

# **CMM for Small Organisations**

## **Level 2**

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**UMINF-00.20**

2000-09-26

### **Abstract**

This paper presents a model for software process improvement, intended for small, growing organisations. The publically available models, e.g. CMM, are not adequate for small organisations. One reason is that the number of roles proposed exceeds the number of employees. Another reason is that the responsibilities and tasks proposed are too many and rigorous, at least, in very small organisations with only a few employees. Neither is that kind of rigour needed if it is easy to get oversight of the activities because of the easy communication and organisational structure. The model described in this paper is a modified CMM, called "Dynamic CMM", applicable from the very start of an organisation and at the same time, supporting the quality and improvement activities while the organisation grows.

The work behind the model is part of the research project QMSE (Quality Management for Small Enterprises), conducted at Umeå University and financially supported by NUTEK. The entire project group consisting of Jürgen Börstler, Olof Johansson, Hans Segerberg, Ola Ågren and Hans Segerstad, in addition to the authors, has participated in the development and reviewing of the document.

## CMM for Small Organisations - Level 2

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# 1 Introduction

## 1.1 Background

The value for the customer has become a most important driving force for many software development organisations. It is of vital importance for survival in the ever increasing competence. At the same time, more and more organisations understand the importance of focusing on the quality of the process, that it is the weakest element in the chain from an idea to high quality products. The ability to produce reliable and usable software within time and budget is still difficult to achieve for many organisations, and many of them now search for solutions from software process improvement.

CMM<sup>1</sup>-model (The Capability Maturity Model) has become quite popular as a model for process improvement for software organisations, especially in USA, but recently also at the European software market. Software CMM, in the sequel called plain CMM, is publically available and is described in the literature [1], but it is also available on the internet [9]. In addition to that, a number of large organisations in USA, e.g. [2], have published studies of the value of using CMM compared to the costs for improvement efforts. A short description of CMM can be found in Section 2.

No doubt, an organisation with notably symptoms of chaos in the software development work should initiate improvement efforts. Such an effort may be undertaken using CMM as a model. It gives a road map to improvement, based on historically proven sound theories and experience, leading to success. The model introduces a ladder, with more and more improvement elements in both development and management. It gives an intuitive and easy accessible way to introduce improvement activities. We do not argue that CMM is the only or the best model to use, it is one of a number of available models, and it has shown to give good results.

To implement CMM in an organisation is a difficult task, and as many other new activities, it requires another way of thinking and other tasks to be performed than those people are used to. Fortunately, there are hints and guidelines and templates, techniques and experiences published and available for implementation, e.g. [3], [4].

It is public knowledge that 2/3 of the organisations worldwide would be on Level 1, the level characterised as "chaos", if assessed against CMM. When the chaos is already there, it is surely wise to start an improvement programme. It would, however, be even wiser to start an improvement programme *before* the chaos is there. The best thing is to start improvement efforts at the time a new organisation starts its operation. In that case, we would not refer to the activities as improvement activities. Simply, we would refer to them as sound engineering and management practices.

Next best thing is to start the improvement activities when the organisation is very small with a few software engineers and with a simple management hierarchy. In the first phase, with a few employees and one or two versions of one product, the communication is easy, configuration management is easy, and everybody knows what the colleague engineer is doing. Neither the development nor management poses any bigger problems.

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<sup>1</sup> Abbreviations are listed on page 27

If the company is successful, it will grow. After a time, there will be many software engineers, one project manager does not manage them all, but there will be several project managers, specialised in different project areas, at the same time as the management hierarchy of the organisation grows. Several versions of the first software product will be there, concurrently with the introduction of new products and services, new application areas and methods adapted to a new technology - the list can be made much longer.

Somewhere on the way the things will become complicated, while the software engineers get more and more overloaded by correcting and changing the code which sometimes is neither well documented nor well structured. It is no longer easy to know what the colleague engineering is doing, it is not easy to know which compiler version was used for a particular product version to a certain customer. The management loses its oversight over the development process and now needs visible evidence for the progress of the projects. This is the situation for 2/3 of all software development companies worldwide.

## **1.2 The Problem**

In order to avoid the picture painted above, it is wise to focus on the development and management processes before that is actually needed, ideally from the start. The CMM model that exists currently is not, however, adapted to the situation in small organisations. As an example, CMM proposes more than 25 roles or groups with varying responsibilities and tasks on Level 2. In a small organisation, there is not enough people to fill all those roles. The model must be scaled down to the possibilities of the small organisations. At the same time it is important that the model is applicable continuously in the course of time when the organisation grows. It should give guidance to introduction of activities in the course of time while the organisation is growing. Otherwise, the model will cease to function after a while.

The model we describe in this paper represents the research, currently going on in the area and intending to develop and adapt CMM for small organisations [6], [7] och [8]. The model is intended to be applicable from the start of the organisation, and to be dynamic in the sense that it is useful when the company grows. We have restricted the work to Level 2. When an organisation has achieved the Level 2 maturity, it has most likely grown in size and maturity to the degree that the original CMM is applicable.

## **1.3 The Goal**

The goal of the research has been to develop an easily accessible and digestible "lazy dog", a guide to getting started and to get support in the quality work. The paper contains graphical representations of the roles, responsibilities, activities, documentation etc, and the relations between certain concepts. In Appendix A a list of all the roles included compared to the original CMM can be found, and in Appendix B the responsibilities and tasks for each of the roles are given. In order to use the model actively in an organisation, further documents are needed. The documentation has been put in Supplements. An overview of the documents required by the model are in Supplement A. A questionnaire for doing assessments is found in Supplement B. Checklists for the activities for all the key process areas are found in Supplement C. Metrics and explanations for them can be found in Supplement D.

For a detailed description of the model, the reader is referenced to [6], [7] and [8].

## 1.4 The Intended Readers

The model is intended for organisations in software development, with less than 50 employees. As employees we count all people working with development or management, excluding administrative staff. We recommend the model already from the start of an organisation, but it can also be used as a framework whenever an organisation grows in number of employees and when it seems more difficult to keep a continuous contact and communication between the affected individuals within the organisation. In short, when no longer everybody knows what the other people are doing.

## 2 A Brief Overview of CMM

The possibilities of developing quality software increase with a quality process, if the software quality aspects are built into the process. If the process can be improved, also the software will be improved but also a more precise estimation of costs and time is obtained as a side effect.

The basic idea of CMM is a continuous improvement process based on small steps which in the long run give more results than major revolutionary efforts. The model can be considered as a maturity ladder consisting of five levels, where each level above the first one corresponds to a measurable maturity in software development and management.

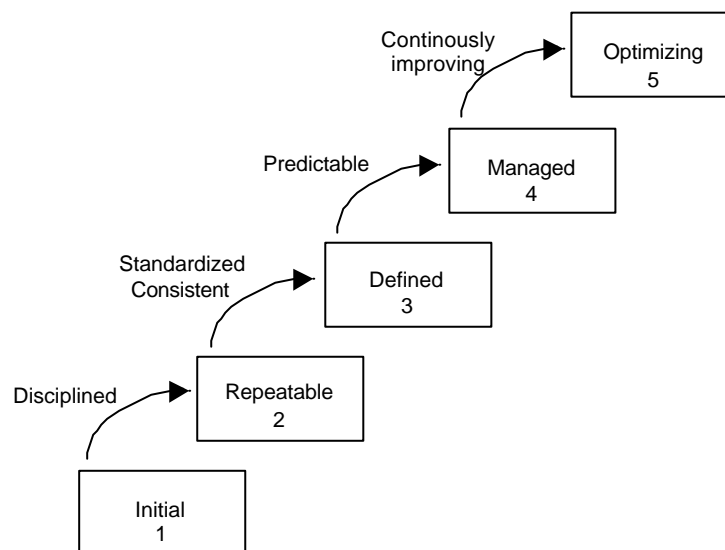


Figure 1. The Maturity Levels in CMM

**Level 1**, the initial level of the model, is characterised by ad hoc solutions. In organisations on Level 1, there are no or very few defined processes for software development. A potential success of a project is completely dependent on heroic efforts of the people involved.

**Level 2**, repeatable. There are basic project management practices in place to control the progress of the individual projects. The experiences and technology from previous projects are utilised. In that way, a successful project can be repeated. On this level, basic measurements are implemented, the first step towards predictability. Without measurement it is impossible to

discover problems arising or take actions before the problems have grown overhead and caused a crisis. Measurement data from previous projects can be used to get realistic cost and time estimates for future projects.

**Level 3**, defined. Different projects are different and the project management must take this into consideration. Though, there is a defined and standardised process in place, and the processes for the individual projects must harmonise with the organisation wide standard process. Measurement is part of the practices at Level 3.

**Level 4**, managed. Measurement data is used to control and to improve the process and the products.

**Level 5**, optimising. It is characterised by high maturity with repeated improvements based on measurable feedback from previous projects.

It is often argued that it takes approximately two years for an organisation to climb from Level 1 to Level 2, from a chaos to a repeatable level. How this is done and which problems might arise have been described in the literature [3]. Even if it seems unrealistic to fulfil the requirements and perform all the activities described in the model, the most difficult step to take is surely the first one, when a new organisation culture is introduced.

Each level contains a number of key process areas (KPA), which describe areas of priority. Each KPA contains a number of goals, commitments, abilities, activities, measurements and verifications. The activities describe what should be done to realise the KPA in question, while the other aspects ascertain that the KPA activities are institutionalised.

The main idea of CMM is that software development activities should not be conducted based on temporary solutions but follow agreed and accepted procedures. The procedures must be documented, otherwise there is a great risk that they are changed according to the individual taste of the users. CMM puts a major emphasis on documentation and a large number of documents are described or referenced in the original CMM as necessary in order to fulfil the goals. It may be difficult to get an oversight of the documents required. In our work, we have put an effort to give easy overview, and all the documents which are realistic for small organisations, are listed. Some irrelevant documents have been deleted, and those remaining are crossreferenced with responsibilities and tasks. Experiences have shown that good intentions in process improvements have disappeared because it is difficult to "see the forest because of all the trees".

### 3 Roles and Characteristics of Small Organisations

The most important reason for introducing a model for small organisations is the large number of roles proposed by CMM and the responsibilities for the roles. To define and distribute the responsibilities is most important in the model and the roles are only carriers of the responsibilities. This implies that a responsibility associated to a role can be shared by one or several persons at the same time as the persons may also possess other roles. This does not jeopardise the original intentions of CMM.

Below the roles relevant for small organisations are shortly described. For a very small organisation, some roles are not even relevant. It should be noted that there are only very few role conflicts in the sense that one and the same person should not possess them all. The relevant roles for the different sizes of small organisations, the roles which are irrelevant, and those that can be shared between persons, are discussed in Section 4.

