. [15,5] For such aims, the individual competence model shown in figure 8 below was used to identify the key areas and elements of competence for a future innovation specialist. [15,6]

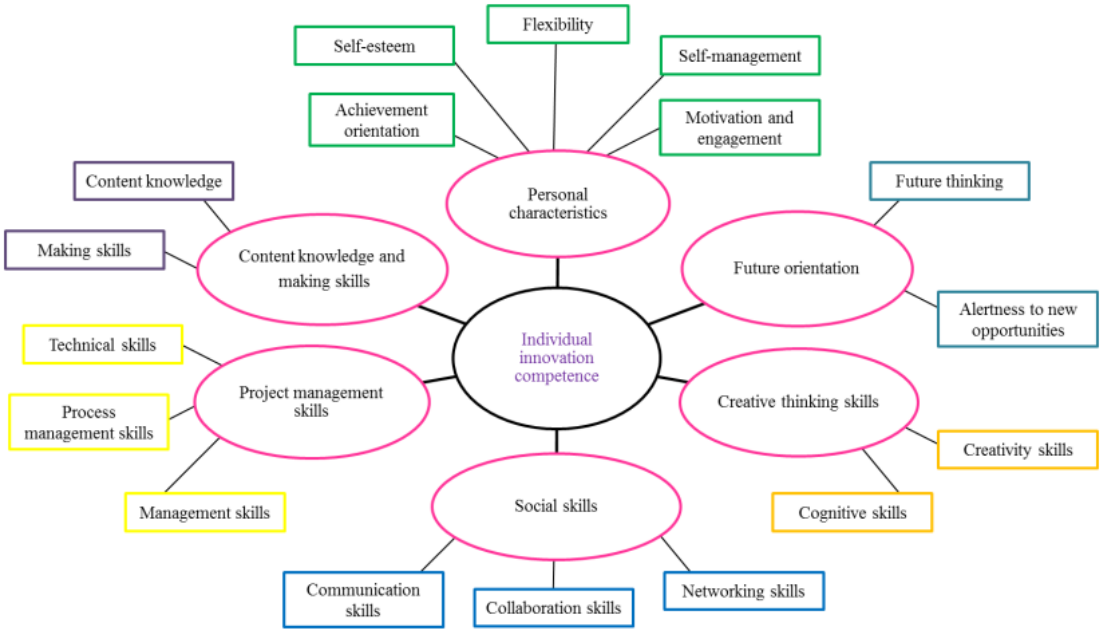


Figure 8. Individual innovation competence model for developing learning environments, pedagogical innovation processes and assessment methods. [15,6.]

As can be seen in figure 8 above, the individual innovation competence model includes some elements similar to the eye of competences of IPMA ICB. However, the thesis found out that it deviates from ICB by bringing up the importance of creative thinking by listing creativity and cognitive skills as a separate group. People competences are also divided into personal and social skills, which provides a deeper understanding on the features of the specialist. Perspective thinking and project management skills, both technical and practical, are also stressed. They add up to a complete model of individual competences in innovation. The thesis found out that such model could be efficiently applied for innovation projects, especially when building a project team, as it presents a broad overview of the soft and hard skills of the person, as well as their creative thinking skills.

Finally, a very practical approach to competence management was found in UX studio, a digital product design company. After defining the key competences required for the workers of the company, UX studio defined five qualification levels within each competency, from novice to expert. Then, the company created a circle-formed visualized competency map for each person working in the company, an example of which is demonstrated in figure 9 below. [16.]

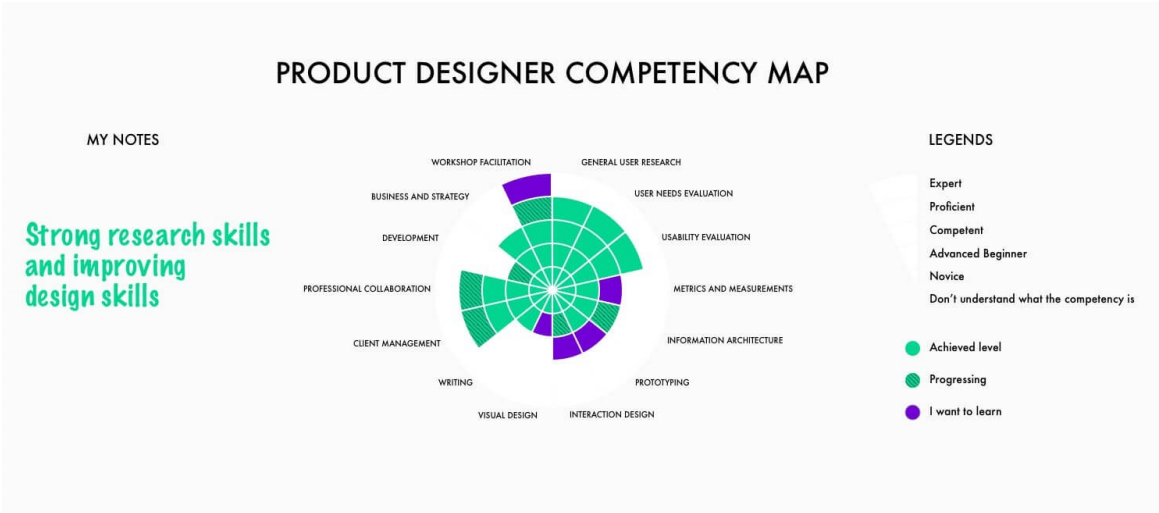


Figure 9. An example of a visualized competency map [16.]

As can be observed in figure 9 above, the visualization tool is very practical, as it clearly presents the strengths and weaknesses of each worker. Thus, it can be applied efficiently in building a project team and defining who suits best for each task or stage of the project.

Moreover, competence maps can be used to identify the skills of each worker, which could be improved in the department studied in this thesis. [16]

3.6 Applicability of Frameworks and Best Practices to Department Activities

The department studied in this thesis had a wide range of projects and activities, making it complicated to completely adopt one framework or practice for project management. Thus, a combined solution had to be carried out, absorbing the best from various approaches and forming a versatile methodology, which would take all of the frameworks and practices discussed in this chapter into consideration.

First, the most suitable one of all the frameworks studied in this chapter appeared to be the PM2 Project Management Methodology, mainly because of its practical approach and a thorough description of certain aspects of project management, which turned out to be relevant to the department's current and desired states. However, even adapting such methodology solely would not tackle some issues of the department, such as low efficiency in product and innovative solutions development due to an organizational approach to most of the projects. However, these issues could be easily solved by implementing the Scrum methodology, an adaptation of the Agile PM framework, to certain projects developing the design processes, as well as to the development of new, standalone products in both digital design and information management. The digital design products mainly consist of creating new software solutions for digital design purposes, whereas the information management products fall under the concept of product creation projects in small and medium scale, which Scrum is great for.

