

# PROJECT MANAGEMENT - SOFTWARE DEVELOPMENT METHODOLOGY

Dipl. ing. Zvonimir Vuković  
Siemens d.d.

## Abstract

This article talks about project management in a software development area. The emphasis is given to the process of software development and the main responsibilities of the project manager. Furthermore, some aspects of different management topics that can be found in almost all projects nowadays are also described. To have a successful project one needs to have a team of persons who will participate in the project according to their professional expertise. The teams and sub-teams are defined and their roles are described.

## 1. Introduction

Today's world market is a very sophisticated business area. A huge number of competitors in most of industrial areas are confronted with requests to deliver "state-of-the-art" products in less time, with less money and higher quality. And those who pick any two mentioned variables and let the third one get "as good as possible" do not survive long. Only those who are able to really manage all three variables will be successful enough to withstand all the challenges and remain active in the market. Of course, it is very hard to achieve remarkable results in all relevant areas. If we concentrate on the area of software development, one of the questions one might ask himself is: "How to manage my software development process to achieve better results than my competitors do?" There is no straightforward answer to this question, but there is definitively a way one should follow to get there. Along this way one very important, if not most important, thing is called "Project Management" (PM)

Today, the increased significance of project management is apparent. Projects are being used as temporary organizations with the goal of performing any kind of large-scaled processes in the project-oriented organizations. Also, project management has established itself as a new discipline and project manager has become a new profession.

## 2. Project Management

### 2.1. What is a Project?

The subject of project management is a project.

"Projects are complex, mostly new, risky and important undertakings for the organization undertaking the project. They are goal-determined tasks, since the objectives for the deliverables, the deadlines, the resources and the costs are agreed between the project owner and the project team" ("pm-baseline", p. 10).

Project is not any repetitive continuous process; it's a one-time event.

Each project is initiated by the need of an organization to deliver new products and solutions to the market in order to produce profit, knowledge or something else of the organization's interest. The economic consequences of an investment through a project can be analyzed in a "Business Case Analysis" and "Feasibility Study". The objective of a Business Case is not only to analyze immediate project costs and benefits, but also the resulting follow-up costs and benefits. The objective of a Feasibility Study is to give us a hint in respect to the possible risks of not being able to achieve defined project objectives for whatsoever reason.

Each project has its own main objective which is defined at the very beginning. It is the task of the project management process to ensure that project main objective is achieved.

There are some common things that most of the projects share among themselves, e.g.:

- Specific start and end date
- Time schedule, budget and quality constraints
- Specific efforts to achieve the result and specific set of risks

## 2.2. What is Project Management?

Let's define the term *Project Management*. A huge variety of definitions for this term are available. I will present here a few definitions that seem to be most adequate for the purpose of this document:

"Project management is a business process of the project-oriented organization" ("pm-baseline", p. 11)

"Project management is a carefully planned and organized effort to accomplish a specific (and usually) one-time effort, for example, construct a building or implement a new computer system. Project management includes developing a project plan, which includes defining project goals and objectives, specifying tasks or how goals will be achieved, what resources are need, and associating budgets and timelines for completion. It also includes implementing the project plan, along with careful controls to stay on the "critical path", that is, to ensure the plan is being managed according to plan. Project management usually follows major phases (with various titles for these phases), including feasibility study, project planning, implementation, evaluation and support/maintenance" ([www.managementhelp.org](http://www.managementhelp.org)).

"Project management is the application of knowledge, skills, tools and techniques to a broad range of activities to meet the requirements of the particular project. Project management knowledge and practices are best described in terms of their component processes. These processes can be placed into five process groups (initiating, planning, executing, controlling and closing) and nine knowledge areas (project integration management, project scope management, project time manage-

ment, project cost management, project quality management, project human resource management, project communications management, project risk management and project procurement management).” ([www.ask.org](http://www.ask.org)).

So we can see that Project Management is not a trivial thing, but a set of activities that are focused on achieving desired results in appropriate way for the company, the clients and the society. There are three very important limits that we can find in almost all the projects: time, money and quality. Two of them we may not exceed - time and money and the third one – quality – must be at least as required by the customers if not even better. Sometimes it seems that these three things determine almost everything we do within the project – and the praxis will confirm this in many every-day situations. But only such project management process that learns on the experiences from the past, that considers future projects and opportunities and that regards the main resources, i.e. people as most valuable thing for the involved organization can be successful for a long time. From the personal experience I consider very important to emphasize that project management must also be rational and objective.

As already mentioned in the given definitions for the term *Project Management*, we can see that this process is actually a process of managing a number of other, mutually dependant sub-processes each having its own objective, but contributing to the main project objective. Let’s tell a few words about most important of them.

### 2.2.1. Integration Management

Integration management is “a subset of project management that includes the processes required to ensure that the various elements of the project are properly coordinated”, ([www.englertandassociates.com/glossary/](http://www.englertandassociates.com/glossary/))

In other words, each project involves a lot of resources that must be coordinated. Be it people who may be placed all over the world and speak different languages, or technologies that must be brought into cooperation, or similar.

### 2.2.2. Scope Management

Scope management is “a subset of project management that includes the processes required to ensure that the project includes all of the work required, and only the work required, to complete the project successfully”, ([www.englertandassociates.com/glossary/](http://www.englertandassociates.com/glossary/))

Scope of the work necessary to fulfil main project objective must be defined to the best possible approximation in the early stages of project development. This is important for many later considerations such as adequate resource planning or time scheduling. If project related activities loose the focus, this will certainly produce higher costs and resource consumption, delivery dates will get shifted and the whole project will be endangered.

### 2.2.3. Time Management

Time management is “a subset of project management that includes the processes required to ensure timely completion of the project. It consists of activity definition, activity sequencing, activity duration estimating, schedule development, and schedule control.”, ([www.englertandassociates.com/glossary/](http://www.englertandassociates.com/glossary/)).

Since time is one of the most important things that must be obeyed during project development, it will involve a lot of planning and reviewing on monthly, weekly or even daily basis.

We shall define here the term “Milestone”. Milestones represent significant points in the project development and are generally associated with important results. They are defined using time and appropriate deliverables. In another words milestones define end of certain project development phase. We shall see later that some of the most important signals of successful or unsuccessful project development are the milestones, i.e. if they are obeyed or not.

### 2.2.4. Cost Management

Cost management is “a subset of project management that includes the processes required to ensure that the project is completed within the approved budget. It consists of resource planning, cost estimating, cost budgeting, and cost control.”, ([www.englertandassociates.com/glossary/](http://www.englertandassociates.com/glossary/))

Of course, the money is one of the most important things one should take care about. If we manage to deliver products with fewer budgets, then we shall definitively be very competitive on the market. It's not all about being cheap at the end. It's also about managing costs during development process. A project manager must have access to all relevant data and means how to track current expenses and to estimate future expenses. Thereby, project manager can influence final, overall costs. It is quite usual, although rarely desired, that initial budget has to be re-planned due to unexpected things in the course of development.