The abbreviations of the role names are those in the table below under the role name at the left hand side. The abbreviations are those from the original CMM.

|   |   |
|---|---|
| <i>Senior Manager</i><br>SM                           | The senior manager has an overall administrative role with responsibility for all the projects in the organisation including the long term strategy for software process improvement.   |
| <i>Project Manager</i><br>PM                          | Project Manager has the total responsibility for a project. She/he controls, administrates and manages the work and has the overall responsibility for the entire system towards the customer. The software engineer group reports continuously to the project manager.   |
| <i>SoftWare Manager</i><br>SWM                        | Software Manager is responsible for the development environment and the operation of the software and hardware. She/he has the responsibility to adapt the software to the computer/software environment of the customer and/or end user.   |
| <i>Software Engineer</i><br>SE                        | Software Engineer works with development and maintenance of software, performs activities as requirements analysis, design, coding, testing and writing technical documentation.  |
| <i>System Engineer</i><br>SG                          | System engineer has the responsibility for requirements specification, to allocate requirements to hardware and software, to specify interfaces between those and to control the design to keep the consistency between the components during the whole lifecycle of the project.   |
| <i>System Test Group</i><br>STG                       | System Test Group is responsible for the system tests, while software engineers have the responsibility for the tests during the development. Validation and verification is of primary importance to obtain a high quality product.  |
| <i>Software Configuration Management Group</i><br>SCM | Configuration Management Group plans and performs the configuration management activities.  |
| <i>Software Configuration Control Board</i><br>SCCB   | Configuration Control Group leads and authorises all the changes in the baselines. The management of baseline library is reviewed and approved by this group before an action is taken. For organisations with less than 16 employees, the tasks are assigned to SCM group.   |
| <i>Software Quality Assurance Group</i><br>SQA        | Software Quality Assurance group plans and acts in quality assurance activities to assure that the software development activities and products do not deviate from the standards. It is important that the group is independent of both the management and development. SQA group reports directly to the senior manager (SM). |
| <i>Customer SQA</i><br>CSQA                           | Customer's SQA group. Relevant only for organisations with development of customer specific solutions.  |

|   |  |
|---|--|
| <i>Marketing and Sales</i><br>MS              | The Marketing and Sales role is not very much emphasised in CMM. The responsibilities and tasks are limited. There is, however, one important role: to be responsible for the documentation and to design subcontractor contracts.   |
| <i>Documentation Support Group</i><br>DSG     | For organisations with at least 16 employees, the need for documentation support should be significant. DSG is responsible for templates and tools for software documentation, and also for the documentation needed for sales and marketing. SE is responsible for the technical documentation. |
| <i>Software Subcontract Management</i><br>SSM | SSM is responsible for subcontractors for organisations with at least 16 employees. She/he is responsible for selection of qualified subcontractors and designs a subcontractor contract together with marketing and sales.  |

In Appendix A, a summary of all the roles compared to the original model can be found, and also which of the roles have been merged or omitted.

## 4 Models for Small Organisations

The small organisations have been classified in three classes, with respect to the number of employees and the number of products under development:

|                         |      |         |   |
|-------------------------|------|---------|---|
| XXS (eXtra eXtra Small) | with | 1 – 2   | employees and one product,              |
| XS (eXtra Small)        | with | 3 – 15  | employees and several products/versions |
| S (Small)               | with | 16 – 50 | employees and several products/versions |

Staff involved in development and management is included in the number of employees count, excluding administrative type of staff, e.g. secretaries.

There are two kinds of organisations:

- organisations developing products for an open market and
- organisations working with specific customer applications

There is not much from CMM point of view distinguishing the one type from the other, regarding size and application areas. Basic requirements are the same. In the case there is any difference, it will be explicitly given in the text. For the smallest organisations, some roles and their tasks will be omitted.

The model is applicable for small growing organisations. When the organisation grows, there will be new roles to be appointed and some of the existing roles do not longer imply the tasks assigned to them previously. The borderline between the models is not sharp but is flowing between the XXS, XS and S organisations. Depending on the application and competence in the organisation, the boarder can be modified and adapted to the current situation.

### 4.1 XXS Organisation (eXtra eXtra Small)

The prototype of an XXS organisation has one or two employees, a usual scenario at the start of a new company. Also, usually there is only one product at the start. When the organisation grows, the number of employees increases and also the number of products/product versions. As long as the organisation is one or two person organisation and only works with one product, it is regarded as an XXS organisation.

The roles which are realistic in the organisation can be seen from Figure 2 below. The legend shows that a link between the roles (the circles) has the semantics that one and the same person may possess the linked roles at the same time. For example, Senior Manager (SM) may very well also work as a software engineer (SE).

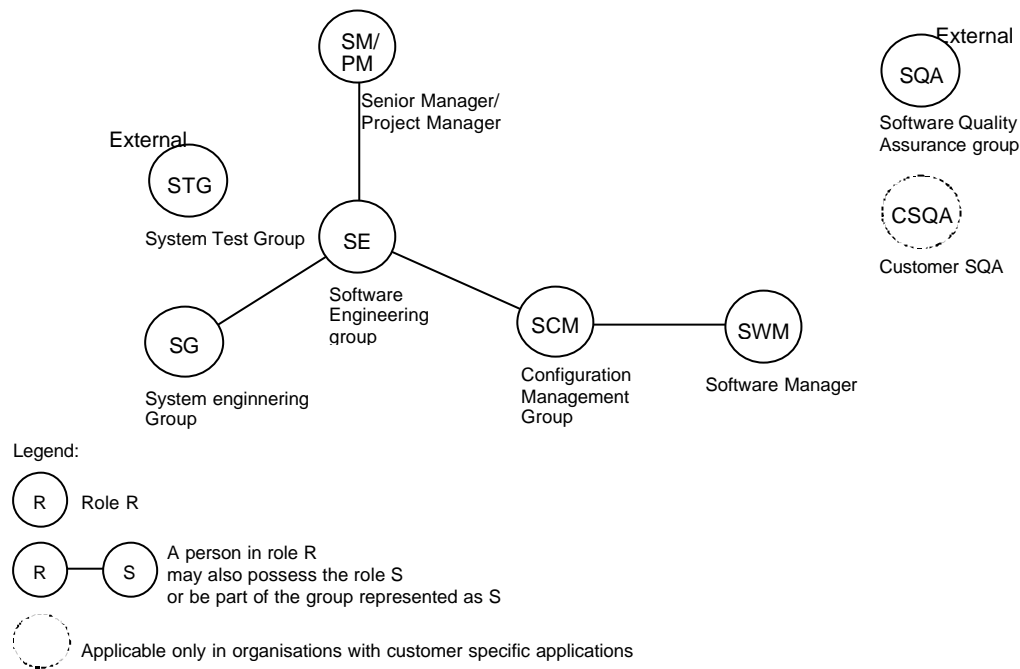


Figure 2. The Roles in an XXS Organisation

With one or two employees, there are certainly no bigger problems with insight into the other person's work, and therefore, a formal project management is not needed. However, some of the usual project management tasks as project planning and tracking cannot be neglected. Those tasks are management activities, and therefore, we have assigned the tasks to the senior manager (SM/PM). Two roles have been merged to one to point out that both roles are taken care of one and the same person.

If there is only one person in the organisation, this person is then SM/PM and SE. In a two person organisation, one may be SM/PM and also work as SE, while the other one takes the SM/PM role.

The system engineering group (SG) is responsible for the integration of hardware and other software needed for the product. The role also includes responsibility for a customer adaptation, i.e. integration into the existing environment of the customer. The role may very well be possessed by a person having SE role.

System Test Group (STG) is responsible for system tests while SE is responsible for the test during the development. STG is responsible for the validation and verification of the entire

system, which is a very important factor for assuring high quality. This requires a person who is independent from development, i.e. no SE should possess the role. This is, however, difficult in an XXS organisation. For organisations with customer specific applications, the group at the customer site responsible for acceptance tests is recommended. For other organisations, external resources are recommended to be used.

Software Manager (SWM) is responsible for the development environment, but also for the daily operation of the hardware and software in the organisation. One and the same person may have the role of SWM and SCM, the responsible for configuration management and version management. Both these roles may be combined with the SE role.

Software Quality Assurance (SQA) is not allowed to be shared with a person working in development or management. Thereby, in an XXS organisation it is unrealistic to find internal resources, both for independent revision but also for the daily quality assurance activities. Organisations with specific customer may use the software quality assurance group at the customer site, if there is one. Otherwise, external resources can be hired.

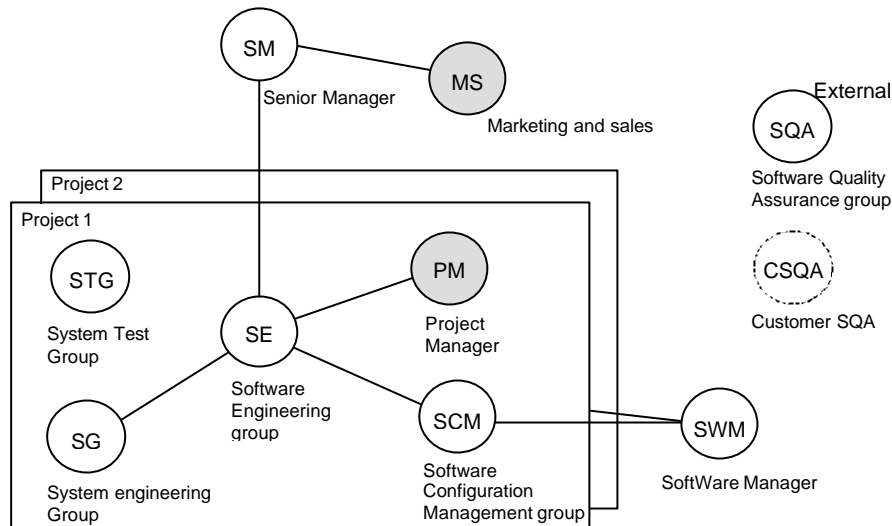
SE is responsible for program documentation. Other documentation is the responsibility of SM.

In an XXS organisation, it is unrealistic, at least from the start, to use subcontracting. The role of responsible for subcontracting (SSM) is therefore omitted. Also, the role of marketing and sales (MS) is omitted. It is not an important role in CMM, and the responsibility associated to the MS role is very limited. The role will of course become important when the product is ready for release. However, at that point of time, the company has probably grown to an XS organisation. The marketing and sales needed before that can very well be associated to the senior manager (SM) role.

## **4.2 XS Organisation (eXtra Small)**

The prototype of an XS organisation (eXtra Small) has 3 - 15 employees and only a few products under development. If the company is developing products for an open market, it is most probable that the organisation moves from XXS to XS at the same time as the first version is released, i.e. when the important and difficult work with change management and the maintenance of several successive versions starts. The life after the first product is of great strategic importance to the company. To be able to keep a successful first product on the market at the same time as new products are under way, it is very probable that recruiting new staff is necessary to be able to perform as expected.

With the new tasks there will be new roles at the same time as the old roles are changed to some extent. The roles are illustrated in Figure 3 below. The roles which have been inserted compared to XXS model are shadowed. The double frames means that several products are marketed and/or under development. Each project has the same roles, i.e. for each project there exists a project manager (PM), a system group (SG), a system test group (STG) and a configuration management group (SCM).