However, it is also important to not neglect the strong background in competences on both organizational and individual level, as in IPMA ICB, IPMA OCB and competence-related international practices, was taken into account in order to create a completely new project management framework for the department of digital design development: competence-based planning, which is described in chapters 4.2.1 and 4.3.2.

4 Developing Project Management in Department

After the initial state analysis was conducted and the theoretical background was collected, the development part of the study began. Since project management is a broad topic which consists of many processes and subjects, a wide range of activities were carried out in order to improve project management in the department.

First, it is vital to eliminate the issue with multiple sources of data entry, in other words, select one information system for project management for the department as described in chapter 4.1.1. Next, it is important to make the decision on how to use the other information systems in the future and transfer their functions and data to the selected main information system as explained in chapter 4.1.2.

Since resource management is one of the greatest problems in the department studied in the thesis, creating a methodological background for the department is the next significant task, described in chapter 4.2.1. Implementing the features of the methodologic framework to the selected information system is the first logical step after the methodologic document is created. It is done through developing a set of instructions on the information system, a development plan for the information system and a higher-level order of using the information system for project management in the department of digital design development, to comply with the corporate governance (see chapters 4.2.2, 4.2.3 and 4.2.4).

Finally, the system is upgraded according to the methodology developed in the thesis (see chapter 4.2.1). This is done with both the initial build of the system and by creating new functions and features inside the system. The results of the development were examined in both qualitative and quantitative ways described in chapters 5.1 and 5.2, respectively.

4.1 Information System Selection

According to the current state analysis conducted in the thesis, there was a clear problem of multiple data sources, as well as double data entry problem, as shown specifically in the information management and systems analysis described in chapter 2.1.3. In order

to tackle the problems, one information system was selected as the master system for project management in the department studied in the thesis. Thus, the system would either generate or accumulate all data required for planning and executing projects, as well as for managing the project resources. It would also contain the project structure and a task breakdown for each project.

4.1.1 Reasoning for Information System Selection

After the initial state analysis described in chapters 2 and 3, it was clear that the most suitable information system for project management for the department studied in the thesis was Redmine. Despite the drawbacks of Redmine described in table 3 in chapter 2.1.3, upgrading an already existing system was an easier task than creating a new product, mainly because of the limited time set by top management to develop PM in the department. The main reasons for the choice of Redmine as the master system were:

- Flexibility in upgrading the system both internally and by adding external plugins
- Integration-friendly and user-friendly interface
- Compliance with the upgraded project structure
- Ability to co-work in the system distantly, i.e. away from the work place
- Existing functions and features of the system, including actual resource load data
- Wide, out-of-the-box functionality.

The main reasons for not selecting one of the other two main PM systems, Microsoft Project and Multi-D Docs&Resources, are listed in tables 1 and 2 respectively. These two systems were found inefficient for the agile project management perspectives of the department. Another factor that contributed to the decision was the information system poll conducted among all employees of the department. The poll was about the usability of three systems in use in terms of both managing the projects and overall experience. As a result, out of 211 votes the majority, 70 percent, were for Redmine.

4.1.2 Decision on Other Systems

Despite the selection of Redmine as the master system, the other systems in use which contained either the processes or data of project management, had to be taken care of.

Generally speaking, there were three ways of dealing with the existing information systems:

- Transfer the unique functionality of existing systems to Redmine and stop using these systems.
- Integrate the systems by transferring to Redmine all information required for its data to be sufficient for PM.
- Leave the systems as they are and carry on using them, if their functions are not crucial for PM. In addition, somehow develop the functions for data generation from such systems in Redmine.

The first option from the list above, abandoning two of the three information systems, is reasonable for the other two main information systems in use, Microsoft Project and Multi-D Docs&Resources. The main reason for why such decision is viable is the amount of information the abovementioned information systems generate and contain. Either way, all this department-related data which Microsoft Project and Multi-D Docs&Resources contain has to be transferred to the master system in full (or almost full) volume.

The second option, integration, was possible for corporate systems used in the whole organization, which the department is also obliged to use. These systems were mainly governed by Rosatom, the government corporation, and they were obligatory for all departments of ASE. However, some information from these systems was confidential, and ASE did not allow the storage of such information in Redmine, because it could be remotely accessed, unlike the corporate systems. Hence, it was only possible to integrate such systems partially, excluding the confidential information.

The last option, continue the use of the existing systems, mainly applies to minor systems which generate little range of information. However, it was also usually obligatory to use them on a corporate level. Therefore, the best solution was to compress the information generated in such systems and enter it in Redmine manually once per month, so that no actual working hours or other significant information would be lost. A good example of such system is ServiceDesk, mentioned in chapters 2.1.3 and 2.1.4.

4.2 Developing Project Management Standards and Documentation

In order to tackle the main project management problem in the department studied in this thesis, i.e. inefficient approach to resource management, it was crucial to create new PM documentation for the department. This would allow the department to replace the irrelevant old standards and guidelines which were followed initially. In addition, in would launch the process of realizing new frameworks in Redmine, the selected master system for project management. It would include project and task structure updates, competence-based planning and plan-fact analysis instruments and other minor developments, which are described in chapter 4.3. The set of documents to be developed was:

- Methodology for project management in the department
- Instructions on planning projects, tasks and resources, including competence cards, of the department in Redmine
- Instructions on using plan-fact analysis instruments and acquiring various reports from Redmine
- Development plan for Redmine
- Higher-level order of information system selection for project management which would confirm the use of Redmine as a master system for PM data in the department.

However, most of the abovementioned documents could only be developed after putting together the first one from the list above, Methodology. On its basis, changes could be made in Redmine, according to the development plan, and a higher-level order could be released.

4.2.1 Methodology for Project and Resource Management

Developing the methodology for project management and resource management in the department studied in the thesis was the key task for both the case study and the workflow of the department. The methodology would define the ways and patterns of initiating, planning, controlling, monitoring and closing the projects, as well as managing its tasks, resources and the other vital elements of all projects of the department. The main aspects covered by the methodological document were:

- Project structure in the department
- Task structure in projects
- Role structure in projects
- Initiation process for a project
- Planning process for a project
- Planning process for resources
- Project and task workflow principles
- Principles of entering actual working hours data
- The process of acquiring project or task results and lessons learned
- Other minor aspects of controlling the project.

The methodology defined the structure of project management in the department, mostly taking into account the PM2 Project Management Methodology described in chapter 3.4, because PM2 offers a thorough explanation on organizing the project and resource management, while taking the organizational structure into consideration. In both the department and the whole ASE, the organizational structure has always governed the project structure and the role of a Project Manager. However, it was important to give Project Managers some amount of power in terms of acquiring the resources to successfully close down the project milestones. Thus, a matrix structure approach was adapted from the PM2 methodology. It means that Project Managers would have the power to acquire the necessary resources upon request from the groups and group heads of the department, but such resource acquisition would have to comply with the operational task load of the workers. Another important scheme adapted from the PM2 methodology was the Swimlane diagram for the project workflow. The project drivers were defined as in the diagram shown in chapter 3.4, and the project phases initiation, planning, executing, closing would be used.