### 2.2.5. Quality Management

Quality management is “a subset of project management that includes the activities required to ensure that the project will satisfy the needs for which it was undertaken. It consists of quality planning, quality assurance and quality control. It includes configuration management“, ([www.eurocontrol.int/eatmp/glossar/teryms/terms-16.htm](http://www.eurocontrol.int/eatmp/glossar/teryms/terms-16.htm))

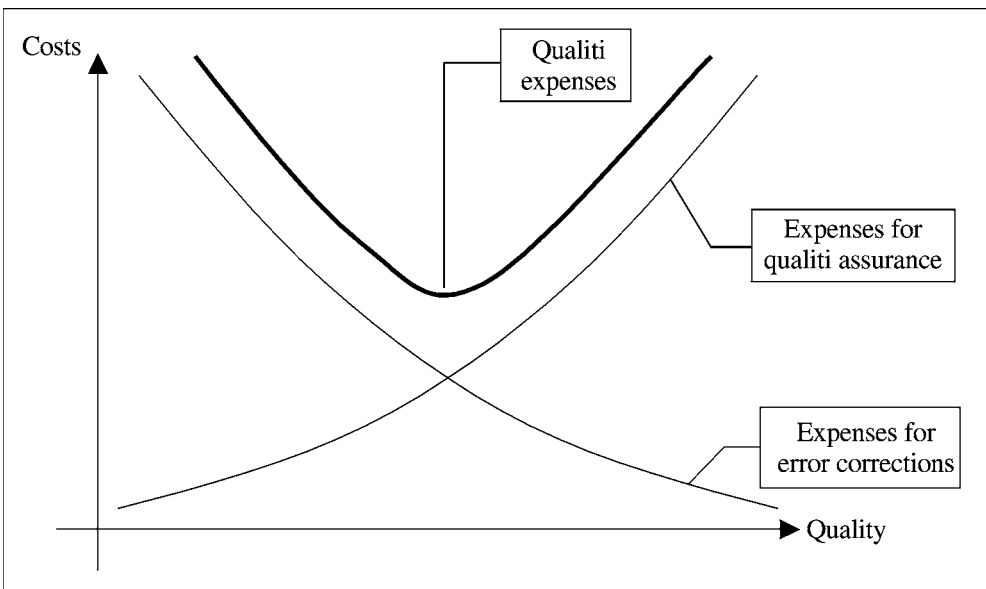
One, also very important thing to take care about is Quality Management. Today, there are a lot of different quality certificates one company can obtain to prove that its products are good quality products (e.g. ISO, CMM<sup>1</sup>). Such certifica-

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<sup>1</sup> CMM (Capability Maturity Model) – certificate of a certain level of quality in software development which was originally developed in USA by NASA. Today it's in use in some companies all over the world.

tes are periodically, mostly on yearly basis, tested and renewed or withdrawn. But, not everything is in a certificate. Each company must find it's own best way how to manage quality in the course of product development. For quality assurance, there are usually specialists – quality assurance responsible persons - who cooperate with project managers during product development and thereby contribute in the areas of their expertise. A common thing to say is “four eyes see better than two”. The main task of a quality assurance responsible person is to assure that product development is done according to the official, and perhaps certified, method that the company uses. Also, the quality of the product is being tested in the course of development. A huge variety of tools and methods are used for this. Some of them are:

- Design reviews
- Internal reviews of documentation and code - reviews done by the development team
- External reviews of documentation and code - reviews done by some other teams or by the customer
- Usage of configuration management tools to manage software versions
- Regression tests - automated tests of all specified features (useful to prove that latest changes or updates did not influence previously developed functionality)
- System tests – overall tests performed by the company that has developed a product. Such tests include not only tests of specified functionality but also performance tests, high-load tests, integration tests, etc.



**Figure 1:** Quality/Costs diagram

Finally, the quality has its price. Following is a diagram showing how much it costs to achieve certain degree of quality.

So, we can see that it's not worth spending enormous amounts of money to reduce the expenses for error corrections. There is an optimum that must be detected, achieved and maintained.

#### 2.2.6. Human Resource Management

Human resource management is “the project management task that ensures that adequate resources are allocated to the endeavour.”, ([www.donald-firesmith.com/Glossary/GlossaryR.html](http://www.donald-firesmith.com/Glossary/GlossaryR.html))

As we all know, in spite of all the technology that we have today, people are still the most valuable and unavoidable resource. First of all, a project manager must be a person that is as such accepted by the team. Second, a project manager must be familiar with the team members, i.e. must know strong sides and weaknesses of all involved persons in order to adequately distribute tasks among them. Finally, a project manager must cooperate with team members, and must be willing to accept other opinions presented by team members. If those preconditions are met, it is most likely that development tasks (usually called “Working Packages”) will be distributed most adequately. Further, a project manager must plan the order and time frame for each individual activity according to development phases. That means that amount of necessary human resources may vary in the course of development. Usually, in the early stages and final stages less people are involved in development, and in the middle stages the pressure gets very high involving most of the people. So, the teams are usually not static, meaning that some team members may in some stages be engaged on some other projects. The project manager must, also, be aware of what is going on within other projects in the company, not only to be able to reserve enough people for different stages in the project, but also to be able to use the knowledge and experience that people gather in other projects. Of course, people are not machines, so a project manager must be aware of planned and unplanned absences, holidays and similar.

#### 2.2.7. Risk Management

Risk management is “the systematic process of identifying, analysing, and responding to project risk. It includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of events adverse to achieving project objectives. It includes the processes of risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and risk monitoring and control.” ([www.fieldoperative.com/Tools/Glossary/Glossary%20p.htm](http://www.fieldoperative.com/Tools/Glossary/Glossary%20p.htm))

All activities within a project, as well as the final outcome of the project, involve certain degree of risk. This is something that cannot be avoided regardless of the level of quality or experience the organization has. Risks are everywhere, and only

possible strategy is the one that systematically takes care of risks from the very beginning. That is, risks must be identified, planned and analysed as early as possible within a document called “Risk Plan” or similar. For each identified risk, a project manager together with the team must recognize necessary measures how to either avoid the risk or minimize it. That is, the identified risks must be evaluated, prioritised, minimized and followed. The risks can be identified in the later phases of the project as well meaning that the risk plan must be updated. Higher management levels must be acquainted with all identified risks in all stages of product development. Sometimes risk analysis leads to the “no go” decision for the project, or to stopping of already ongoing projects. Gathered experience from earlier projects is of enormous value for risk analysis and management. Some project development methodologies consider so called “Kick Off Meeting“ and “Lessons Learned Workshop”. The former is held at the very beginning of the project, the latter at the very end of the project. Both occasions have a common item in agenda – risk management. In the “Kick Off” meeting risks are usually being identified by all team members on a risk management session using a variety of methods (e.g. brainstorming, or experience). In the “Lessons Learned” workshop all involved team members analyse how the risks have been planned, identified and taken care of with respect for the future projects and better risk management.