Legend:


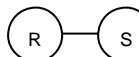


-  Role R
-  A person in role R may also possess the role S or participate in a group represented by role S
-  Light gray circle marks a new role compared to XXS organisation
-  Applicable only in organisation with specific customer applications

Figure 3. Roles in an XS Organisation

The project manager (PM) role is now of great importance. A correct project management requires a project manager and there must be a formally appointed project manager for each project. The senior manager does no longer need to share the role with the project manager, but may of course have the project manager role for some of the project(s) of the company.

Marketing and sales (MS) becomes more and more important as the organisation grows. System test group (STG), which in XXS organisation is supposed to be external service, may now be an internal role as the number of products and version increases. Naturally, external resources can be used also in the future for this task. The main thing is that the role is independent of the other roles in one and the same project.

Software Manager (SWM) who is responsible for the development environment and for adaptation to the customer environment, may also be part of the software configuration management group for one or several projects.

Software Quality Assurance (SQA) is an independent group/person, which may or may not be part of the organisation, depending on the resources. For the everyday quality assurance work it is important to have an internal resource, while for an independent revision of the quality assurance work of the organisation, the best thing is to use external services.

### 4.3 S Organisation (Small)

The prototype of an S organisation has 16 –50 employees and develops several products including several versions.

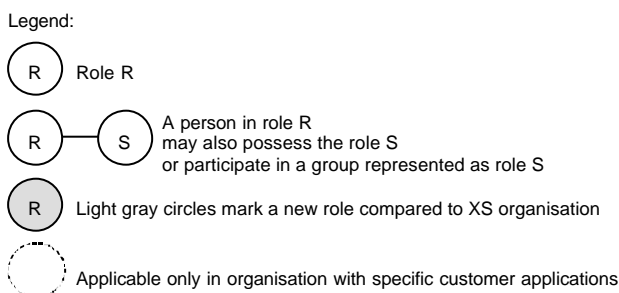
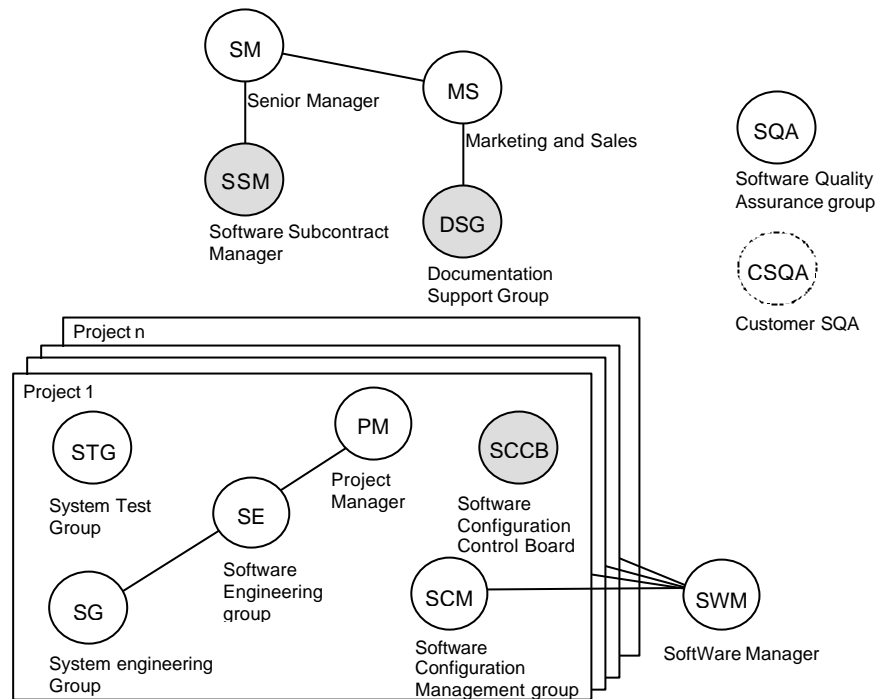


Figure 4. Roles in an S organisation

Organisations working with product development, the documentation is an important factor, especially for marketing and sales of the company products. Documentation Support Group (DSG) has as its responsibility to support all documentation within the organisation and for standards, templates etc.

There is a new role, the software subcontract manager with the key process area Software Subcontract Management (SSM).

The size of the S organisation also motivates an internal quality assurance group (SQA), which is important to keep the continuity in process improvement activities.

A software configuration control board (SCCB) should exist for each project and its tasks include to review and approve all changes in the baselines. It is also possible that one and the same SCCB-group is shared between several projects, i.e. the individuals that are members of the SCCB for one project are also members of the SCCB for another project.

## 5 Key Process Areas

All the five levels in CMM are divided into a number of key process areas. The intention is to describe each element that significantly contributes to a more efficient process improvement. Level 2 contains the key process areas (KPAs) that must first be introduced to obtain a more efficient software development process with tracking costs and functionality, basic requirements for repeating success from previous projects with similar applications.

The KPAs on Level 2 are:

- 5.1 Requirements Management, RM
- 5.2 Software Project Planning, SPP
- 5.3 Software Project Tracking and Oversight, SPTO
- 5.4 Software Subcontract Management, SSM  
(only S organisations)
- 5.5 Software Quality Assurance, SQA
- 5.6 Software Configuration Management, SCM

The goals and activities will be illustrated graphically to provide easier overview of the responsibilities and commitments and the activities which are recommended to obtain the stated goals. For detailed description, the reader is referenced to [6],[7],[8].

Below the semantics of the different symbols are given:

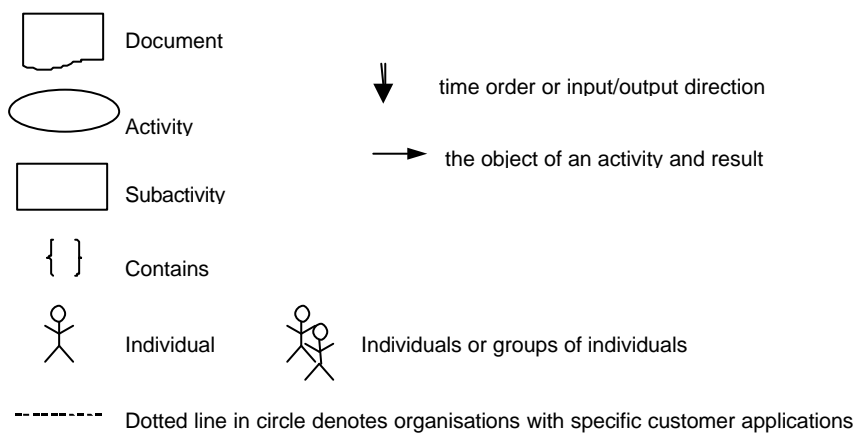


Figure 5. Semantics of the symbols

A subactivity is an activity implied by another activity, or a more precise description of what should be done. It may also be a commitment which concerns the entire KPA without explicitly belonging to an activity, e.g. to define/generate measurement data. Labels on individuals and groups denote roles according to the role list in Section 3.

Common to all the KPAs is that there

- exists a documented policy for the KPA in case,
- exist documented procedures for activities and commitments within the KPA in case,
- exist available resources and
- all involved possess satisfactory knowledge

An outline of the documentation required and of the contents of the documents can be found in Supplement A.

For the smallest organisations, some roles are omitted and the tasks are assigned to other roles. In the overview and activity diagrams all the roles are included to make the oversight simpler, but some of the roles only concern S organisations.

## 5.1 Requirements Management

The purpose of the requirements management is to achieve a common understanding between the customer and the project group for the customer requirements, which will be the basis for activities as preparation to acceptance tests, documentation and training.

**Goal 1:** *The collected requirements are controlled to be the basis for the software baseline.*

**Goal 2:** *Plans, products and activities are kept consistent with the requirement during the entire project lifecycle.*

### Requirements Management - Overview

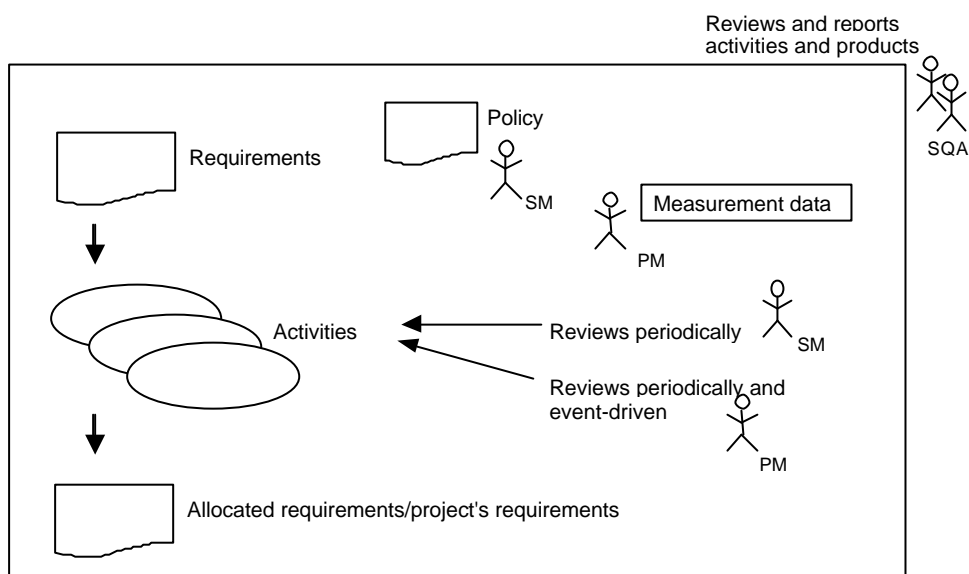


Figure 6. Requirements Management - Overview

The customer or the requirements owner may be the software engineering group, marketing and sales or another internal or external customer. The agreement, i.e. the allocated requirements, contain both technical and non-technical requirements. When the allocated requirements change, the involved project plan, statement of work and activities are changed to be consistent with the requirements. The requirements management process is reviewed by an independent SQA especially concerning

- that reviewing of the requirements has been done and possible problems have been solved before the requirements are handed over to the software engineering group,
- that project plans and activities are changed when requirements change, and
- that changes in requirements are negotiated between the affected individuals/groups.

Metrics (examples):

- status of each allocated requirement,
- change activities for the allocated requirements,
- number of changes in the allocated requirements including
  - number of proposed, approved, completed changes into the baseline.