Next, in order to increase the efficiency of projects and improve the process of executing a project, Agile and Scrum methodologies, discussed in chapter 3.3, were adapted in the project team. The visibility of the task and project progress is ensured in Redmine, the information system for project and resource management, and a certain workflow is defined for the project teams. After selecting the team for a certain task, Team Leader forms an Agile Board of tasks to be completed in the whole project, and a mini-board for the first sprint. The Team Leader also informs the team, the Project Manager and the functional customer of the boards. Then, the team holds a so-called Planning Poker session,

which weights out all the tasks in the sprint, and the executors of the tasks are defined. During the sprint, the team meets every day for 10 minutes for a Scrum session, summarizing the results achieved and potential obstacles to face. After a defined one-week period of the sprint, the team gathers for a two-hour summary session, editing the Agile board and evaluating the results. A lessons learned session is organized separately in order to properly document the successes and downsides of the sprint, or a full task, and work more efficiently further on.

A combined approach, using various methodologies for project management, perfectly suits the department studied in the thesis because it combines a big amount of rapid-paced projects with most of operational tasks coming from the features of the organization above the department. A combined framework opens up the visibility of the project progress for both Project Managers and top management, and allows a PM to access the resources easier. The framework also improves the efficiency of the project core teams and give Team Leaders more control of task completion processes within a team.

It is important to define the project structure, task structure and role structure in the department studied in the thesis in order to have a fixed and certain approach to project management and organize its components in the information system for PM which is Redmine. The task is divided into three categories according to the main functions of the department, the initial state at the department and the perspectives for future aims: NPP Projects, Development Projects and Service Projects. All Nuclear Power Plant-related projects are in the first category, and the subproject structure of each NPP project is defined separately, depending on the main areas of focus in the projects. The second category consists of a defined set of development projects which are placed on the second level of the project structure and mainly focus on developing the new information systems, methodologies for designers, frameworks and new instruments for the design process. The subproject structure is defined initially and can not to be changed if there is an understandable set of subprojects within a certain development project. In the third category the main service functions are put as second level projects, the main ones being license purchasing for software, hardware purchasing, overall technical support of the designers and IT-client service function.

Task structure of the projects of the department of digital design development, in turn, is united for all the projects, and present on every level of the project structure starting from

the second level of the structure – the first level of the structure does not have any tasks in it as it serves as a root for the projects. The tasks themselves are presented in three main levels: as TOP level tasks, TOP_L2 level tasks and subtasks. A TOP level task means a big scale, long-perspective overall task with a duration of more than 2 months, with a set of middle scale TOP_L2 level tasks no more than 2 months long. The resources are always planned for TOP_L2 tasks and accumulated in TOP level task. After that each TOP_L2 task can be potentially distributed to a free-forming branch of subtasks, each having a certain small scale task with just one worker responsible for each subtask. The person responsible for the completion of a TOP_L2 task is the Team Leader and the person responsible for the completion of a TOP task is the Project Manager.

The role structure is also defined in the thesis in order to organize all steps of the projects and distribute the responsibilities for the completion of such steps accordingly. The main roles defined in the department are:

- Project Manager who can create subprojects in a project, tasks of all levels for such projects, plan the resources and edit the status and details of all tasks
- Project Administrator who can do the same as the Project Manager, substituting the PM upon request
- Head of Group who can create subprojects for the Service Project part of the project, tasks of all levels in such projects, plan the resources and edit the tasks
- Group Administrator who can do the same as a Head of Group, substituting upon request
- Team Leader who can create subtasks in a project where the Team Leader role is given, plan the resources in such projects and edit TOP_L2 tasks and subtasks
- Engineer (executioner) who can create and edit subtasks, comment on all tasks
- Head of Department – can do all the abovementioned actions.

As can be seen from the list above, the role structure is not complicated and is aimed to improve the efficiency of the project workflow in Redmine, as well as the resource management. The roles not only serve as a permission to use a certain set of functions in the system, but also as functional roles in the processes for project management.

Another important aspect to describe in the methodological document is competence maps concept. In general, the idea is to create a mind-map of workers' competencies in different areas, including both soft skills and hard skills, creating a general overview of

what the worker is capable of, and what kinds of tasks suit the worker best. Hence, five different areas of competencies are established, each having a set of competencies inside of it which was decided by the thesis:

- Project Management and Leadership
- Technical Skills in Software
- Personal Characteristics
- Interaction Skills
- Vision and Creativity.

Project Management and Leadership area contains a set of competencies defining a worker's ability to put together a team, control and manage it and be efficient in critical thinking and problem solving within the team and within the project. The area also includes some specific competencies related to the worker's background in managing NPP and non-NPP projects in the past or present.

Technical Skills in Software area focuses on specific software and contains the competencies of a worker in various roles in various, specific software. The area defines the hard skills of the worker for the software exclusively, showcasing different technical capabilities of the worker.

Personal Characteristics area emphasizes the importance of individualistic approach to each member of the project team and contains the competencies which describe the person as an individual. The area forms some sort of psychological portrait of the worker, which can play a vital part in forming project teams for specific tasks, ensuring the team members are compatible.

Interaction Skills area focuses on communication and interaction with other people and the competencies in this area define the person as a team member. The competences are formed in such way in order to understand what kinds of tasks the person would be most efficient at: more technical and individual ones, or more collaborative and teamwork-related ones.

Vision and Creativity area contains a set of competencies related to strategical approach, perspective and non-trivial thinking. The area stresses on describing the worker as a creative unit and as an influencer, not necessarily leading the team but rather bringing the alternative vision and thinking to the team in order to solve the more complicated tasks.

In order to have a more or less rational picture of the workers' competencies, the competences would be evaluated in three different ways: through self-evaluation, Team Leader evaluation and Head of Department evaluation. The results would then be equalized arithmetically and a general competence map would be confirmed in the beginning of each quarter of the year, also keeping the history of workers' competence maps to show the growth or decline in certain areas. The competence maps would be involved in an automated competence-based planning described in chapter 4.3.2.

Finally, it was important to cover the planning process in Methodology in the thesis, as well as the process of entering planned and actual working hours in the system conceptually. Regarding the planning process, it was agreed that the scale of planning would be one month, with a possibility of doing more detailed planning in the scale of one week in certain exceptional cases. The planning process would be initiated by Project Manager. It would start with filling the project with the list of tasks, with the perspective of at least one month. Then, in the middle of the month, the PM sets up Team Leaders to conduct a Planning Poker session in order to understand the importance and level of difficulty of the project tasks. Then, the Project Manager enters a competence-based resource plan into the system for each task, without the names of workers. The Team Leaders would then have ten days to convert the drafted resource plan into a real one with real planned tasks for the team members, with the help of automated competence-based planning tool. In order to do so, the Team Leaders would have to communicate with the Head of Department, Heads of Groups, Project Managers of various projects and other Team Leaders in case of a resource conflict. If there is a conflicting situation, which would not allow a Team Leader to plan the execution of a given task in the required time and quality because of the lack of resources, the Head of Project Office would be involved in order to carry out the decision on resource distribution.