In some recent terminologies, the word *risk* is replaced with the word *challenge*. All highly project oriented, methodology based organisations with high degree of self confidence and market strength tend to see the risk as an opportunity to find solution for it and thereby get more advantage over others.

#### 2.2.8. Claim Management

In the world of software development, we understand the term *Claim Management* mainly as a way in which to cope with changes in requirements that are being received or identified at some later phases in the project. Usually, the client finds out some new and interesting services that can be delivered to end-users. These ideas are then being translated into so-called *Change Request* in a form of a technical document describing the desired features or functionality. It is up to the project manager to decide what is the best way to deal with such change requests. The options are either to postpone the implementation of the change request until previously agreed product is finished or to do it immediately. The decision depends mainly on complexity of necessary changes.

#### 2.2.9. Configuration Management (CM)

Configuration management is “the process of identifying and defining Configuration Items in a system, recording and reporting the status of Configuration Items and Requests For Change, and verifying the completeness and correctness of Configuration Items.”(<http://www.itil.co.uk>)

In another words, configuration management is a system that makes it possible to have a centralized storage place for all relevant project specific data (e.g. documents, source code, test tools, ...). It is possible, and of course widely used, to keep track of all versions of the stored data throughout the whole project development process and to make a centralized backup as well. All this makes it a “must have” tool for every serious project. Usually, there is a separate team of experts (CM team) who maintain such system for number of projects. Sometimes CM team contributes to the project by creating CM specific documentation.

#### 2.2.10. Information Management

Information Management is “a method used to organize information to avoid information overload and to keep information in a format that is efficient to retrieve whenever needed. Filing systems, cognitive maps, manuals, and electronic databases are examples of devices that can prove useful in information management. A network of consultants is an additional way to ensure that necessary information will be readily available.”, ([www.iime.org/glossary.htm](http://www.iime.org/glossary.htm))

Today we have Internet as a global network available for everyone and everywhere. From the organizational point of view, there is a similar thing called Intranet. Intranet is “a private network inside a company or organization, which uses software like that used on the Internet, but is for internal use only, and is not accessible to the public. Companies use Intranets to manage projects, provide employee information, distribute data and information, etc”, ([www.getnetwise.org/glossary.php](http://www.getnetwise.org/glossary.php))

Intranet, as the definition already mentions, is the ideal resource for keeping and publishing all relevant project specific data. Usually, though not necessary, development methodologies include a point in early stages where it is the task of the project manager to organize an Intranet Web Site dedicated for the project purposes. Of course, such Web Sites have a common “look and feel”, are easy to use and employees are used to them. Besides that, there is also e-mail as a way for publishing information. E-mail is used very often and in distributed environments it is sometimes the most important way of communication. So, the combination of Intranet and e-mail makes it possible to manage information flow very efficiently and with low resource consumption. Having such technology available, the projects are being managed much easier.

#### 2.3. A Key Person - Project Manager

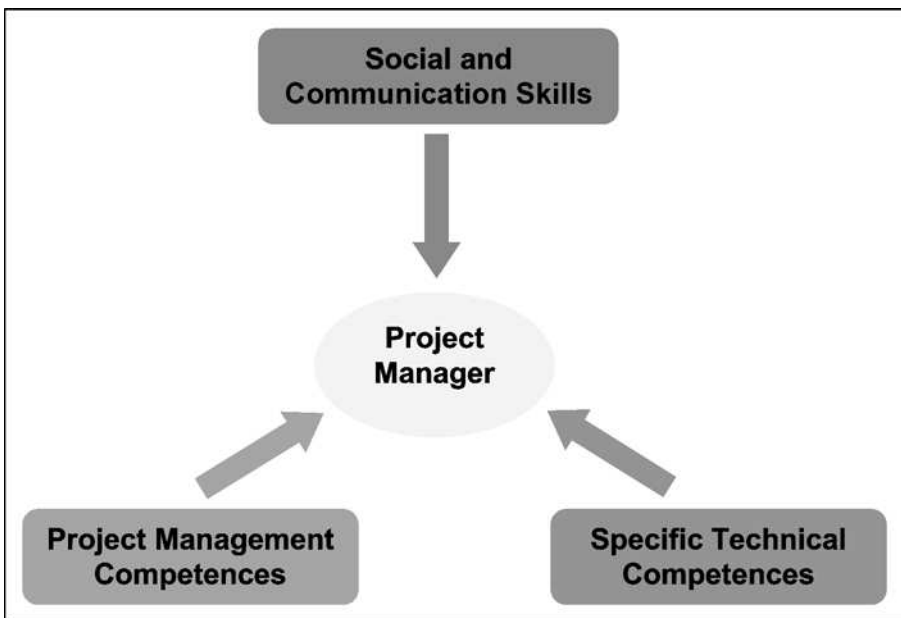
A Project Manager is a person that is responsible for the project and, therefore, the one who leads the project towards a successful or, sometimes, unsuccessful finish. A project manager must have a set of competences that make him/her appropriate person for such a duty. These competences cannot be learned in the school or in a workshop. One must develop himself/herself through active engagement on specific tasks within one or more projects. Visiting and participating in dedicated



seminars and workshops can help gathering further experience and knowledge. Therefore becoming a project manager is not something that people should be afraid of, it's just something that doesn't occur over night.

A project manager, besides leading the project, communicates with other related instances involved in and around the project. There is a role of interface that the project manager must play. Most common and important relations are those with project sponsors and clients. Project manager is directly responsible to the project sponsor since the sponsor is the one who orders a project to be executed. Project sponsor (usually higher management levels of the organization) usually defines some specific boundaries (e.g. budget, time, quality) and monitors them closely. Clients are those who usually specify the requirements and negotiate technical details of realization that are of high importance to them. When we talk about software development, a common situation is that the client orders some extensions of already existing systems, or wants some new systems that are compatible to other existing systems. In any case, very usual things are change requests during development or after finishing the original project. A project manager is the one that must coordinate all negotiations with the client.

So, how to pick the right person for this job? There are some guidelines to help in such situations. The project sponsor or other higher management instances could use the following picture to think about necessary competences.