## Requirements Management - Activities

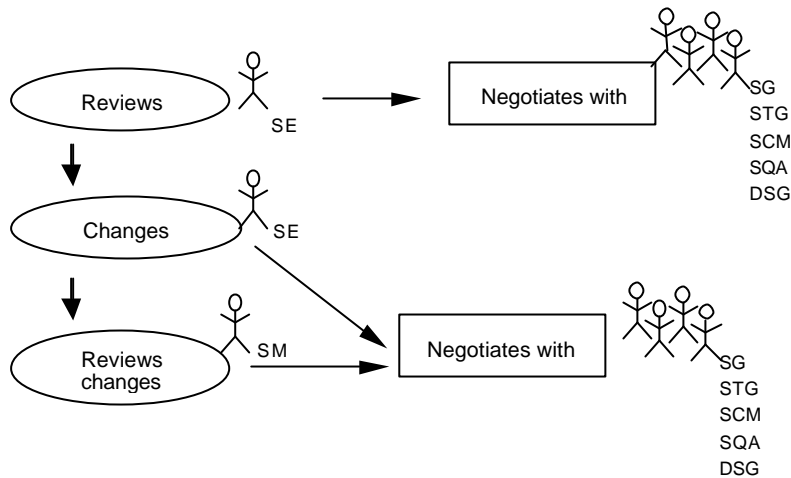


Figure 7. Requirements Management - Activities

Senior manager appoints for each project a person to be responsible for requirements management. In small organisations, the project manager usually gets the role. The responsibility implies to

- analyse the requirements and to allocate them to hardware, software and other system components,
- control and document the requirements during the entire project life cycle
- control that the changes in the requirements are analysed and allocated.

Software engineering group reviews the allocated requirements:

- incomplete requirements or missing requirements are identified,
- control concerning
  - that the requirements are realistic to implement,
  - that the requirements are stated and documented,
  - that they are mutually consistent, and
  - that they are verifiable.
- the allocated requirements which are expected to imply problems are reviewed of the responsible for the requirements management,
- commitments are negotiated between the affected groups.

The allocated and documented requirements form the basis for the project plan, work products, project activities and changes to the requirements.

## 5.2 Software Project Planning

The purpose of the software project planning is to develop reasonable plans for development and control of the software project

**Goal 1** *Estimates of resources and costs are documented to be used in planning and tracking.*

**Goal 2** *Activities and commitments are planned and documented.*

**Goal 3** *Affected groups and individuals agree to their commitments.*

### Software Project Planning - Overview

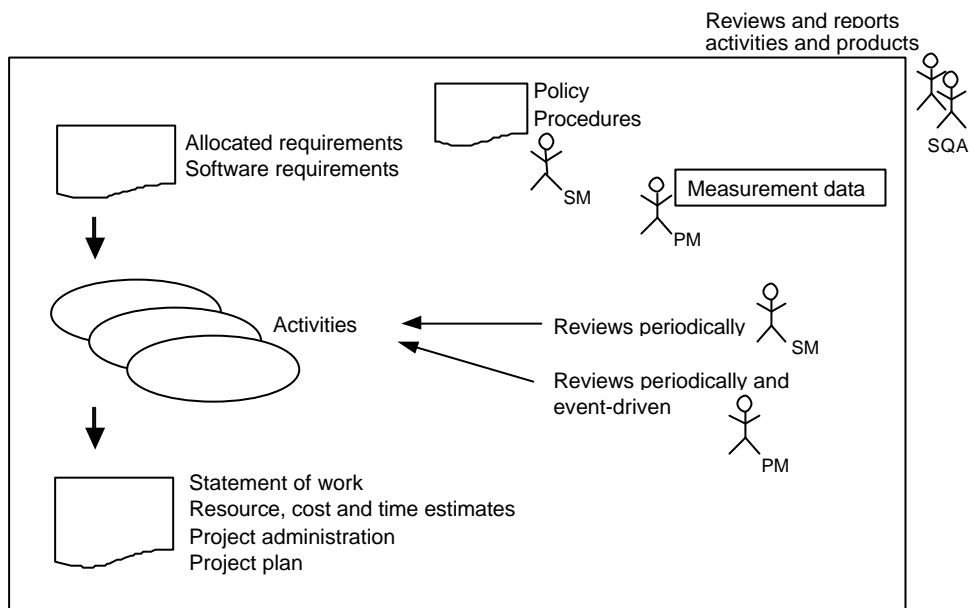


Figure 8. Software Project Planning - Overview

Senior manager appoints a project manager who then is responsible for the software project planning. Project manager coordinates the planning, divides the project into activities and working products and appoints responsible persons for those tasks. Examples of a working product are a delivery to the customer, product to be used by other groups or a product for internal use.

Resources for project planning should be available, as well as experts and development tools.

Software project planning process is reviewed by independent SQA, especially concerning:

- the activities for estimating and planning,
- the activities for reviewing and commitments,
- the activities and standards for preparation of the project plan,
- the contents of the project plan.

Metrics (examples):

- completed milestones in project planning compared to the plan
- effort and costs for planning compared to the estimates in the plan.

Software Project Planning - Activities

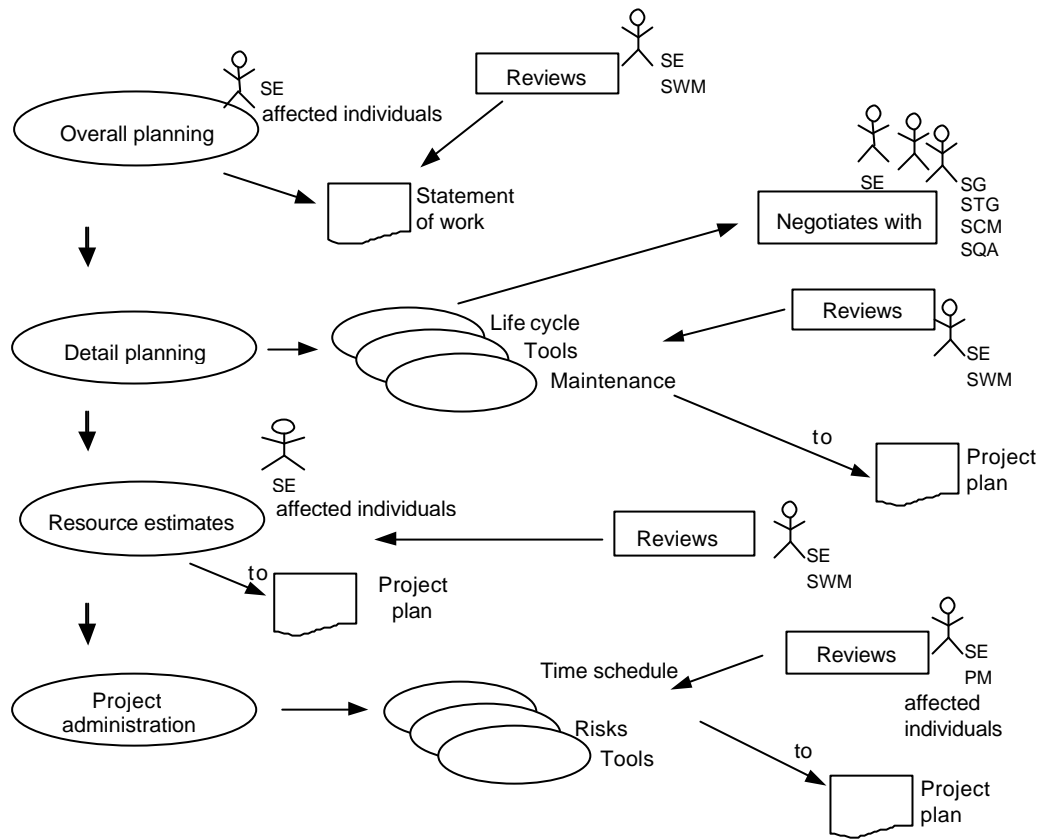


Figure 9. Software Project Planning - Activities

Statement of work and project plan are described in Supplement A, both the scope and contents.

Quality plan and configuration management plan are developed in parallel with the project plan.

The life cycle of the product is defined as a number of predefined phases of adequate size to facilitate control and maintenance. Examples of a life cycle are waterfall, overlapping waterfall, spiral, prototyping.

Procedures for resource estimation are described in Supplement A.

Commitments to external individuals or groups are reviewed by the senior manager.

### 5.3 Software Project Tracking and Oversight

The purpose of the project tracking and oversight is to give adequate visibility to the process to the management to be able to take efficient actions if a project significantly deviates from the plan.

**Goal 1** *The results are tracked against the project plan.*

**Goal 2** *Actions are taken when the results significantly deviate from the project plan.*

**Goal 3** *Changes in commitments are negotiated between the affected groups and individuals.*

#### Project Tracking - Overview

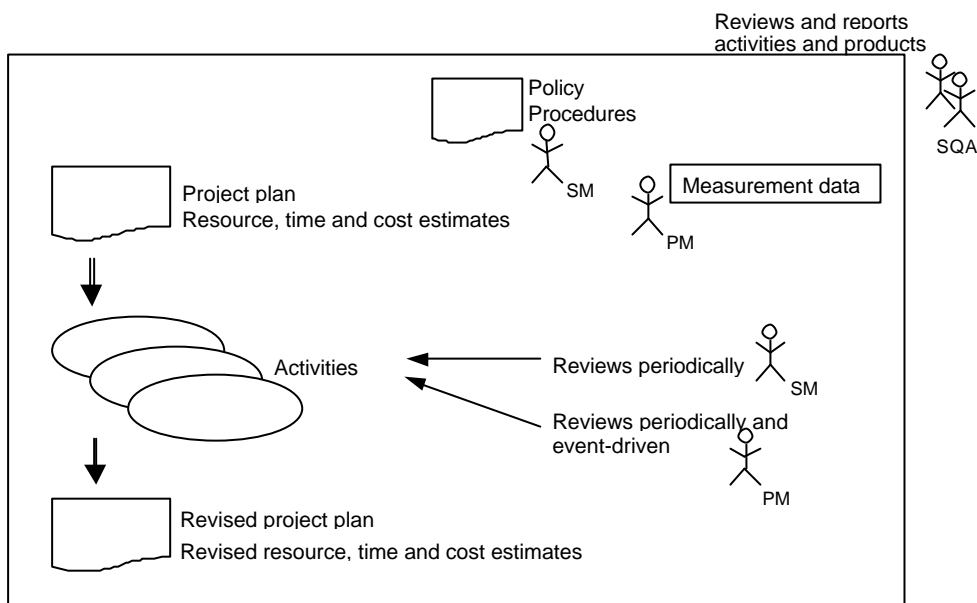


Figure 10. Project Tracking - Overview

The senior manager appoints to each project a person to be responsible for project tracking. In small organisations, it is normally the project manager. The responsibility includes:

- products and work products developed or services offered,
- effort and cost for those activities,
- time schedule and
- budget

Project tracking process is reviewed by an independent SQA especially:

- the activities concerning reviewing and revising the commitments
- activities concerning revising the project plan
- the contents of the revised project plan
- the activities concerning tracking of costs, time, risks, technical constraints, functionality and performance.

Metrics (examples):

- effort and other resources for tracking activities
- changes compared to the project plan (costs, size, resources, time).