Finally, after all the discussions are finalized, Team Leaders or assigned administrators in the project have to enter the planned human resource load into the system, which can

be done either from the task page or from the worker page directly. It is also possible to enter the planned resource load from a special resource management board. The process of entering planned resource load data as well as the concept of planned periods is described in chapter 4.3.2. After the resources are planned, Team Leaders build Agile Boards with the task lists and form the weekly sprints for the team, according to the Scrum methodology mixed with an Agile approach, both explained in chapter 3.3. The actual resource load of the workers is entered in the system weekly, according to the sprints. It is entered by the workers themselves in Redmine tasks or sub-tasks directly according to the source of actual resource load. The data is then checked and verified by the Team Leader in order to have a clear match of sprint results and actual resource load data in the system. Weekly plan-fact analysis is carried out by both Team Leaders and Project Managers after the sprints, in order to flexibly adjust the plans, or even the teams if necessary to successfully complete the critical path tasks of the project. In the end of the month, a joint session of Lessons Learned is carried out in each project, as well as an interdisciplinary Lessons Learned session in the department, in order to analyse the critical resources, the common mistakes, and the future steps of development.

4.2.2 Development Plan for Redmine

Based on methodology for project and resource management briefly described in chapter 4.2.1, a development plan for Redmine is carried out. The plan is created in order to bring Redmine to a state where it complies with the requirements for the information system claimed by the methodology. The development plan drafted in the thesis considers the scope of development, its possibility, priority and method of execution. The latter means that some development tasks can be completed by correctly using the existing functions of the system, whereas other tasks can only be completed by upgrading the system's functionality either internally or with external plugins. The key points of the development plan are listed in table 6 below.

Table 6. Main tasks from Redmine Development plan.

Priority, number	Development	Way to execute
1	Project and task structure update; role model update	Customization of existing functions
2	Resource planning module	Internal upgrade
3	Resource, task and project reports	Internal upgrade
4	Plan-fact analysis module	External customizable plugin
5	Competence maps interface and function	External customizable plugin
6	Competence-based automated planning module	Internal upgrade

Apart from the tasks listed in table 6 above, the development plan contains some minor tasks, which are mainly dedicated to customizing the system to become more usable and ergonomic. A thorough description of main developments carried out in Redmine is provided in chapter 4.3.

4.2.3 Instructions on Project Management in Redmine

Based on the developments carried out in Redmine according to the development plan described in chapter 4.2.2 above, a set of accompanying instructions is created. The instructions are focused on step-by-step user actions in the system regarding both existing functions of the system and the freshly added ones. In fact, the existing functions of the system were never explained thoroughly in any instructions, which sometimes led to an incorrect use of Redmine's functions and features. Therefore, the newly developed instructions covers these functions, ensuring the correct and efficient use of the system.

For all the instructions developed, a new section called Wiki is created in Redmine in order to store all knowledge, including the instructions on the system. All the other project management related documents of the department, as well as some international standards and guidelines, are also put in Wiki section. The main instructions for project management in Redmine are:

- Instruction on planned and actual resource load data entering
- Instruction on forming and exporting reports
- Instruction on forming a competence map
- Instruction on using the automated competence-based planning module

- Instruction on working in the plan-fact analysis module
- Instruction on managing a project and its tasks in Redmine, i.e. creating, editing, changing the hierarchy, and deleting.

As can be seen from the list above, the instructions cover all the main features of Redmine and explain the main resource-related functions of the system. The instructions also cover the basic functions of the system, so that the user is acquainted with Redmine after reading them.

4.2.4 Higher-level Order of Information System Selection

In order to comply with the corporate rules and regulations, a higher-level document has to be released, claiming that Redmine is the master system for project management in the department. The document is called a Higher-level order of information system selection for project management in the department of digital design development. The document itself contains a number of statements, which eliminated previously used systems in favour of Redmine. In addition, it includes all the documents developed as a result of this study, sufficient for using Redmine and its full, newly developed functionality for the project management processes. The attached documents are:

- Methodology of project management in the department of digital design development
- Development plan for Redmine upon its completion
- Instructions for project management in Redmine
- A presentation demonstrating the features of Redmine and how they are sufficient for PM in the department
- Statistical reports of resource plan-fact load, task structure and project structure.

Together, the documents listed above provide a strong background for the order. The release of the higher-level order allows the department to stop using the old required software: Multi-D Docs&Resources, Microsoft Project and some other minor corporate systems and services. However, as stated in chapter 4.1.2, the department still has to enter various data in some corporate systems. But the release of the order definitely makes a positive impact on project management efficiency in the department, which is shown in chapters 5.1 and 5.2.

4.3 Developing Redmine

Undoubtedly, the core of a correct project and resource planning process is a flexible and functional information system. The information system is a place where all the data is entered, stored and extracted from, forming a suitable massive of information for different types of analytics. When implementing a new methodology of managing projects and resources, described in chapter 4.2.1, it is important to take the possibilities and opportunities of developing the information system into account. In order to comply with the development plan for Redmine, a thorough analysis of open-source plugin solutions was done, as well as an analysis of possible internal upgrades. In the case of the latter, it is essential to avoid damaging the core structure of the system by implementing major upgrades to the code and the structure of the system.

The main upgrades are carried out according to the development plan, which is described in chapter 4.2.2. Fortunately, for some of the upgrades the team managed to find suitable third party plugins with an open license and adapt them to the specific project management approach in the department of digital design development studied in this thesis. In addition, some minor changes, bug fixes and improvements are carried out in Redmine, further improving the usability of the system and user experience, which positively affected the qualitative comparison of user satisfaction described in chapter 5.1.

Overall, the development process is similar in all three types of developments carried out: internal upgrades, customization of existing functions, adaptation of external customizable plugins. The process starts with the Team Leader forming a conceptual technical requirement, which is then discussed and further transformed into a final technical requirement. Then, an implementation would is carried out on a test server with constant feedback sessions organized if necessary. After that, the tester analyses the implemented development and gives feedback and comments. Further corrections are usually made, and once the function works perfectly on the test server, it is installed on the productive server with an additional check. Potential corrections can then be made, usually on the test server again, but some minor changes can be done on the productive server. All processes are carefully curated by the Team Leader and the final result is thoroughly checked before confirming the task completion.

4.3.1 Correct Use of Existing Functions

The essential part of upgrading Redmine as the main project and resource management information system is to analyse its existing functions. A set of decisions is made as a result in order to flexibly manipulate these functions to suit the methodology and approaches to project management implemented in department. The main functions of Redmine, which are not changed, but are instead used more efficiently, are the project structure, the task structure and the role structure.