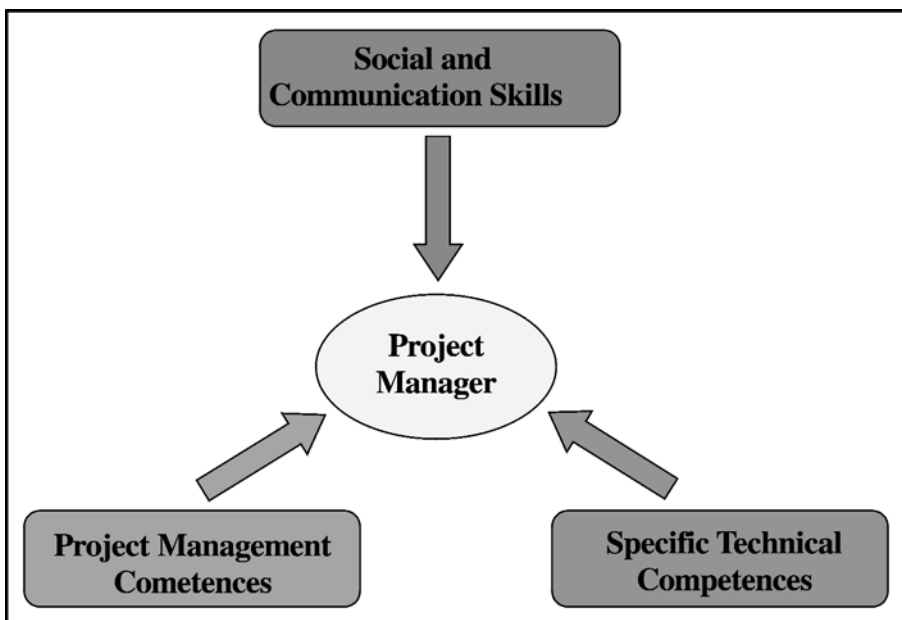
**Figure 2:** Project Manager Competences

*Specific Technical Competences* were earlier one of the main things that were necessary for the person to become a project manager. Today, this is not any more the only criterion, sometimes even not relevant at all.

*Project Management Competences* together with appropriate knowledge of methodology and experience are becoming more and more important nowadays.

*Social and Communication Skills* are necessary for leading all the people involved in a project, for being an interface towards external parties and for understanding and using team-oriented approach.

Now, to choose from a number of available and adequate persons following approach could be used:



**Figure 3:** Process of choosing the right Project Manager

*Selection Process* is a decision making process done by higher level management by means of examining, qualifying and evaluating all relevant aspects of a particular project.

*Specific Requirements Profile* describes necessary or specific qualifications of the potential Project Manager for the particular project.

*Qualification Profile* describes all relevant qualifications and competences of a potential Project Manager. This information is gathered from a point of view of higher-level management and a person itself, agreed upon and published

In practise, many companies have an automated process (computer aided, using variety of available software solutions) to help gathering all relevant data and choosing the right project manager.

### 2.3.1. Project Manager Tasks and Duties

Everyone, confronted with project manager duties would like to know at least the answer to the following question: “What do I have to do now?”

Well, like in many other things, there is no straightforward answer to this question. But, some hints do exist. Following table presents some key objectives<sup>2</sup> with respect to the client and higher-level management that each project manager has to be aware of:

Objective	Responsibility	How
Obtain the user requirements	Analyst/PM, Client	Interviews and discussions with the client
Define the project	PM, Client	Project definition report, Business case study, Feasibility study
Plan the project	PM	Use official organization's project development methodology, available tools and experience
Negotiate for resources	PM, Higher Management	Resource plan
Create the project team to perform the work	PM	Kick-Off meeting
Execute the project, including changes	PM	By following the official methodology
Control and monitor the actual versus planned	PM	Insist on status reports from the team, create overall status reports, Issue and Risk logs
Close the project and release the resources	PM, Client	Final (closure) report
Review project and support post project	PM, Client	Lessons Learned workshop, support contract

**Table1:** Project Manager Objectives

<sup>2</sup> Partially taken from - Jason Charvat: ” Project Management Methodologies-Selecting, Implementing, and Supporting Methodologies and Processes for Projects”

In addition, there are some common responsibilities that we can identify here<sup>3</sup>:

- Obtaining approval for the project to proceed.
- Determining the project scope and its feasibility to the overall business.
- Ensuring the necessary project resources are identified and allocated.
- Planning the project to the relevant detail it requires.
- Ensuring that the project methodology and associated processes are adhered to.
- Monitoring the project in terms of cost, quality, and schedule.
- Identifying and monitoring project issues and risks.
- Providing updated reports and summaries to the higher management and clients.
- Providing leadership to the project team.

In more details, we can pinpoint here some experience-based suggestions or rules that are useful to the project manager<sup>4</sup>:

*Project success criterion must be well defined.* It is not enough just to meet the scheduled dates of delivery. Nowadays, it gets more and more important to achieve global market success by means of either technological achievements, new and interesting services, or similar.

*Release criteria must be identified well.* Early in the project it must be known what criterion will be used to determine if product is ready to be released or not. This can be a number of critical defects that are not solved, list of available and not available features regarding given requirements, performance results, etc.

*Commitments must be negotiated.* A good project manager will not make commitments that are not realistic despite of the applied pressure. Good-faith negotiations (also known as *win-win* negotiations) must take place between higher management, customers and project manager to find acceptable solutions for all sides.

*A plan must be written and available before any development starts.* By writing plans, one must do thinking, discussing, brainstorming, experience gathering and similar activities. All this gets very useful at later stages in the project by avoiding problems, being more productive, having better quality and better mood in the team

*Create and use working packages.* It is very useful to break large development tasks into smaller pieces keeping their integrity. Distribute such tasks appropriately among project team members and keep track of progress at regular intervals.

*Plan to do enhancements as a result of quality control activities.* Usually, if not always, there will be necessary to undertake corrective actions based on performed testing activities.

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<sup>3</sup> Partially taken from - Jason Charvat: " Project Management Methodologies-Selecting, Implementing, and Supporting Methodologies and Processes for Projects".

*Manage the risks.* Risks must be identified and controlled. The time spent on this is not thrown away. Use brainstorming, experience and other methods to identify risks, evaluate them and avoid them as much as possible. But, one should be aware of the fact that it is not possible to avoid all the risks. Therefore, detect when it is not worth spending further efforts on risk analysis and calculate certain buffer.

*Do your estimations feature based not calendar based.* All identified development efforts should be estimated based on necessary time for realization (a measurement unit is usually called “Man-Hours”, MA). Most of all it is experience, but also a variety of developed estimation methods that can help here. Only then, translate the results into calendar days.

*Don't over schedule your team members.* Every project manager must be aware of the fact that there is a certain amount of overhead in every activity. It is either switching among activities or preparation for certain activities or temporary resource congestion or similar that needs time to be solved. Plan your people with 80% of their time.

*Calculate training time, vacation time, sickness, etc.* Use experience or average values for vacations, sickness and training activities. Ask your team members to give you some forecasts. Build this data into your plans

*Note your estimation data.* It can be very useful to document all assumptions, approaches, identified key issues and other relevant discussion topics for later usage. This can help in later estimation adjustments and it can improve overall estimation process.

*Record actual progress and estimated efforts.* By comparing actually achieved results to the estimated ones, a project manager can improve estimation process significantly.

*Recognize tasks as completed only when they are 100% complete.* The way how to recognize tasks as completed must be transparent and understood by everyone. As long as there are any open issues, even minor ones, the tasks should not be treated as finished

*Track project status openly and honestly.* All team members must feel free and comfortable when discussing project status issues. Reports on this matter must be accurate and available. An experienced project manager will not let the misleading optimism, that sometimes exists, to influence his/hers objectiveness. Organize celebrations at important stages and at the end of a successful project.