## Project Tracking - Activities

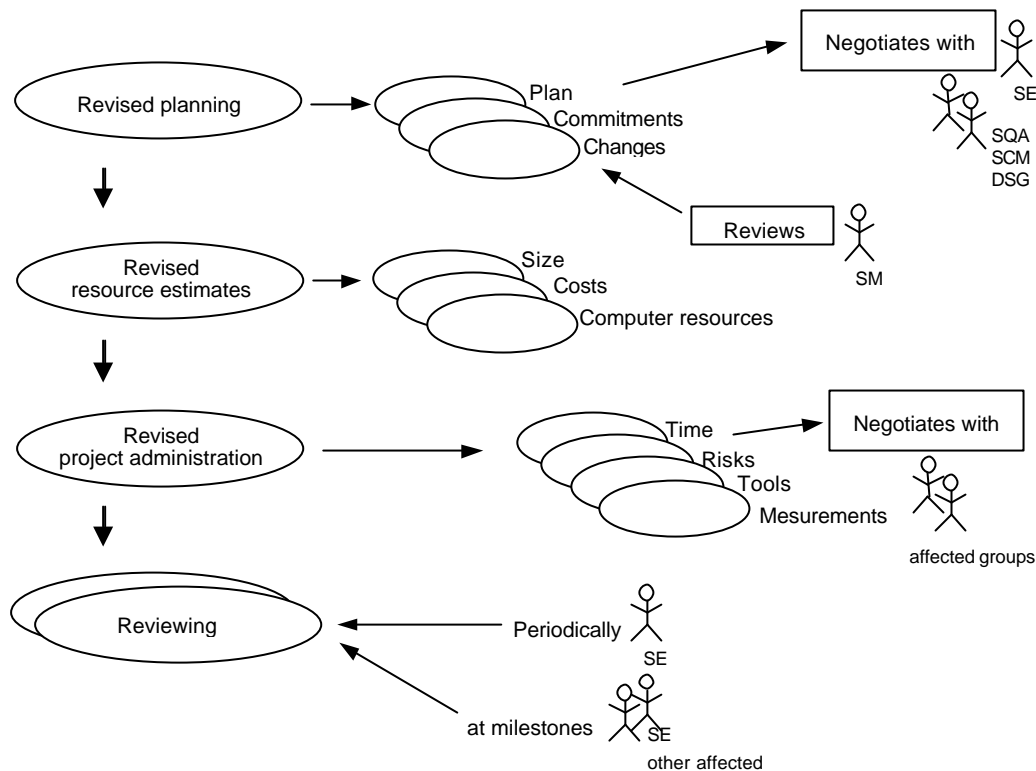


Figure 11. Project Tracking - Activities

The project plan should be available for affected groups/individuals, e.g.

- software engineers
- software manager
- project manager
- senior manager.

The project plan is revised according to a documented procedure described in Supplement A.

Time schedule is tracked and corrected concerning

- completion of activities, milestones and other commitments compared to the project plan
- judgement of the consequences of too early or too late completion on future activities and milestones.
- revised time schedule and commitments are negotiated with affected groups.

High risk areas are periodically reviewed by the senior manager.

Measurement data for the revised planning are recorded and tracked and can be used in the current and future projects. The information includes estimates and information concerning the realism of the new estimates.

A documented procedure for reviewing completed results is described in Supplement A.

## 5.4 Subcontract Management (only S organisations)

The purpose of the subcontract management is to select qualified subcontractors and to control them efficiently.

**Goal 1** *The prime contractor selects qualified subcontractors.*

**Goal 2** *The prime contractor and the subcontractor agree on their commitments.*

**Goal 3** *The prime contractor and the subcontractor maintain continuous communication.*

**Goal 4** *The prime contractor tracks the results and performance of the subcontractor against the commitments.*

### Subcontract Management - Overview

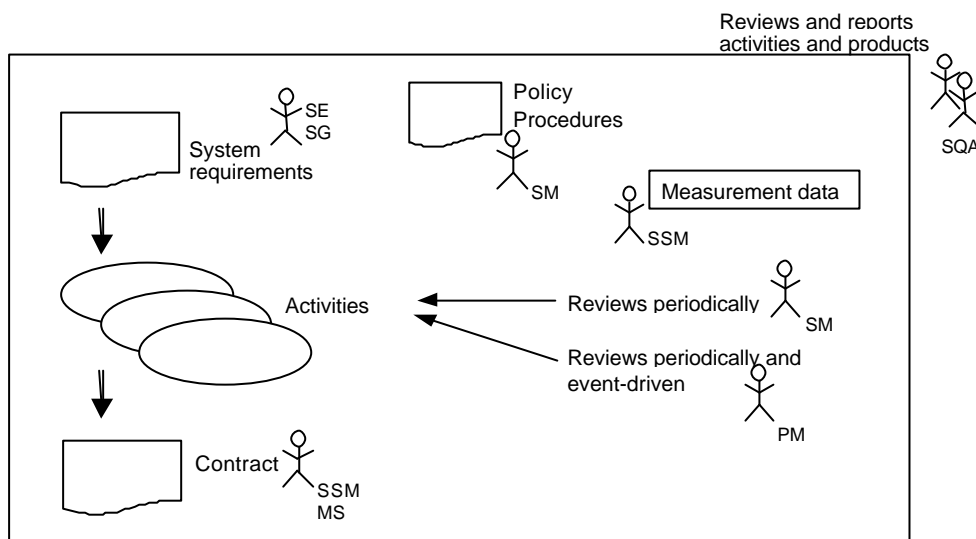


Figure 12. Subcontract Management - Overview

The project manager and other affected within the project receive orientation in the technical aspects of the contract.

The process of subcontract management is reviewed by an independent SQA especially:

- the activities for selecting a subcontractor,
- the activities for controlling the subcontractor's contract,
- the activities for coordinating the configuration management activities of the prime contractor and the subcontractor,
- reviews of the planned subcontractor reviews,
- acceptance test of the subcontractor software.

Metrics (examples):

- costs
- delivery dates
- actual delivery dates compared to the planned

## Software Subcontract Management - Activities

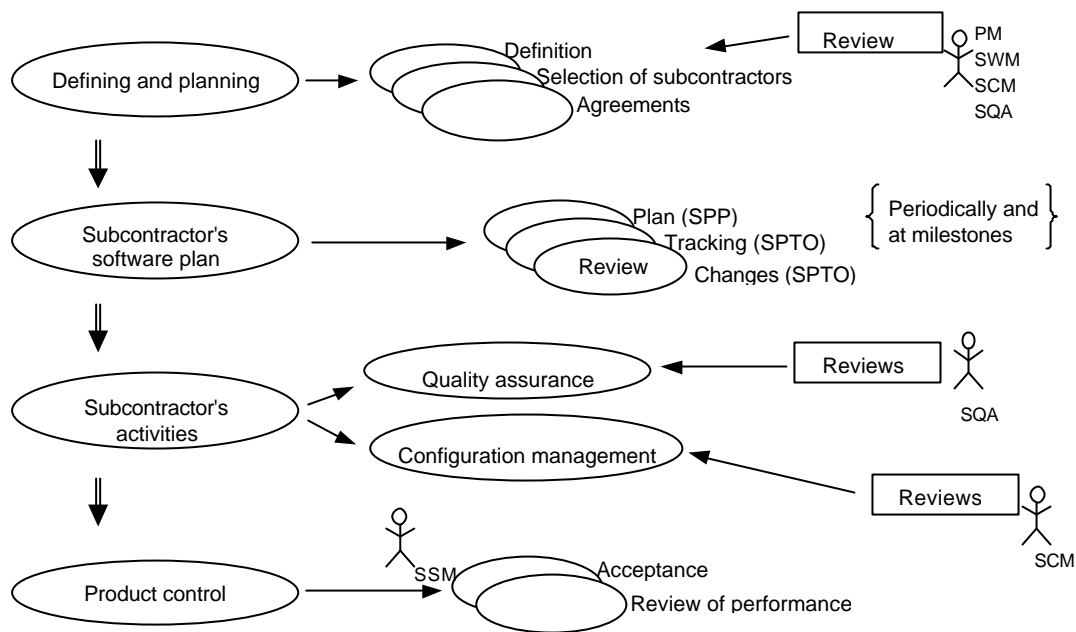


Figure 13. Software Subcontract Management - Activities

Procedures for software subcontract management are described in Supplement A, including a the contents of a contract.

Periodic reviews and communication with subcontractor:

- give the subcontractor visibility into the customer needs and wishes,
- control the technical activities of the subcontractor,
- verify that the subcontractor has interpreted and implemented the technical requirements according to the requirements definition,
- verify that all the commitments have been fulfilled,
- verify that the technical issues have been solved appropriately.

It should be noted that when doing changes of subcontractor's contractual conditions, working tasks and/or commitments, the affected groups at prime contractor and subcontractor sites should be involved.

## 5.5 Software Quality Assurance

The purpose of the software quality assurance is to give the management visibility into the development process.

**Goal 1** *SQA-activities are planned.*

**Goal 2** *Objective verification that software products and activities conform to the current standards, procedures and requirements.*

**Goal 3** *Affected groups and individuals are informed about SQA-activities and SQA-results.*

**Goal 4** *Conflicts which cannot be solved within the project group are handled by the senior manager.*

### Software Quality Assurance - Overview

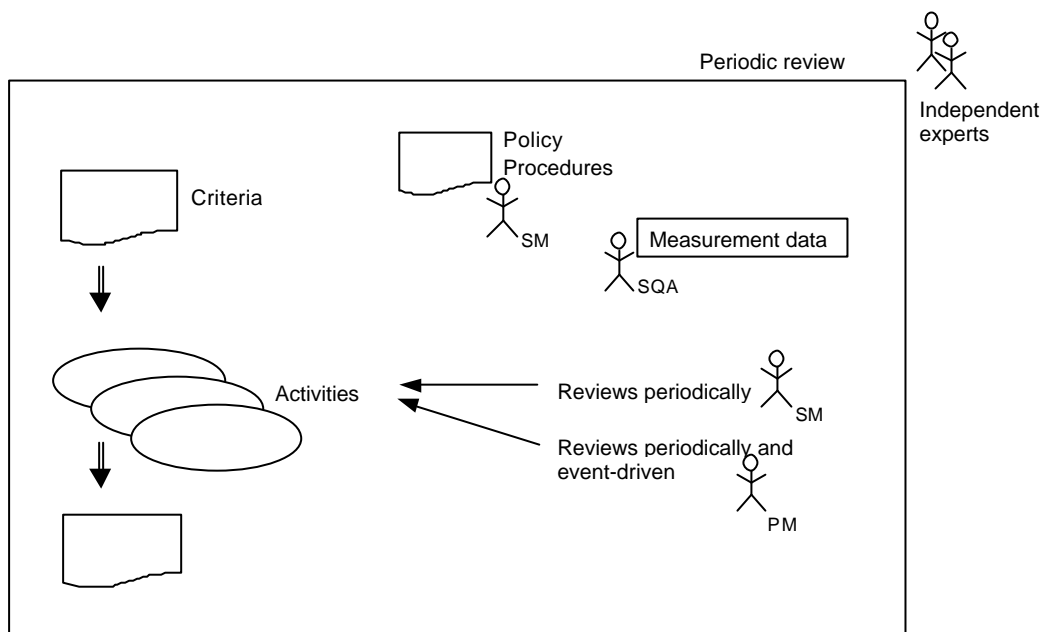


Figure 14. *Software Quality Assurance - Overview*

The members of the software engineering group should be informed about the role, responsibility and authority of the SQA group, and the reasons for quality assurance.