First, the project structure in Redmine is significantly changed according to the newly confirmed project structure in the department of digital design development according to the methodology described in chapter 4.2.1. It is mainly an administrative task. However, some back and forth changes are made in the previously confirmed structure in order to make it more user-friendly in Redmine. For example, some minor Design Development Projects which included neighbouring topics are joined in a bigger project, degrading previous projects into subprojects and thus assigning one Project Manager for various minor projects in order to control them in a uniform and cohesive way. As a result, the final project structure is reconfirmed in the department and organized accordingly in Redmine.

Next, the task structure in the system is completely renovated compared to its initial state, when the tasks were never categorized by scales and there was no task branching organized in Redmine. New task types and task tags are created in the system using its already existing interface according to the accepted methodology described in chapter 4.2.1. All the existing tasks in the system are reorganized and edited to suit the new task structure, and the new «TOP» and «TOP_L2» tasks are imported into the system by the Project Managers in each project.

Finally, the role structure is also updated in the system according to the methodology described in chapter 4.2.1. The update significantly affects the user satisfaction with the workflow in the system as it strictly limits the amount of people having impact on the tasks and planned resources of a project. The role structure is also made project-specific and subproject-specific, allowing Project Managers to flexibly change the role structure according to the project workflow. The improvement of the role structure also positively

affects the experience of basic users, as the system only shows the information needed instead of a great amount of projects and tasks the user did not participate in.

In addition, the organizational structure of the department of digital design development is created in Redmine, with automated scripts updating the personal data of workers in the system. Having a more detailed data on each user greatly improved the quality of statistical reports in the system, as well as the plan-fact analysis, displaying the data more clearly and thoroughly according to the structure of the department.

4.3.2 Upgrading the System

In spite of the numerous functions Redmine has initially, it is clear that a set of upgrade is required. The main aim is to bring the system to a satisfactory level as an instrument for planning projects and resources, as well as monitoring and analysing the data.

Since most Redmine upgrades, according to the development plan shown in chapter 4.2.2, are focused on resource data and the competence maps of workers, most of the upgrades influence the «user page» segment of the system. The first update to carry out creates the competence maps on each user's page. According to the methodology described in chapter 4.2.1, it was decided that the interface solution for Redmine is a mind-map found in an external open-source plugin. The plugin is customized to show the main areas of competencies, united for each user, listed below:

- Project Management and Leadership
- Technical Skills in Software
- Personal Characteristics
- Interaction Skills
- Vision and Creativity.

Each of the competence areas is detailed in the form of a circled histogram similar to the one proposed by UX Studio like in one of the international practices in competence-based planning and explained in chapter 3.5. For all areas except for the Technical Skills in Software, a circle is formed of a certain number of pre-written competencies and a possibility to rate such competencies from zero to five, five being master level and zero

being non-existent level, meaning that the worker does not have such competence whatsoever. For the Technical Skills in Software, the model remains the same, but the competencies are not fixed and the worker can select some of the given options, equal to the software options used in the department. Then, each software option forms its own mini-circle histogram, including a fixed set of roles in each, and these roles are rated from zero to five, using the same logic as with the other areas of competence. The roles are:

- Developer
- Technical writer
- Tester
- Administrator
- Team leader
- Licensing manager
- Technical support worker.

Such set of roles create a full picture of what the worker is capable of within the system, allowing the Project Managers and Team Leaders to flexibly pick the candidates for specific tasks. The grading is done quarterly and it consists of three grades: Worker grade, Project Manager grade and Head of Department grade. All three grades are then weighted according to the pre-written factors and a final grade is calculated.

Next, before starting to develop an automated system of competence-based planning, the core development of resource planning has to be carried out in the system. Since Redmine does not have any functions for planning the resource load, and the planning concept developed in the methodology is very specific, it is decided to make an internal upgrade to the system regarding the abovementioned function. The main focus of the upgrade is to make sure that the planned resource load data is accessible for entering, editing and deleting from multiple segments of Redmine.

Initially, the segments of the system for planned resource load data management are defined as:

- TOP or TOP_L2 level tasks, directly from the task page
- User page, where an additional resource load tab is created next to competencies tab

- Resource owner's user page, where an additional plan-fact analysis tab is created for future integration with actual working hours data and comparison analysis.

In all cases, the same concept of resource planning is used, only changing the amount of data displayed in each segment. The solution is to use the load periods, meaning a period of time from date to date, when the human resource is loaded for a certain amount of hours. The load hours are then equally divided between each working day within the period and contribute to a total resource load. The total resource load does not show on the task page, as can be seen in figure 10 below, but is shown on resource load tab for each user and on plan-fact analysis tab for resource owners. It is very important to display the resource load periods both in tasks and in user pages in order to make the planning process flexible and user-friendly in its interface and functionality.

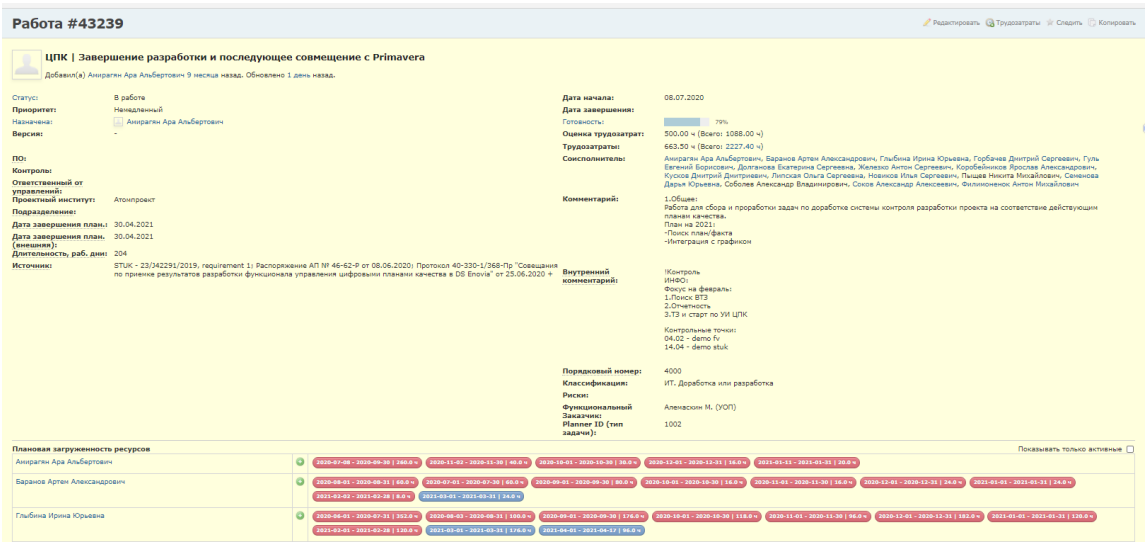


Figure 10. Resource planning from task page.