### **3. Project Management Methodology**

According to Jason Charvat<sup>5</sup> a methodology is a set of guidelines or principles that can be tailored to a specific situation. In a project environment, these guideli-

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<sup>4</sup> Partially taken from – Karl E. Wieggers: “Secrets of Successful Project Management”.

<sup>5</sup> Jason Charvat: ” Project Management Methodologies—Selecting, Implementing, and Supporting Methodologies and Processes for Projects”.

nes might be a list of things to do. A methodology could also be a specific approach, templates, forms and even checklists used over the project life cycle.

Today, there is a huge number of methodologies in use. Some companies use methodologies that cover all aspects of the business, from pre-sales activities to operational support. Some other companies use methodologies only during design and development. There is no universal methodology available; everybody uses its own methodology. Even similar methodologies get adapted to the specifics of the company, i.e. many project managers have realized that “methodologies from the book” must be modified and tailored to suit their own project needs.

Also, there are different methodologies within the same company for big and small projects (those that engage many or few people, last longer or shorter, etc.).

A company that uses certain methodology should make it transparent to the customers as much as possible. Furthermore, some companies offer their customers to choose from a set of methodologies the one that will be used for the project realization. This makes it possible for the customer to track the progress and to know exactly what intermediate results and deliverables should be available at certain points in time.

Many companies get their methodologies certified. Certificates are usually tested at regular time frames by external certification authorities to prove that the methodology is really being used and that it addresses all relevant and important areas (e.g. environmental protection is an important issue even for the software development companies)

Finally, a methodology must not be too complex or inappropriate in any way to be seen as a burden for the people who use it. It must be light, understandable and goal oriented, it must be seen as a tool for achieving success. It should make the life easier.

#### **4. Software Development Methodology**

Further in this document an example of a software development methodology will be presented. The aim is to have a methodology that is easy to implement and follow, that is goal oriented and that can easily be adapted to large-scale as well as small-scale projects.

##### 4.1. Main Phases

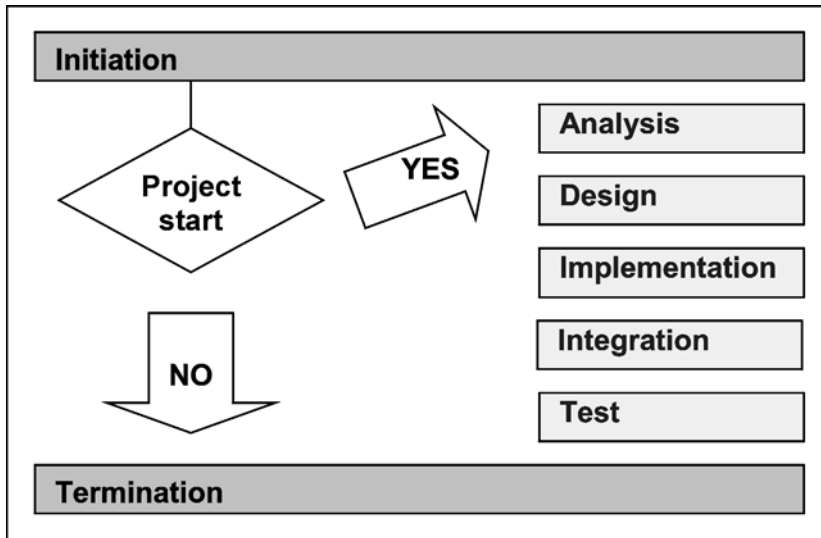
Following picture presents main phases of such methodology

##### 4.2. Milestones

It is necessary to define some milestones. Milestones are “interim objectives, points of arrival in terms of time for purposes of progress management”<sup>6</sup>. In other words, milestones are used to define necessary deliverables at appropriate points in

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<sup>6</sup> [www.maxwideman.com](http://www.maxwideman.com)



**Figure 4:** Project Phases

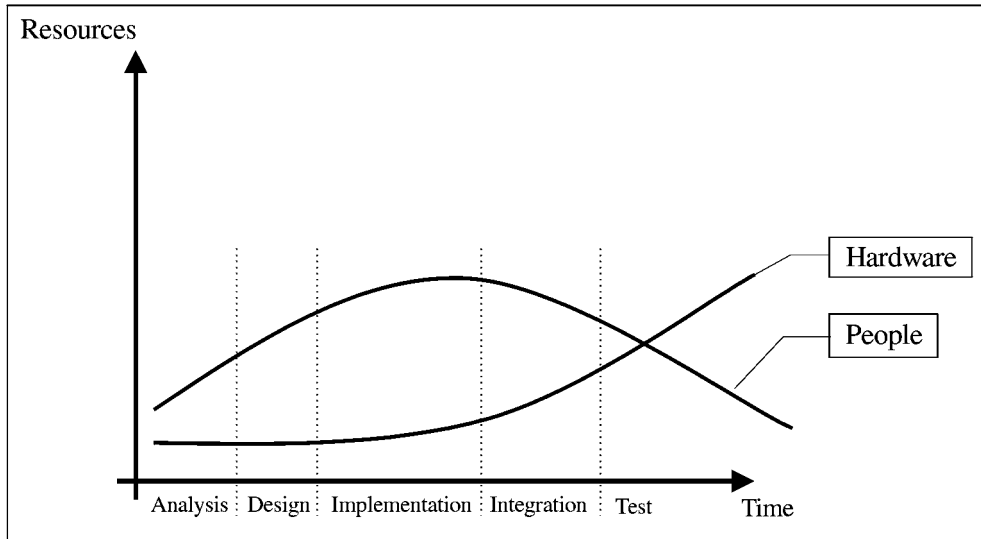
Milestone	Description	Phase
M100	Project “Kick Off” meeting	Initiation
M200	Completion of analysis	Analysis
M300	Completion of Design	Design
M400	Code complete	Implementation
M500	Integrated system	Integration
M550	Beta release	Test
M600	Market release	Test

**Table 2:** Milestones

time. Mostly, when milestones are met certain phases are finished. Nevertheless, milestones can be defined within the phases if necessary. Let’s define following milestones:

#### 4.3. Resources

Resources, be it people, money, hardware or similar, are necessary throughout the whole project development. Based on experience and specifics of each project it is possible to foresee the trend of amount of necessary resources in regards to each project phase. Following picture presents some usual cases.



**Figure 5:** Time – Resources Diagram

So we can see that necessary amount of people involved in a project gets the maximum in the phase of implementation. Early phases as well as later phases involve less human resources.

Hardware, on the other hand, is a resource that grows towards final phases. This is characteristic for software development since final phases involve tests where it is actually attempted to simulate real environments.

Of course, there can be more or less differences to what is presented here. Furthermore other resources, such as money, must be planned in advance according to inputs that are available at the beginning of the project.

Every project manager must know the trends of resource consumption and according to the experience and available inputs (there are also software tools available for such purposes) must plan exact amounts of necessary resources for the whole project. During project development there will usually be necessary to do certain corrections, but the goal of planning is to make later corrections as minor as possible.