SQA group cooperates with the project manager in the early stage of the project to develop plans, standards and procedures so they fit in the organisation's quality assurance policy and to facilitate reviews during the whole project life cycle.

SQA group has the responsibility to assure that measurements are defined and conducted.

SQA activities are reviewed by independent quality assurance experts.

## Software Quality Assurance - Activities

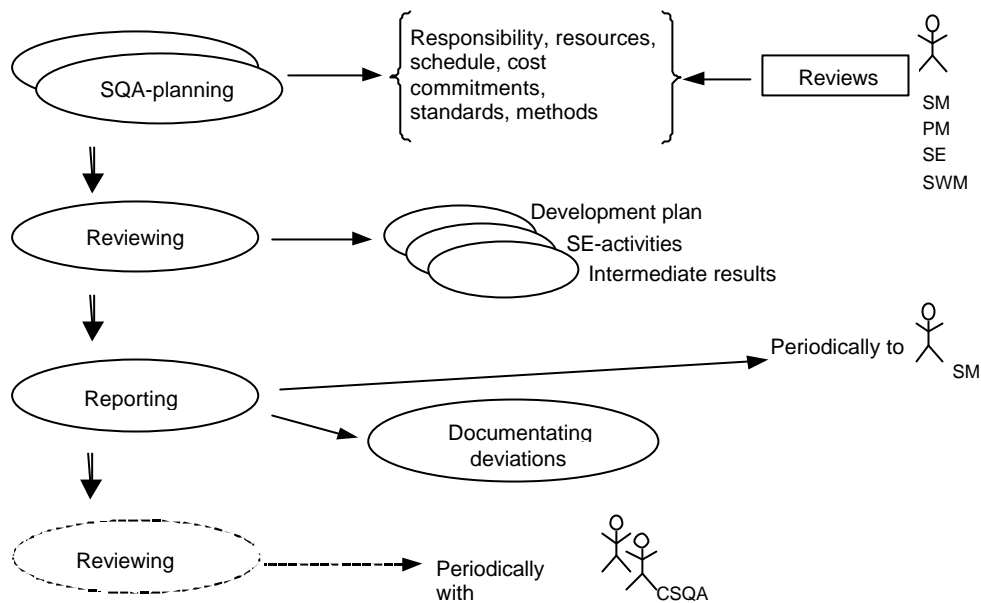


Figure 15. Software Quality Assurance - Activities

Quality assurance plan, called quality plan for short, is prepared according to a documented procedure and is initiated at an early stage, in parallel with the overall project planning. The procedure for development of a quality plan and what it should contain can be found in Supplement A.

SQA-group participates in the project proposal and reviews and controls that

- the plan conforms to the organisational policy,
- the plan conforms to the standards and requirements,
- adequate standards are used in the project,
- main purpose of the project is visible from the plan.

SQA-group reviews development activities especially

- that the activities are performed according to the project plan and to the standards and procedures,
- that deviations are identified, documented and tracked to closure,
- that corrections are verified.

SQA-group reviews development activities and verifies the conformance to project plan. SQA-group also reviews work results and verifies the conformance to standards and contractual requirements before delivery to the customer.

Deviations are documented and documentation is controlled.

## 5.6 Software Configuration Management

The purpose of the configuration management is to initiate and maintain integrity through the whole project life cycle.

**Goal 1** *SCM-activities are planned.*

**Goal 2** *Selected work results are identified, controlled and made available.*

**Goal 3** *Changes to working results are controlled.*

**Goal 4** *Affected groups and individuals are informed about the status and contents of baselines.*

### Software Configuration Management - Overview

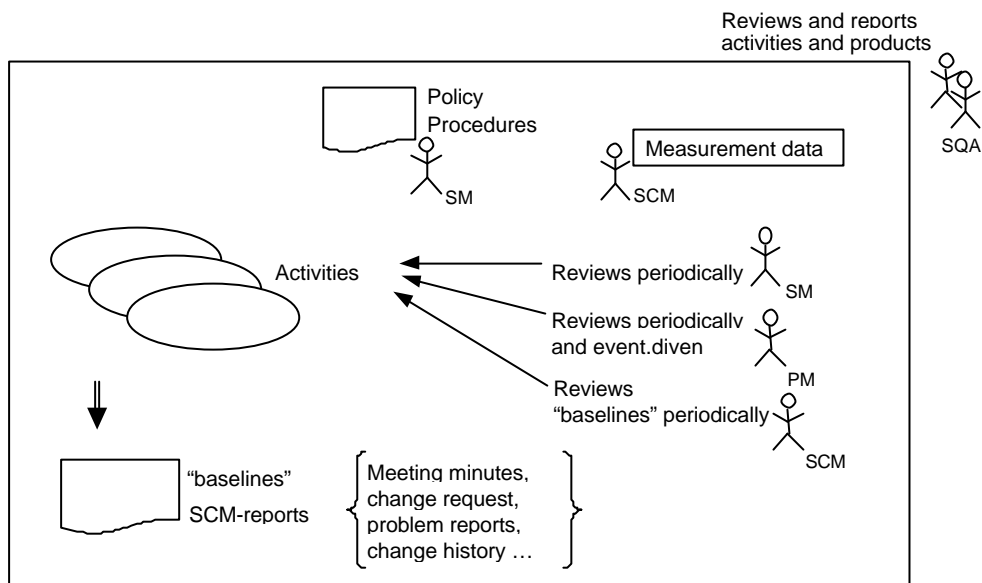


Figure 16. *Software Configuration Management - Overview*

A software configuration management group (SCM-group) and Software Configuration Control Board (SCCB) are assigned to every project. In organisations with less than 16 employees, i.e. in XXS and XS, the groups coincide. SCCB-group has the following tasks:

- to authorise the establishment of baselines and to identify configuration items,
- to represent the interest of the project manager and all groups affected by changes in baselines
- to review and authorise changes to baselines,
- to authorise products created from baseline library.

SCM-group has the responsibility to coordinate and implement SCM for a project including the following tasks:

- to create and manage the baseline library
- to develop, maintain and distribute SCM plans, standards and procedures,
- to identify the work products to put under configuration control,
- to manage the access to the library, and to update the library,
- to create products from baseline library,
- to record SCM activities, and to produce and distribute SCM reports.

## Software Configuration Management - Activities

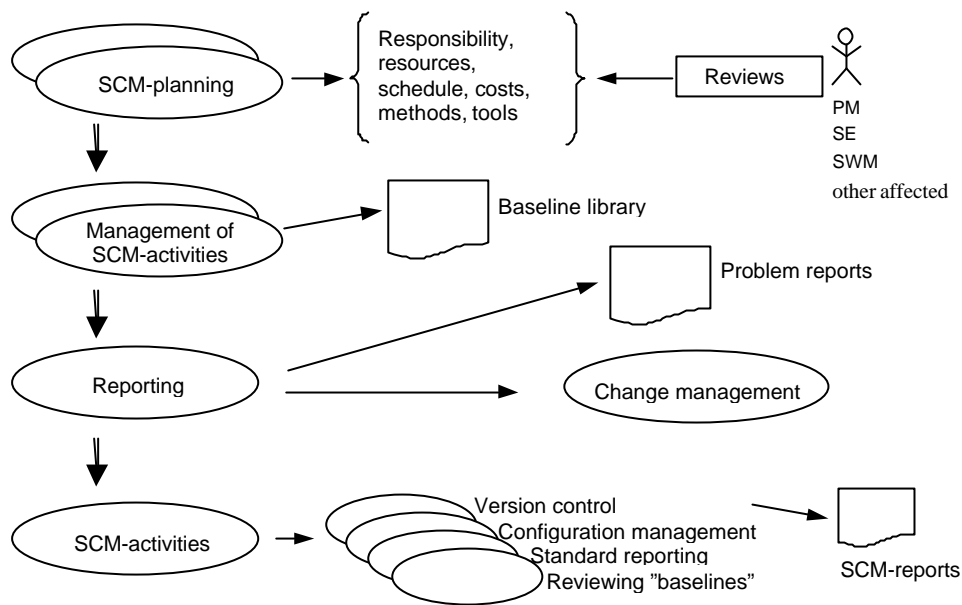


Figure 17. Software Configuration Management - Activities

Planning of configuration management means identifying configuration items. Configuration items are normally decomposed into configuration components, which in turn are decomposed into smaller units. The borderline between items, components and smaller units is context dependent.

A configuration plan is developed early, in parallel with the overall project planning. The procedures for developing configuration plan and a description of its contents can be found in Supplement A.

Training in SCM activities is offered to the members of SE-group and other affected groups, e.g. SQA group and documentation support group (DSG).

Procedures for SCM activities can be found in Supplement A.

## 6 First Steps in Implementation of CMM in a Small Organisation

To implement CMM in an organisation might seem a difficult task. As any other new task, it requires another way of thinking and other things to be done than before. But with the right employee attitude and with a good guidance it is possible quite soon to notice a significant process improvement, that in the end gives a better quality of the end product and at the same time, better precision in time and budget planning.

The model we have described here is dynamic in the sense that it can be applied from the start of a company, after the start and until the company has less than 50 employees. Nothing prevents the use or implementation of the model while the company is growing.

To support the implementation, we give some guidance proven to be of some help.

1. The senior manager is supposed to initiate the process improvement process, alternatively to implement the model in the development process already from the start of the company.

All people working in the project must participate and contribute actively to the improvement process. A group of individuals SEPG (Software Engineering Process Group) should be appointed. The tasks of SEPG are to coordinate the activities, develop and document procedures for the project work. The main responsibility is by the senior management, to control the quality work and commit the necessary resources.

It is important to choose the right person(s) to SEPG. Competent and skilled software engineers have a tendency to forget that they share the responsibility for the entire development process.

The model implementation must start in a project. To first develop procedures and policies and then to apply them to a project does seldom work, but must grow in a project and everybody working in the project must understand the importance of good procedures.

2. The next step is to choose the model adequate for the current size of the organisation

The different types of companies, XXS, XS and S have in the model been divided according to the number of employees and the number of products under development. The entry point into the model can be seen in Table 1 below. If the company has more than 50 employees, the original CMM can be used.

|                                 | 1-2 employees | 3-15 employees | >15 employees |
|---------------------------------|---------------|----------------|---------------|
| 1 product/version/project       | XXS           | XS             | S             |
| 2-5 products /versions/projects | -             | XS             | S             |
| >6 products/versions/projects   | -             | S              | S             |

*Table 1 Entry points to CMM for small organisations*

The alternatives with "-" are considered unusual, although not completely unrealistic. An organisation with 2-5 products and 1-2 employees might have a possibility to stay on the market with the support of a number of subcontractors. It is however an exception rather than a rule. An organisation grows usually with the number of products.