As can be observed in figure 10 above, planning the resources on the basis of the task is not the most efficient way, since the total resource load of the worker is not visible in order to not overload the task page. However, the task page presents a good image of how filled with human resources the task is (blue ovals), and how loaded it was historically (red ovals). Each oval describes a period of resource load, including information about the start date, end date and the amount of working hours, which is the same for the resource load tab on the user page shown in figure 11 below.

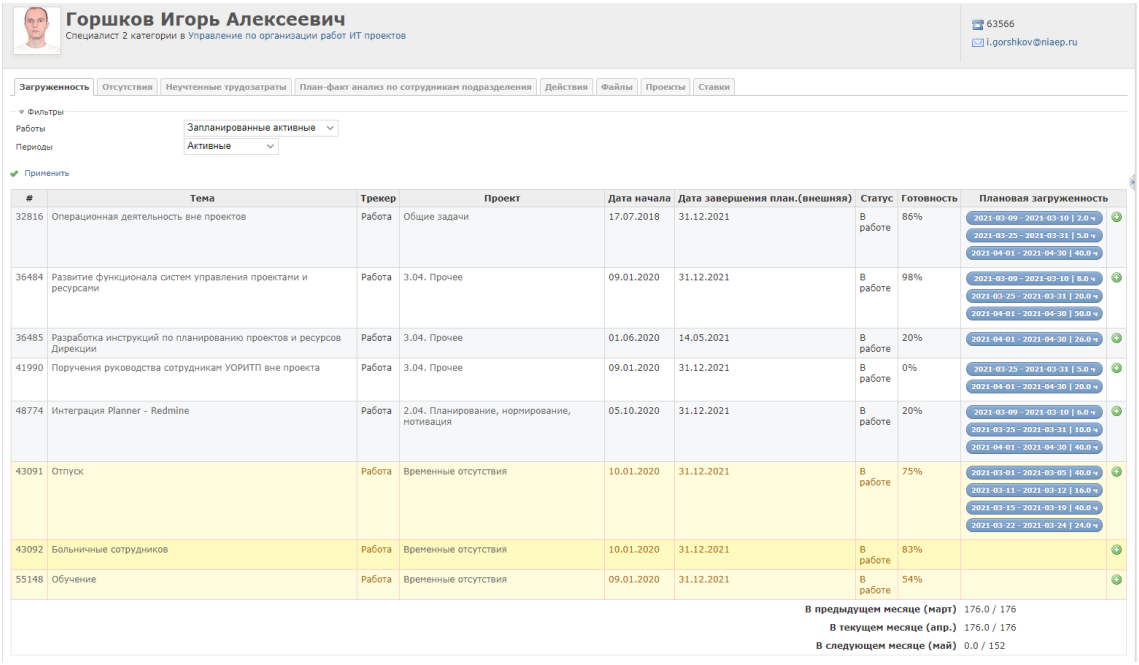
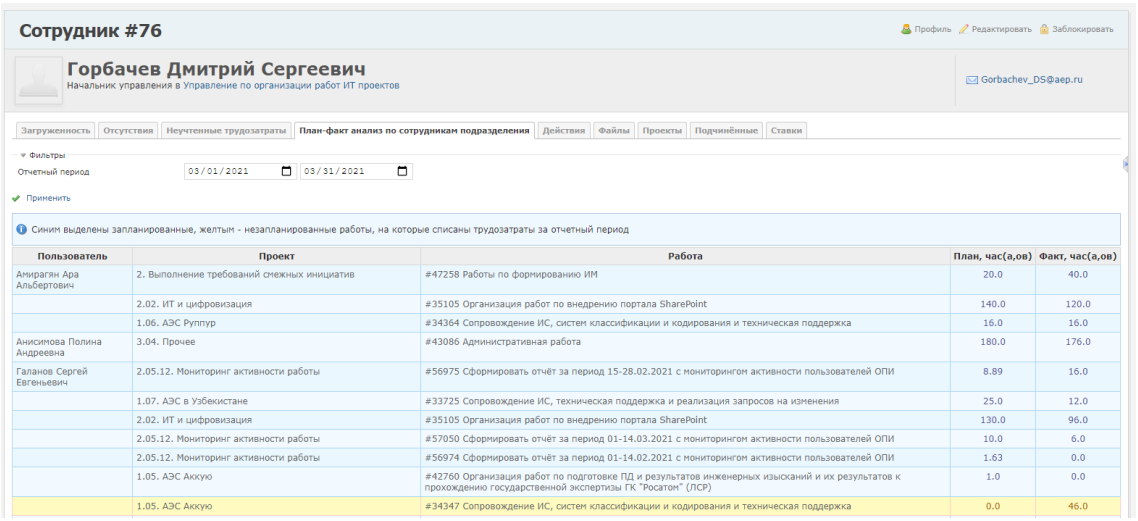


Figure 11. Resource planning from Resource Load tab on user page.

Unlike the task page, the user page includes total information about the resource load throughout three months: the previous month, the current month and the following month, which can be seen in figure 11 above, in the bottom right corner. A comparison of planned hours to total work hours in the month is also carried out, and the green circle with a white plus inside of it is used to create a new load period, whereas the existing ones can be edited or deleted, unlike in the plan-fact analysis on the resource owner's user page, specifically the plan-fact resource load analysis tab displayed figure 12 below.



Пользователь	Проект	Работа	План, час(а,ов)	Факт, час(а,ов)
Амирагян Ара Альбертович	2. Выполнение требований смежных инициатив	#47258 Работы по формированию ИМ	20.0	40.0
	2.02. ИТ и цифровизация	#35105 Организация работ по внедрению портала SharePoint	140.0	120.0
	1.06. АЭС Руппур	#34364 Сопровождение ИС, систем классификации и кодирования и техническая поддержка	16.0	16.0
Анисимова Полина Андреевна	3.04. Прочее	#43086 Административная работа	180.0	176.0
Галанов Сергей Евгеньевич	2.05.12. Мониторинг активности работы	#56975 Сформировать отчёт за период 15-28.02.2021 с мониторингом активности пользователей ОПИ	8.89	16.0
	1.07. АЭС в Узбекистане	#33725 Сопровождение ИС, техническая поддержка и реализация запросов на изменения	25.0	12.0
	2.02. ИТ и цифровизация	#35105 Организация работ по внедрению портала SharePoint	130.0	96.0
	2.05.12. Мониторинг активности работы	#57050 Сформировать отчёт за период 01-14.03.2021 с мониторингом активности пользователей ОПИ	10.0	6.0
	2.05.12. Мониторинг активности работы	#56974 Сформировать отчёт за период 01-14.02.2021 с мониторингом активности пользователей ОПИ	1.63	0.0
	1.05. АЭС Аккую	#42760 Организация работ по подготовке ПД и результатов инженерных изысканий и их результатов к прохождению государственной экспертизы ГК "Росатом" (ЛСР)	1.0	0.0
	1.05. АЭС Аккую	#34347 Сопровождение ИС, систем классификации и кодирования и техническая поддержка	0.0	46.0

Figure 12. Resource plan-fact resource load analysis and planning from plan-fact analysis tab on resource owner page.