#### 4.4. Project Team

##### 4.4.1. Teamwork

“A team is a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable“<sup>7</sup>

<sup>7</sup> Jon Katzenbach and Douglas Smith, The Wisdom of Teams



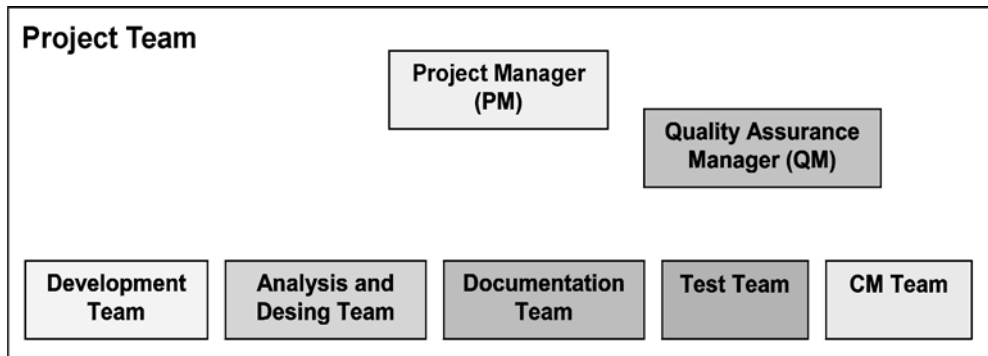
Teamwork is more and more becoming a core factor of modern organizations. Mainly projects ask for integration of different disciplines and procedures across the organizations. Successful teams have a clear goal understood and accepted by all members. In addition there is an atmosphere of open and useful discussion among the members, conflicts get solved easily and openly. Everyone within such team understands their roles and tasks and carry out their share of load. A success-oriented motivation is developed.

All this and many other things make it necessary to develop and maintain good quality teams of people that are available for project tasks. If a team is available, project can be done, otherwise key resources are not available.

One very important characteristic of a project manager is to be recognized by the team as a team leader.

#### 4.4.2. Sub Teams

Project team consists of people who work on the project. As shown previously, the number of involved persons is not constant and it depends on the actual phase of the project. Nevertheless, it is possible to identify certain groups (sub-teams) within project team that share common tasks (or duties) and in general act more closely together. Following picture gives an overview of the groups of people within a project team:



**Figure 6:** Project Team – Sub-Teams

*Project Manager* is responsible for the whole project

*Quality Assurance Manager* is responsible for achieving necessary level of quality by ensuring that project tasks are being conducted according to the official development method. Since all involved persons in the project should know the methodology well, QM has mainly controlling function. QM is the often “right hand” for the project manager and his/hers representative. For QM it is not unusual to be focused on few projects in parallel.

*Development Team* is responsible for product implementation (coding in our case) according to the requirements and design. Development team is present in certain amount in almost all phases of the project. During analysis and design it is quite usual that development team members are involved or at least consulted. Phase of implementation belongs entirely to the development team. Integration is a phase where development team is integrating all developed components in a functional entity. During test phase, development team is engaged in error corrections. Also, development team is responsible for internal, highly technical documentation such as interface specifications, developer manuals and similar

*Analysis and Design Team* consists of senior developers, analysis specialists and design specialists. This team is mostly engaged in early phases of the project. Later in the project analysis and design team members are consulted in case that special circumstances occur or change requests appear.

*Documentation Team* is responsible for creation of all necessary documents that must be delivered together with the final product. Sometimes it is hard to distinguish what documents should be created by documentation team and what should be created by development team. It is the task of PM and QM to make appropriate work split in such situation.

*Test Team* is responsible for creation of test specifications, execution of all necessary test cases and, in case of detected errors, reporting to the development team with appropriate error descriptions.

*Configuration Management Team* (CM Team) is responsible for maintaining configuration management system. This team is usually working in parallel for a number of projects since in most cases, due to nature of the CM systems, there is no need for a 100% engagement on a single project. Nevertheless, the duties and responsibilities of a CM team are of huge importance for each project.

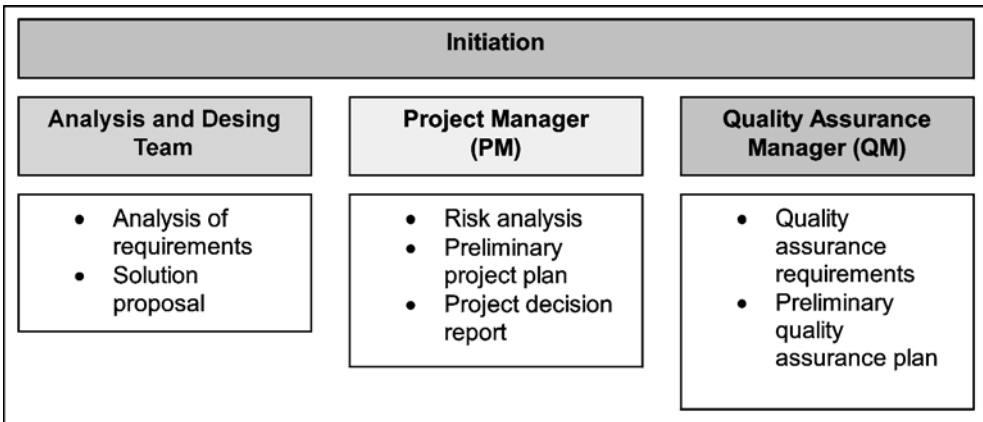
## 4.5. Phases in Details

### 4.5.1. Initiation

This is the first phase of each project. In this phase it is decided if the project will be done or not. The decision is based on the Project Decision Report as a result of undertaken activities at this stage.

Analysis and Design team must analyze customer's requirements and if possible provide a solution proposal. If it turns out that requirements analysis has a negative outcome due to complexity, risks or some other reason, the analysis and design team will suggest to the project manager to make a decision not to do the project. An immediate consequence must not necessarily be a final "no go", but further negotiations with the customer could take place.

Project manager and quality assurance manager are preparing preliminary project plans and quality assurance plans as well as analyses of risks.



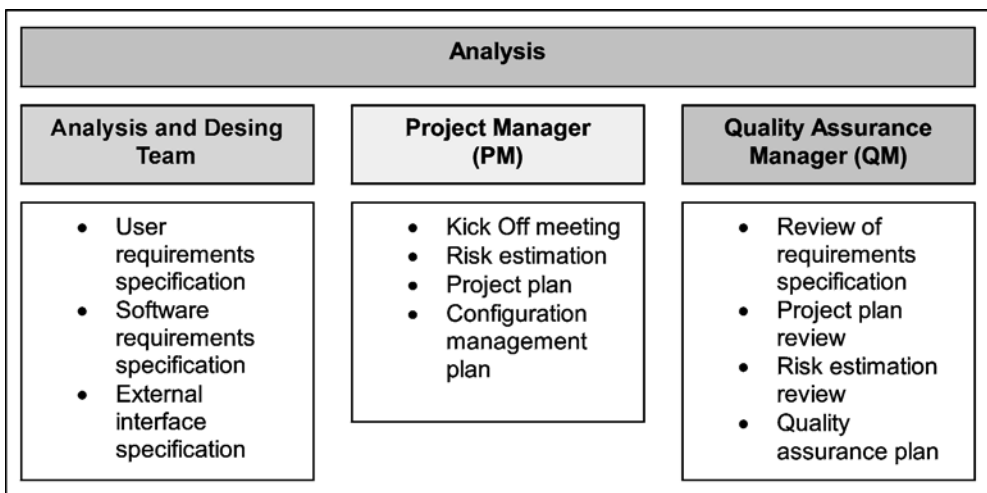
**Figure 7:** Initiation Phase

Final, and most important result of this phase is a project decision report where it is decided is and how to proceed with the project.