Within each model the company can grow up to the model limits. When the number of employees or products/product versions overrides the limit, the next higher model can be

entered. The roles introduced in each shift can be seen from Figure 3 and Figure 4 as shadowed circles. Next step is to choose a KPA.

### 3. Which KPA to start with?

It is not realistic to introduce all the KPAs at once. The basic idea of CMM is a continuous process improvement based on small steps which in the long run give better effect than big revolutionary efforts. To introduce an improvement process in some other way than stepwise implementation of KPAs is deemed to fail. We cannot give any recommendation of which KPA is best to start with, and which would be the next. It varies from a company to another. But it is fair to say that without any defined processes but chaos and temporary solutions it is meaningless to start with SQA. SQA is intended to assure that the activities are implemented according to a certain pattern and that the results agree with the requirements. Without requirements and certain patterns there is nothing to assure. Before SQA is meaningful most of the KPAs should be introduced.

It is difficult to give a general order of the KPAs to implement except that SPTO should become after SPP, and that version management and problem reporting are important in each company as soon as there is more than one version. Requirements Management does not only result in a requirements specification, but it also serves to keep the requirements specification consistent with the working products during the whole project life cycle. It is equally important as project planning, tracking and version management. But if RM should be implemented before SPP is dependent on the current situation. SQA might come last or at least after some other KPA. If there are subcontractors, SSM is relevant but hardly more important than RM, SPP and SPTO.

## 7 Documentation

CMM recommends a large number of documents. In principle everything that occurs in a project is documented. There are different types of documents, e.g. plans and documents describing procedures. It may seem impossible or at least hard in a small company to produce, disseminate, maintain and archive such a large number of documents. In this model we have taken that into consideration and made some simplifications without affecting the original intentions of CMM. Much of the things to be documented can be put in one and the same document. It increases visibility and supports maintenance.

In Supplement A a collection of all documents on Level 2 is available. Some of them describe procedures to be followed in the different KPAs, some of them are company policies for the KPAs. In Supplement A the contents are also described and it can therefore be used as a guidance to adapt the documentation to the company and the process. All those documents can be put into one document, a manual for the company software process.

In Supplement A also the contents of a number of other documents are described. Those can be helpful when documenting e.g. allocated requirements, project plan, subcontractor contract, quality plan, configuration management plan, and other standard reports.

## 8 Measurements

Each KPA includes a common feature Measurement and Analysis, with some examples of what can be measured. Measurement on Level 2 concerns the status of the KPA activities, and is intended to give visibility into how well the activities conform to the standards. One example in RM is the number of changes to the allocated requirements. Thru time, to get an understanding

whether the number of changes is extremely large in relation to the average or normal, that is visible from the measurement data, and the causes to the situation can be studied. Possible reasons could be the customer, the current development situation, or that the company is getting worse to acquire the requirements from the beginning for some reason.

Measurements on Level 2 is simple, and easy to conduct. To use the measurement data as a control vehicle for the development and management activities is not required on Level 2. Measurement is the necessary requirements for analysing and taking actions based on it. Measurement as control vehicle is required not until Level 4.

Supplement D describes measurement more in detail.

## 9 Abbreviations

|      |  |
|------|--|
| CMM  | Capability Maturity Model                            |
| CSQA | Customer Software Quality Assurance (*) <sup>2</sup> |
| DSG  | Documentation Support Group (*)                      |
| KPA  | Key Process Area                                     |
| MS   | Marketing and Sales (*)                              |
| PM   | Project Manager (*)                                  |
| RM   | Requirements Management                              |
| S    | Small enterprise                                     |
| SCCB | Software Configuration Control Board (*)             |
| SCM  | Software Configuration Management group (*)          |
| SE   | Software Engineer (*)                                |
| SEPG | Software Engineering Process Group                   |
| SM   | Senior Manager (*)                                   |
| SPP  | Software Project Planning                            |
| SPTO | Software Project Tracking and Oversight              |
| SWM  | SoftWare Manager (*)                                 |
| SQA  | Software Quality Assurance                           |
| SSM  | Software Subcontract Management                      |
| SG   | System engineering Group (*)                         |
| STG  | Software Test Group (*)                              |
| XS   | eXtra Small enterprise                               |
| XXS  | eXtra eXtra Small enterprise                         |

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<sup>2</sup> Abbreviations with (\*) concern roles.

## 10 References

- [1] Paulk, M. C. et al: The Capability Maturity Model – Guidelines for Improving the Software Process. Addison-Wesley, 1995
- [2] Grady, R. B., Practical Software Metrics for Project Management and Process Improvement. Prentice Hall, 1992
- [3] Caputo, K., Implementation Guide – Choreographing Software Process Improvement. Addison-Wesley, 1998
- [4] Zahran, S., Software Process Improvement. Practical Guidelines for Business Success, Addison-Wesley, 1997
- [5] Van Solingen R., Berghout E., The Goal/Question/metric Method. A Practical Guide for Quality Improvement of Software Development. McGraw Hill, 1999
- [6] Terttu Orci, Capability Maturity Model for Extra Extra Small Organizations, Level 2, 2000, UMINF 00.12
- [7] Terttu Orci, Capability Maturity Model for Extra Small Organizations, Level 2, 2000, UMINF 00.13
- [8] Terttu Orci, Capability Maturity Model for Small Organizations, Level 2, 2000, UMINF 00.14
- [9] <http://www.sei.cmu.edu/cmm/cmms/cmms.html>

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| Original role ref. [1]  | short <sup>3</sup><br>name | Corresponds to in <sup>4</sup> |                |                |
|---|----------------------------|--------------------------------|----------------|----------------|
|   |                            | XXS                            | XS             | S              |
| Contract management group   |                            | SM                             | MS             | MS             |
| Customer SQA representative   | CSQA                       | CSQA                           | CSQA           | CSQA           |
| Document Support Group  | DSG                        | SE                             | SE             | DSG            |
| First line software managers  |                            | --                             | --             | --             |
| Group responsible for analysing and allocating system requirements                                  |                            | SG                             | SG             | SG             |
| Hardware engineering group  |                            | SG                             | SG             | SG             |
| Individuals who have experience and expertise in the application domain and in software engineering |                            | other affected                 | other affected | other affected |
| Manager   |                            | SM                             | SM             | SM             |
| Managers in SQA reporting chain   |                            | SM                             | SM             | SM             |
| Marketing and Sales   | MS                         | SM                             | MS             | MS             |
| Other individuals   |                            | other affected                 | other affected | other affected |
| Other affected groups   |                            | other affected                 | other affected | other affected |
| Prime contractor's management   |                            | --                             | --             | SSM            |
| Project Manager   | PM                         | PM                             | PM             | PM             |
| Project software manager  |                            | PM                             | PM             | PM             |
| Senior Manager  | SM                         | SM                             | SM             | SM             |
| Software Configuration Control Board  | SCCB                       | SCM                            | SCM            | SCCB           |
| Software Configuration Management group   | SCM                        | SCM                            | SCM            | SCM            |
| Software Configuration Management Manager   |                            |                                |                |                |
| Software Engineering group  | SE                         | SE                             | SE             | SE             |
| Software estimating group   |                            | PM                             | PM             | PM             |
| SoftWare Manager  | SWM                        | SWM                            | SWM            | SWM            |
| Software Quality Assurance group  | SQA                        | SQA                            | SQA            | SQA            |
| Software quality assurance manager  |                            |                                |                |                |
| Software task leaders   |                            | PM                             | PM             | PM             |
| Software Subcontract Manager  | SSM                        | --                             | --             | SSM            |
| System engineering Group  | SG                         | SG                             | SG             | SG             |
| System Test Group   | STG                        | STG                            | STG            | STG            |

<sup>3</sup> Abbreviations used in this report

<sup>4</sup> -- means "not relevant"

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| Role                | Responsibility/Task   | Source <sup>5</sup>   |
|---------------------|---|---|
| Senior Manager (SM) | <p>Is responsible for a documented policy for</p> <ul style="list-style-type: none"> <li>- requirements management</li> <li>- project planning</li> <li>- project tracking</li> <li>- <i>subcontract management</i><sup>6</sup></li> <li>- quality assurance</li> <li>- configuration management</li> </ul> <p>Appoints a person responsible for</p> <ul style="list-style-type: none"> <li>- requirements management (PM)</li> <li>- project; planning/tracking (PM)</li> <li>- <i>subcontractor management (SSM)</i></li> <li>- quality assurance (SQA)</li> <li>- configuration control board (SCCB)</li> <li>- configuration management (SCM)</li> </ul> <p>Is responsible for the necessary resources and funding for</p> <ul style="list-style-type: none"> <li>- requirements management</li> <li>- project planning</li> <li>- project tracking</li> <li>- <i>subcontractor management</i></li> <li>- quality assurance</li> <li>- configuration management</li> </ul> <p>Is responsible for the necessary knowledge is available for</p> <ul style="list-style-type: none"> <li>- requirements management</li> <li>- project planning responsible (PM)</li> <li>- project manager to manage technical and personnel issues in projects</li> <li>- <i>all those working in management of subcontractors</i></li> <li>- quality assurance activities</li> <li>- configuration management concerning goals, methods/tools for those activities</li> <li>- those affected from configuration management</li> </ul> <p>Reviews periodically</p> <ul style="list-style-type: none"> <li>- requirements management activities</li> <li>- project planning activities</li> <li>- project tracking activities</li> <li>- <i>activities for subcontractor management</i></li> <li>- quality assurance activities</li> <li>- configuration management activities</li> </ul> | <p>RM/C.1<br/>SPP/C.2<br/>SPTO/C.2<br/><i>SSM/C.1</i><br/>SQA/C.1<br/>SCM/C.1</p> <p>RM/AB.1<br/>SPP/C.1,SPTO/C.1<br/><i>SSM/C.1</i><br/>SQA/AB.1<br/>SCM/AB.1<br/>SCM/AB.2</p> <p>RM/AB.3<br/>SPP/AB.3<br/>SPTO/AB.3<br/><i>SSM/C.1</i><br/>SQA/AB.2<br/>SCM/AB.3</p> <p>RM/AB.3<br/>SPP/AB.4<br/>SPTO/AB.4</p> <p><i>SSM/AB.2</i><br/>SQA/AB.3<br/>SCM/AB.3</p> <p>SCM/AB.4</p> <p>RM/V.1<br/>SPP/V.1<br/>SPTO/V.1<br/><i>SSM/V.1</i><br/>SQA/V.1<br/>SCM/V.1</p> |

<sup>5</sup> Refers to CMM terminology Ref [1]: KPA/subtitle.number with  
 RM for requirements management, G for Goal,  
 SPP for project planning, C for Commitment,  
 SPTO for project tracking, AB for Ability,  
 SSM for subcontract management, AC for Activity,  
 SQA for quality assurance, M for Measurement,  
 SCM for configuration management, V for Verification

<sup>6</sup> Text in italics refers to KPA only applicable to S-organisations.