A part of the tab Plan-fact analysis table, shown in figure 12 above, focuses on comparing the planned resources and actual resource load task to task, enabling the resource owner to go to either the task page or the user page to edit the data if needed.

Regarding the technical part of the solution, resource load is automatically calculated in a monthly scale, showing the user whether the load is full or not, or if the load is excessive compared to the amount of working hours in a certain month. The system also blocks the creation of clashing resource load periods for one task, as well as resource periods that are outside of a task's start to end date range. The development of the resource planning module is one of the most essential upgrades done in Redmine, completely changing the planning process in the department of digital design development and vitally reorganizing all projects in terms of resources.

After assembling the resource planning module in the system, the data has to be not only displayed in the system in the form of various tables and dashboards, but the Redmine statistics module has to be developed using an internal upgrade in order to get the data out of the system in a pre-scripted, automated manner as statistical reports. The selected forms of exports are PDF, XLSX and HTML, with Excel tables having an option to build pre-defined pivot tables, one of which is shown in table 7 below.

Table 7. A part of resource load report.

People	Planned resource load, ppl/mth	Planned resource load, hrs/mth	Actual resource load, hrs/mth	Plan-Fact completion percentage, %
Group of Accounting	9,557	1688	1673,8	951,0227
Irina Kalinina	1,115	196,9	178,4	101,3636
Irina Kononova	1,316	232,6	232,6	132,1591
Elena Maslova	1,115	196,9	196,9	111,875
Irina Pushkareva	1,329	236,2	236,2	134,2045
Petr Subbotin	1,436	252,5	178	101,1364
Mikhail Holschevnikov	1,012	178,4	179,5	101,9886
Ekaterina Shipulina	1,061	187,7	178,6	101,4773
Anna Rybakova	1,173	206,8	188,5	107,1023
Yana Privalova	1,115	196,9	105,1	59,71591

As can be seen in table 7 above, the pivot table presents a clean and accurate data about the resource loads in all groups of the department, allowing for the analysis and use of the data for various purposes. The other pivot tables usually focus on a detailed project load, critical resource analysis and other ways of displaying the resource load.

Finally, considering all the completed upgrades and developments in Redmine, it is critically important to make use of the competence maps of workers and integrate them with the new functions for resource planning. In order to do that, an automated competence-based planning function is developed. When setting up the task in the system, the Project Manager must fill in the field named ‘Required competencies’, where the PM enters the amount of people required for the task to be completed in time with a high quality outcome. Then, for each person selected, a full list of competencies pops up, distributed by areas of competencies, exactly like in the competence maps. Project Manager has to select the required competencies and the minimum and maximum level of such competencies. Since no task requires all competencies entered in the system, the PM can select any number of competencies, including none. The system then uses a certain programmed mechanism, which analyses the competence maps for each worker, as well as their current resource load for the given dates, and suggests the three best candidates for each position, showing their competence maps on request. The Project Manager has an option to either make a request to use a certain resource of the given options, or decline the options and manually enter another candidate, while displaying the competence map of the selected worker. The competence map shows the margins between the requested competencies for the task and the actual competencies of the worker,

helping the PM to select the right candidate. Competence-based planning is the most vital upgrade of all in Redmine, changing the planning process completely and making it greatly more convenient for Project Managers and Team Leaders in terms of communication and resource distribution.

5 Results of Development Project

After the development is carried out, it is necessary to compare the state of the department's project management processes after the changes to the initial state described in chapter 2. In order to register the results and fix the positive influence of the study, multiple comparison methods were used. Mainly, these methods were divided into a qualitative comparison and a quantitative comparison. The former was mainly based on the perception of workers and top management, in other words, with their satisfaction with PM processes and overall data quality. The latter, in turn, was based on numerical comparisons regarding the resources of the company, the success of the projects within the department and the change in distribution of resources and tasks in the projects.

In addition, all the downsides of the development were fixed as well, in order to form a rational and honest feedback on the study. This methodology is called Lessons Learned and it not only analyses the final results of the study, but also goes through the process of development, identifying what went wrong and not as planned, and why. Then, the identified problems are fixed and successes are identified. Both are always considered in the future developments to increase their efficiency. [19.]

5.1 Qualitative Comparison

When analysing the results of the development from a qualitative perspective, human factor is often used as a marker. Hence, the comparison was based on multiple interviews with the department's workers both before and after the development. The interviews focused on the satisfaction of people with various aspects of project management: how well are projects managed in the department, how well the projects progress, and how well the project teams are functioning. The results of the interviews are demonstrated in table 8 below.

Table 8. Results of interviews with the workers of the department about PM processes before and after the development.

Questions / Answers	Satisfaction with the overall progress of the projects		Satisfaction with the personal working process in the project teams (role, work load, communication)		Satisfaction with the reputation of the department in the organization	
	Before	After	Before	After	Before	After
Fully satisfied	10%	21%	12%	37%	14%	19%
Partially satisfied	11%	42%	18%	31%	17%	34%
Neutral	6%	20%	37%	12%	10%	16%
Partially unsatisfied	35%	12%	18%	12%	37%	19%
Fully unsatisfied	38%	5%	15%	8%	22%	12%

As can be clearly seen in table 8 above, the development made a positive impact on the majority of department's workers, which definitely had a positive impact on the working process in the department overall. Moreover, people grew a feeling of being a part of an innovative and efficient department. People also felt that the criticism from the top management significantly decreased compared to the initial state of the department before the development project was carried out.

Another qualitative comparison carried out concerned the overall data quality. It included resource load data, both planned and actual resource load, and project task data. Both planned and actual resource loads were compared by analysing the overall criticism of the department from various sources: the UDI, top management of the organization and the accountants receiving the resource data and using it as an argument for the top management on why different projects have different priorities and contracts in terms of money. All the abovementioned parts of the organization were criticizing the project management processes in the department for their own separate reasons. Comparing the change of criticism levels on all ends was a good indicator of the development project's success.

First, the UDI was usually concerned with the quality and speed of the support and system development functions, as well as the transparency of the work progress of the department. The transparency was successfully improved by clarifying and correctly assembling the task structure within projects, which made it possible for the UDI to keep track of the progress of tasks and quickly communicate with the project manager and

team leaders about the tasks. The support and system development functions, in turn, were improved by upgrading the quality of resource data. It was done by developing Redmine and entering the planned and actual resource load in the system in such way that it was clear which project and which task in the project the worker spends time on. As a result, the criticism level from the UDI dropped significantly, decreasing the intensity and frequency of conflicts between the department and the designers from all institutes.

The top management and the accountants were mainly concerned about the overall success of the projects, as well as a transparent and logical distribution of resources between the projects in accordance to the organization's priorities and budget. Both aspects got improved by implementing an understandable and thorough methodology described in chapter 4.2.1. Moreover, the improvement of data quality in Redmine and the improvement of the statistical reports module in the system made a positive impact on the stakeholders of the data. As a result, the overall criticism level from both the top management and the accountants dropped significantly after the development was carried out.