#### 4.5.2. Analysis

This phase of the project has a main goal to answer the question “WHAT should be done?”

There are number of important activities at this phase. A user requirements specification contains thorough description of the product requirements in terms of its functions, interfaces and other features from the perspective of the user. A soft-



**Figure 8:** Analysis Phase

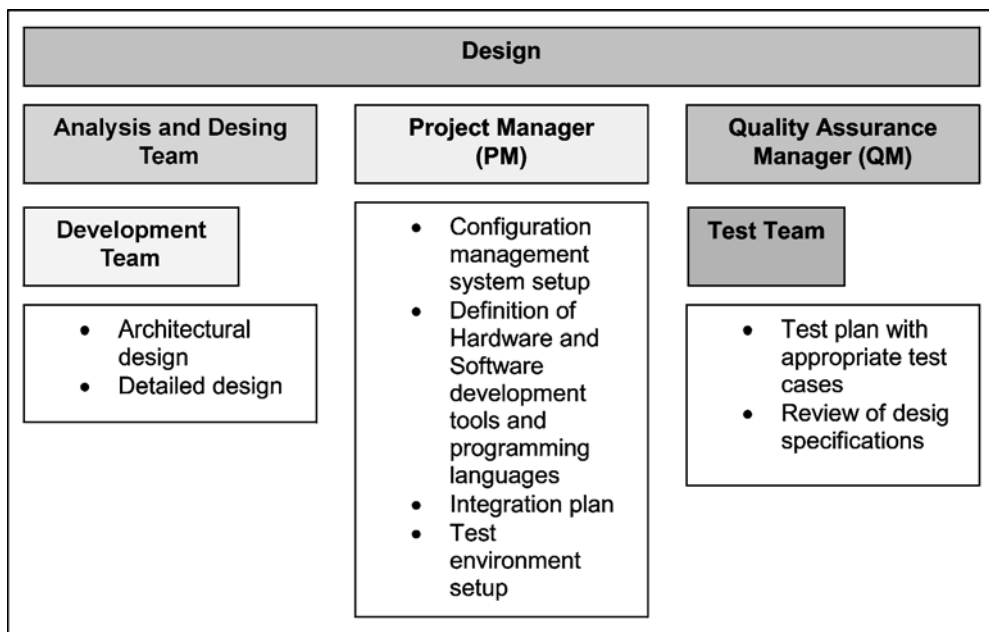
ware requirements specification is one of the most important technical documents for design and development. It describes the functionality, internal and external interfaces and all other relevant facts about the product. Both requirements must be reviewed externally (by the client) and internally (by development).

Project manager organizes a so-called “Kick Off” meeting where all project team members are gathered. The people get acquainted with each other and each person presents professional experiences in a form of short curriculum vitae. Project manager gets presented also. Furthermore, the project manager to the team presents main goals and functionality of the future product. Team members get acquainted with their future responsibilities.

#### 4.5.3. Design

This phase of the project has a main goal to answer the question “HOW should the product be developed?”

At this phase there is a close cooperation of analysis and development team. The goal is to produce architectural and detailed design of the product. Members of analysis and design team are being consulted by development team members on architectural questions to ensure that the architecture corresponds appropriately to what has been required by the client.



**Figure 9:** Design Phase

Architectural design describes the product components together with their functions, interfaces and other features. The requirements made on the product must be assignable to the individual product components. The content of the architectural design specification must correspond to the requirements set out in the software requirements specification.

Detailed design specification describes the components of the architectural design specification together with their functions, interfaces used, algorithms and internal data structures as a basis for implementation.

Both documents get reviewed internally and, if necessary, also externally.

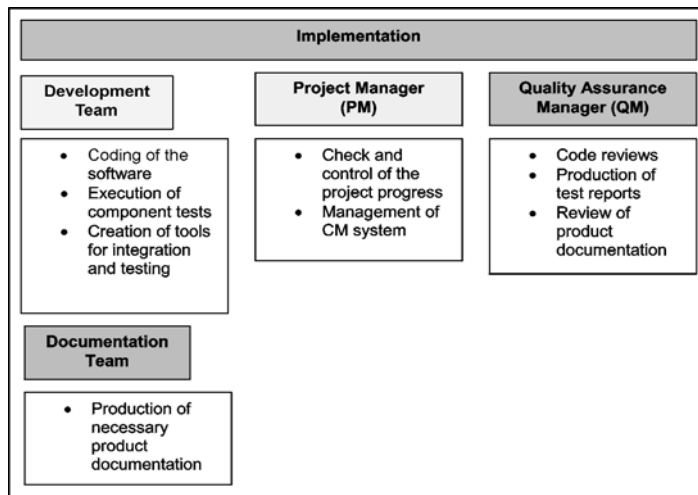
The project manager prepares necessary tools for development, ensures that configuration management system is set up appropriately and prepares necessary things for future phases (integration and test).

Quality assurance manager cooperates with test team to develop a test plan with appropriate test cases

#### 4.5.4. Implementation

This is a typical phase where development team plays a crucial role. Coding of software components takes place, component tests are being executed and all other activities are done with respect to the status and problems of development team.

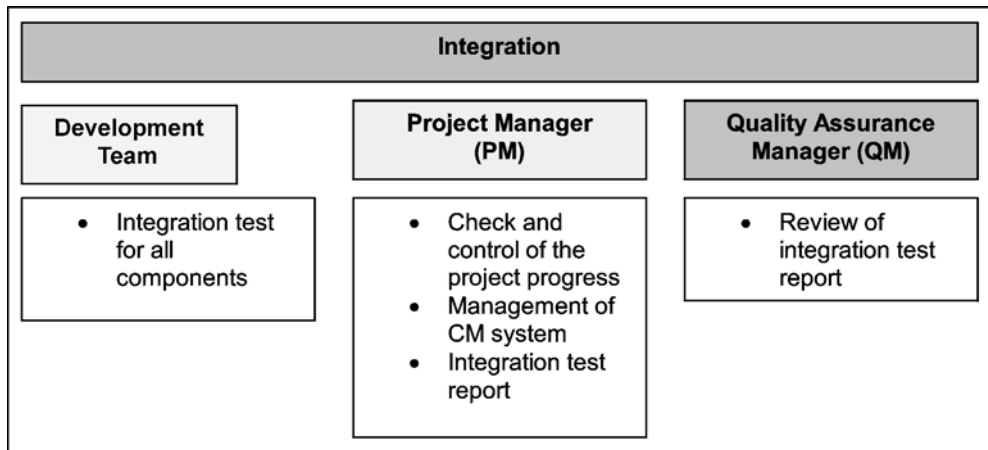
Documentation team produces user manuals that will be provided together with the product to the end user or the client. There can be a number of relevant documents, like installation manuals, configuration manuals, interface specifications, compliance documents and similar. This depends on the nature of the product that is being developed.



**Figure 10:** Implementation Phase

#### 4.5.5. Integration

This is a phase where code-ready components are being integrated into a single system and tested for mutual cooperation. Usually, development team tries to execute a number of successful requests against the system with respect to all required features of the product. As soon as this minimum level of quality is reached, the phase is being documented and finished.



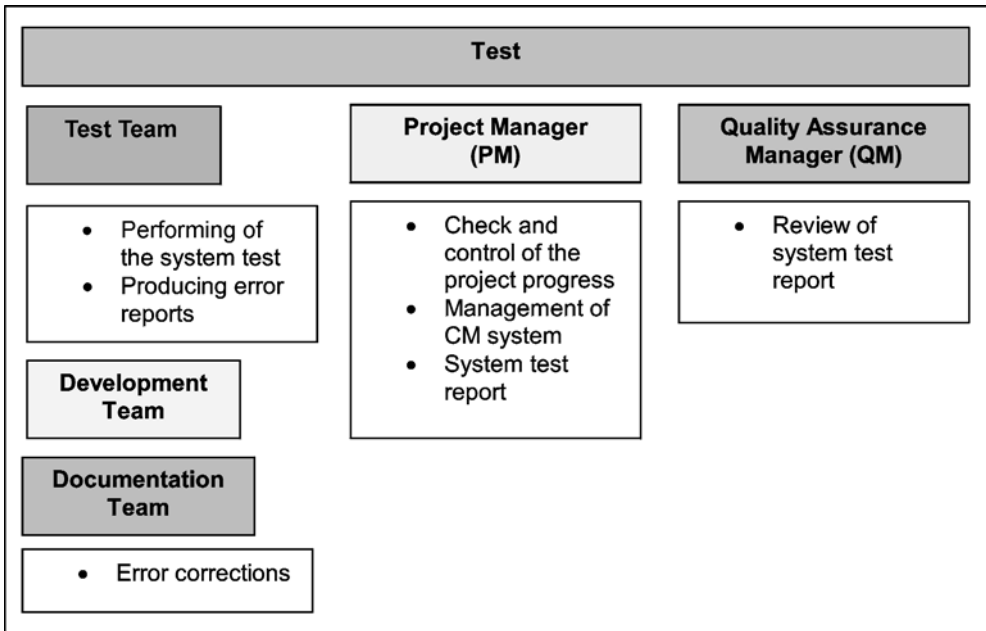
**Figure 11:** Integration Phase

#### 4.5.6. Test

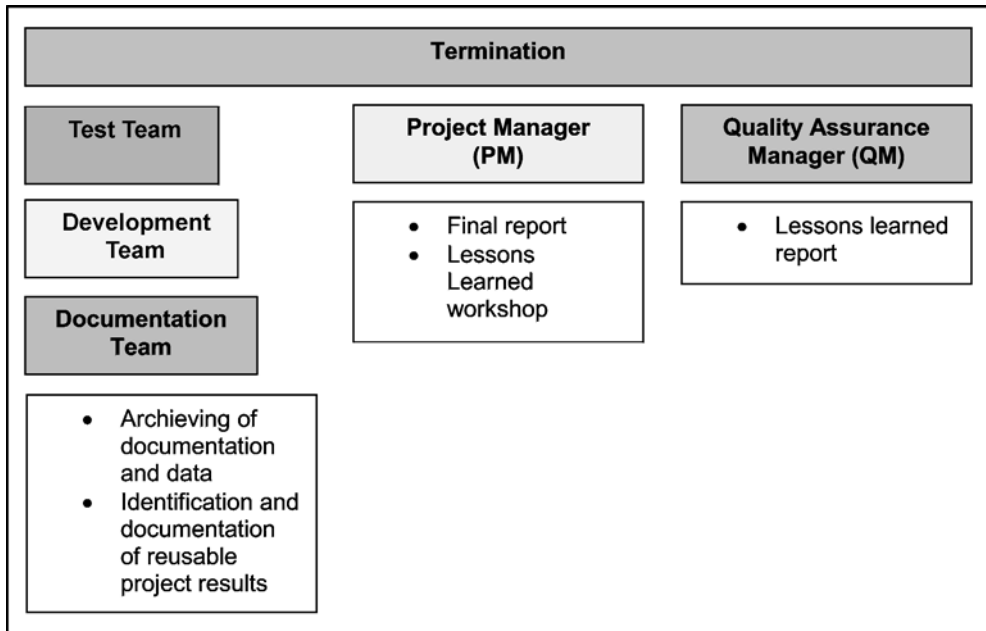
In the test phase the test team members and development team members have a central role. The test team executes test cases according to previously developed test specification and reports all errors or inconsistencies to the development team members. The development team does error corrections in the code. Generally speaking, the product gets tested very thoroughly. Sometimes documentation team has to update or correct the product documentation. Usually there are specialized tools for error reporting needs. If such tools are available, the project manager can easily track the progress and status of the product. Otherwise, all errors and applied corrections must be documented manually. Finally, a test report is being produced that certifies that the product has reached the necessary level of quality and conformance to the requirements. After the review is finished, the product is being released to the market.

#### 4.5.7. Termination

This is a phase when finishing work is done. There are no further changes in the product itself or in the product documentation. The project team achieves all results of the project and identifies reusable results. Project manager writes a final report to the higher management levels and, together with quality assurance respon-



**Figure 12:** Test Phase



**Figure 13:** Termination Phase

sible, organizes a so-called “Lessons Learned” workshop. The whole project team is gathered once more and immediate impressions, results and experiences are discussed and documented. If the project was successful there is a further reason for celebration. One very important goal is to identify new and useful experiences, to document them and to make them available for all future projects.

## 5. Conclusion

The things presented and explained here give a rough overview of what is a project management in a software development area and what it consists of. The goal was to present at least most important aspects, terminology and procedures. Every organization has some specifics that can more or less influence how the projects are managed. Furthermore, within a single organization there are rarely two so similar projects that no significant differences exist in the way the projects are managed.

What is very interesting in the whole area of management is that every manager in any business area uses own experiences to learn from them. Also, management techniques a full of *Low Hanging Fruits* (i.e. useful things and techniques that once identified are very easy to use) that can be exchanged among managers to improve their skills.

Project management methodology in software development area as presented here is a subject for customization and enhancements by project managers. Those with less experience might find some very useful things and techniques here; those with huge experience might find it incomplete in some areas. Also, what has been presented here is not going deep into details of how some internal procedures and activities are executed. This is usually a matter of experience, flexibility of the team and available technology.

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