5.2 Quantitative Comparison

Comparing the initial state of the department with its state after the development using actual numbers is a more precise method than doing a qualitative comparison. It demonstrates the technical improvement instead of the human perception. In order to properly evaluate the results of the study, two main comparisons were considered. First, the percentage of department's workers, essentially meaning resources who have a fully and rationally entered planned and actual resource load, was calculated. The comparison between the initial state and the developed state can be observed in table 9 below.

Table 9. Percentage of fully covered human resources of the department.

Groups of the department	Percentage of fully covered human resources (planned and actual resource load)	
	Before	After
IT Project Management	40%	100%
Design Supporting Systems	20%	79%
System Engineering	32%	88%
Design Systems	22%	79%
Engineering Data Systems and Integrational Solutions	41%	83%
Simulation Systems	80%	100%
Accounting	100%	100%

As can be seen in table 9 above, there is a clear increase in the transparency of resource data. In addition, the resources started being attached to proper tasks in Redmine instead of vague typical activities in Multi-D Docs&Resources. Hence, it became significantly easier to analyse whether a person was assigned to a correct task according to their competences and qualifications, as well as their correct belonging to the projects.

Using the resource planned resource load data, the amount of people working on each project every month on average was analysed. It was also important to match the data with the project priorities of the department and the organization. This means that projects with higher priorities had to have more resources involved in them, in order to withstand their great intensity. The comparison of several projects is demonstrated in table 10 below. The data taken before the development came from Multi-D Docs&Resources, whereas the data taken after the development was taken from Redmine.

Table 10. Comparison of people with entered planned resource load data monthly per project before and after the development.

Project Group	Project	Average amount of people with entered planned resource load data monthly, before (of full working time)	Average amount of people with entered planned resource load data monthly, after (of full working time)	Organizational priority
NPP projects	Hanhikivi-2 NPP (Finland)	28,64	35,15	Very high
NPP projects	Paks-2 NPP (Hungary)	24,86	17,38	High
NPP projects	Rooppur NPP (Bangladesh)	8,96	3,32	Low
Design Development projects	Design methodology, Requirement, Configuration and Change Management.	4,55	12,46	High
Design Development projects	Catalogue and data structure; Integration	5,61	3,03	Low
IT support of UDI projects	Methodological support	0	7,55	Medium
IT support of UDI projects	Software licensing support	13,55	8,73	Medium

It is clear from table 10 above that the resource distribution within the department started matching its priorities, which are also the strategical priorities of the organization. Moreover, a monthly analysis of the data can be a strong argument to change the prioritization of the projects, when some projects are becoming less loaded and others start to grow in their task number and intensity.

5.3 Lessons Learned

When conducting a study which involves a wide range of developments, interviews and communication within the development team, it is greatly important to do self-analysis of the development process. The self-analysis is done in order to properly evaluate whether something went wrong in the process of development, and to ensure that similar mistakes are not made in the future, when further development is carried out. Such self-analysis is called Lessons Learned and it is the final element of a development cycle. It not only closes the development lifecycle, but also opens the next one, forming a great part of the initiation stage.

In order to correctly initiate future project management development in the department, it is essential to outline the main failures or disappointments of the preceding development round. This helps tackling such problems easily and increases the efficiency of the workflow further on. The challenges in the development project were divided in two categories: the development project planning issues and the development project execution issues. The planning problems consist mainly of mistakes made at the planning stage of the final year project, which slowed down the execution process as a consequence. The execution problems consist of problems which occurred when executing the development itself. These issues further slowed the execution process, adding up to planning mistakes. The planning mistakes were:

- Initiating the current state analysis straight away, not having a strong theoretical background to rely on.
- Arranging a small number of interviews covering only a part of the development project aspects before and after the development. It resulted in not gaining enough information to take into consideration when conducting the development project and whose results to compare at the end of the study.
- Incorrect prioritization of Redmine development, not leaving any space to proper large-scale testing of the intermediate changes.

As it can be seen from the list above, the main problems arose from either missing some steps in the development and rushing it too much, or from not doing a deep research prior to the analysis stage. Obviously, some of these mistakes led to consequential problems at the execution stage, the main ones being:

- Constant criticism from the users and the management after bringing out too many system updates at the same time, not having them tested one by one.
- Miscommunications between the methodological and the coding teams as a result of not outlining the development project as a separate project.
- Inability to constantly stick to one product development management approach, hence slowing down the development process itself.

While the first problem on the list above is a direct consequence from a planning mistake, the second and third ones are separate mistakes. These mistakes were made at the execution stage, and they must be taken into consideration and thought through in all future development projects. The lessons which were learned were also attached in a separate document and shared to all people involved in the development to ensure the increase of project efficiency in the future.

6 Conclusions

Both project and resource management consist of a well-structured and complex set of processes, and there are multiple completely different ways to approach such processes. In order to successfully operate a huge and multi-dimensional organization with both domestic and international projects, it is important to establish the most efficient frameworks for PM. When doing that, the most vital factors to consider should be the original state, or the background, of the organization, previous experiences with certain outcomes and a variety of best international practices and knowledge bases. The thesis focused on all of the abovementioned factors, taking the specifics of the actions of the organization and department into consideration.

In order to develop the project management processes in the desired way, a proper analysis of the initial state of the PM in the department was carried out. The main flaws were pointed out and the potential possibilities and paths for development were marked. Using a wide range of PM approaches and best international practices, a set of PM-related documents was developed in the department, focusing on the methodology of project and resource management, as well as on the technical solution to be carried out. The methodological part of the study explained the newly developed project management approach in the department which was a combination of various approaches to PM. It was considered the most useful for the department. The method basically used the best parts of various major international frameworks, approaches and practices, generating a new flexible methodology for project management in the department of digital design development. The technical part of the development project described in chapter 4.3 in turn, emphasised the selection of the most suitable information system for the PM. The final year project chose Redmine, and one of the most important parts of the development project was developing this information system efficiently, following the methodology described in chapter 4.2.1.

The development project carried out in the final year project proved to be greatly successful, enhancing the user experience inside and outside of the system and sorting out the main mistakes and problems in project management which were identified in the initial state analysis. Both qualitative and quantitative analyses described in chapters 5.1 and 5.2 showed that the development project really pushed the department's results for-

ward, increasing the reputation and reliability of the department of digital design development in the organization, JSC ASE EC, making the employees more satisfied with their workflow.

To conclude, all the main aims of the final year project were accomplished. Starting from a good background analysis, continuing with a thorough analysis of international frameworks and practices, and ending with a multi-dimensional development of project management frameworks, influencing the methodological, organizational and technical sides of the department of digital design development. The study was finalized with a brief yet constructive analysis of the results and a brainstorming session on the process of the development project, building the ground for future improvements.

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