|                              |   |  |
|------------------------------|---|--|
| <p>Senior Manager (cont)</p> | <p>Reviews changes in commitments to external individuals/groups concerning</p> <ul style="list-style-type: none"> <li>- project planning</li> <li>- project tracking</li> </ul> <p>Is responsible for quality assurance, that</p> <ul style="list-style-type: none"> <li>- affected groups and individuals are oriented in SQA group role, responsibility and authority</li> <li>- review SQA-plan</li> <li>- solve possible unsolved problems as consequence of disagreement within SQA group</li> <li>- that independent experts periodically review SQA activities and results</li> <li>- be responsible for that company policy for SQA is followed (concerns XXS-company with external SQA)</li> </ul>  | <p>SPP/C.2<br/>SPTO/C.2</p> <p>SQA/G.3</p> <p>SQA/AC.1<br/>SQA/G.4</p> <p>SQA/V.3</p> <p>SQA/C.1</p>   |
| <p>Project Manager (PM)</p>  | <p>Is responsible for requirements management:</p> <ul style="list-style-type: none"> <li>- that the company policy is followed,</li> <li>- review the allocated requirements,</li> <li>- that the requirements are documented,</li> <li>- negotiate with affected individuals,</li> <li>- implement version management of the requirements,</li> <li>- that changes are reviewed and documented,</li> <li>- negotiate with affected groups about changes in commitments,</li> <li>- that measurements are defined and implemented.</li> </ul> <p>Is responsible for that project follows the company policy for</p> <ul style="list-style-type: none"> <li>- project planning,</li> <li>- project tracking,</li> <li>- quality assurance,</li> <li>- configuration management.</li> </ul> <p>Is responsible for documented and approved</p> <ul style="list-style-type: none"> <li>- project plan,</li> <li>- statement of work.</li> </ul> <p>Is responsible for evaluation and documentation of</p> <ul style="list-style-type: none"> <li>- resource estimates, time schedules, risks.</li> </ul> <p>Is responsible for</p> <ul style="list-style-type: none"> <li>- planning tools</li> <li>- recording planning data (configuration management)</li> <li>- intermediate results, products/tools<br/>(development, effort, cost, time schedule, budget)</li> <li>- that project plan is available for affected individuals</li> <li>- revising project plan</li> <li>- revising resources and commitments</li> <li>- revising risk analysis</li> </ul> <p>Negotiate with the affected groups and individuals about</p> <ul style="list-style-type: none"> <li>- commitments and development of the project plan</li> <li>- changes in commitments, resource estimates and time schedule</li> </ul> | <p>RM/C.1<br/>RM/C.1<br/>RM/AB.2<br/>RM/AC.1<br/>RM/AC.2<br/>RM/AC.3<br/>RM/AC.3</p> <p>RM/M.1</p> <p>SPP/C.2<br/>SPTO/C.2<br/>SQA/C.1<br/>SCM/C.1</p> <p>SPP/AC.7<br/>SPP/AB.1</p> <p>SPP/AC.9-13</p> <p>SPP/AC.14<br/>SPP/AC.15<br/>SPTO/AB.2</p> <p>SPTO/AC.1<br/>SPTO/AC.2<br/>SPTO/AC.5-8<br/>SPTO/AC.10</p> <p>SPP/C.1<br/>SPTO/AC.4<br/>SPTO/AC.5-8</p> |

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| <p>Project Manager (cont)</p>                      | <p>Reviews</p> <ul style="list-style-type: none"> <li>- statement of work</li> <li>- project plan</li> <li>- project tracking</li> <li>- regularly areas of high risk</li> <li>- periodically development against the plan</li> <li>- quality plan</li> <li>- configuration management plan</li> </ul> <p><i>Reviews</i></p> <ul style="list-style-type: none"> <li>- <i>specification of subcontract</i></li> <li>- <i>subcontract</i></li> </ul> <p>Is responsible for SQA group participation in project planning</p> <p>Is responsible for that measurements are defined and implemented for</p> <ul style="list-style-type: none"> <li>- project planning (SPP),</li> <li>- project tracking (SPTO).</li> </ul> <p>Participates in reviews, periodically and event driven basis of</p> <ul style="list-style-type: none"> <li>- requirement management activities</li> <li>- project planning activities</li> <li>- project tracking activities</li> <li>- <i>activities for management of subcontractors</i></li> <li>- quality assurance activities</li> <li>- configuration management activities</li> </ul> | <p>SPP/AB.1<br/>SPP/AC.6<br/>SPTO/AC.12<br/>SPTO/AC.10<br/>SPTO/AC.12<br/>SQA/AC.1<br/>SCM/AC.1</p> <p><i>SSM/AC.1</i><br/><i>SSM/AC.</i></p> <p>SQA/AC.3</p> <p>SPP/M.1<br/>SPTO/M.1</p> <p>RM/V.2<br/>SPP/V.2<br/>SPTO/V.2<br/><i>SSM/V.2</i><br/>SQA/V.2<br/>SCM/V.2</p> |
| <p>SoftWare Manager (SWM)</p>                      | <p>Is responsible for development environment, both hardware and software</p> <p>Reviews statement of work</p> <p>Reviews</p> <ul style="list-style-type: none"> <li>- project plan</li> <li>- resource estimates</li> <li>- quality plan</li> <li>- configuration management plan</li> <li>- periodically development against the plan</li> </ul> <p><i>Reviews specification of subcontractor contract</i></p> <p>Reviews subcontractor contract</p>   | <p>SPP/AB.1</p> <p>SPP/AC.6<br/>SPP/C.2<br/>SQA/AC.1<br/>SCM/AC.1<br/>SPTO/AC.12</p> <p><i>SSM/AC.1</i></p> <p>SSM/AB.1</p>   |
| <p>Software Configuration Control Board (SCCB)</p> | <p>Approves baselines and identifies configuration items</p> <p>Represents the interests of the project manager and groups affected by changes in baselines</p> <p>Reviews and approves changes in baselines,</p> <p>Authorises products created from baseline library</p>   | <p>SCM/AB.1</p> <p>SCM/AB.1</p> <p>SCM/AB.1</p> <p>SCM/AB.1</p>   |

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| <p>Software Configuration Management (SCM)</p> | <p>Is responsible for that company policy for configuration management is followed</p> <p>Participates in negotiations concerning</p> <ul style="list-style-type: none"> <li>- commitments as consequence of allocated requirements</li> <li>- changes in commitments</li> </ul> <p>Reviews statement of work</p> <p>Reviews resource estimates, time schedules, commitments</p> <p>Appoints a responsible person for configuration management in a project</p> <p>Develops a plan for configuration management activities</p> <p>Identifies configuration items</p> <p>Creates and maintains</p> <ul style="list-style-type: none"> <li>- baseline library</li> <li>- database for problem reports</li> <li>- database for SCM-reports and protocols</li> </ul> <p>Controls baseline version management</p> <p>Is responsible for documentation of SCM-standard reports</p> <p>Informs affected individuals about changes and status of baseline</p> <p>Revises baselines periodically concerning conformance with the documented baseline</p> <p><i>Reviews subcontracts according to a documented procedure</i></p> <ul style="list-style-type: none"> <li>- <i>specification</i></li> <li>- <i>subcontractor's configuration management</i></li> </ul> <p>Is responsible for measurement definition and implementation in SCM</p> | <p>SCM/C.1</p> <p>RM/AC.1</p> <p>RM/AC.3</p> <p>SPP/AB.1</p> <p>SPP/C.2</p> <p>SCM/C.1</p> <p>SCM/AC.1</p> <p>SCM/AC.4</p> <p>SCM/AC.3</p> <p>SCM/AC.5</p> <p>SCM/AC.8</p> <p>SCM/AC.7</p> <p>SCM/AC.9</p> <p>SCM/G.4</p> <p>SCM/V.3</p> <p><i>SSM/AC.1</i></p> <p><i>SSM/AC.11</i></p> <p>SCM/M.1</p> |
| <p>Software Engineer (SE)</p>                  | <p>Reviews allocated requirements</p> <p>Participates in negotiations and review</p> <ul style="list-style-type: none"> <li>- proposed project commitments</li> <li>- overall project planning</li> </ul> <p>Reviews resource estimates, time schedule, commitments</p> <p>Reports</p> <ul style="list-style-type: none"> <li>- regularly technical status of the work</li> <li>- unsolved technical problems</li> </ul> <p>Reports project status</p> <p>Reviews</p> <ul style="list-style-type: none"> <li>- quality plan</li> <li>- configuration management plan</li> </ul> <p>Performs the configuration management related tasks</p>  | <p>RM/C.1</p> <p>SPP/AC.1</p> <p>SPP/AC.2</p> <p>SPP/C.2</p> <p>SPTO/AC.9</p> <p>SPTO/AC.9</p> <p>SPTO/AC.12</p> <p>SQA/AC.1</p> <p>SCM/AC.1</p> <p>SCM/AC.2</p>   |

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| <p>System Test Group (STG)</p>          | <p>Is responsible for system tests</p> <p>Participates in negotiations concerning</p> <ul style="list-style-type: none"> <li>- commitments as consequence of allocated requirements</li> <li>- changes in commitments</li> </ul> <p>Reviews statement of work</p> <p>Reviews resource estimates, time schedule, commitments</p>   | <p>RM/AC.1<br/>RM/AC.3</p> <p>SPP/AB.1<br/>SPP/C.1</p>  |
| <p>System Engineering Group (SG)</p>    | <p>Is responsible for integration of hardware and software</p> <p>Participates in negotiations concerning</p> <ul style="list-style-type: none"> <li>- commitments as consequence of allocated requirements</li> <li>- changes in commitments</li> </ul> <p>Reviews statement of work</p> <p>Reviews resource estimates, time schedule, commitments</p>   | <p>RM/AC.1<br/>RM/AC.3</p> <p>SPP/AB.1<br/>SPP/C.1</p>  |
| <p>Software Quality Assurance (SQA)</p> | <p><i>Is responsible for that the company policy for quality assurance is followed (concerns companies with internal SQA-group)</i></p> <p>Participates in negotiations concerning</p> <ul style="list-style-type: none"> <li>- commitments as consequence to allocated requirements</li> <li>- changes in commitments</li> </ul> <p>Reviews statement of work</p> <p>Reviews resource estimates, time schedule, commitments</p> <p>Develops quality plan and quality assurance activities</p> <p>Participates in preparation and review of project plan</p> <p>Reviews development activities</p> <p>Reviews/revises products before delivery to the customer</p> <p>Reports SQA-results</p> <p>Reviews/revises periodically activities and results of</p> <ul style="list-style-type: none"> <li>- requirements management</li> <li>- project planning</li> <li>- project tracking</li> <li>- <i>subcontractor management</i></li> <li>- configuration management</li> </ul> <p><i>Reviews subcontractor contract according to a documented procedure</i></p> <ul style="list-style-type: none"> <li>- <i>specification of subcontract</i></li> <li>- <i>subcontractor's quality assurance (SQA)</i></li> </ul> <p>Is responsible for that measurements are defined and implemented for SQA</p> | <p><i>SQA/C.1</i></p> <p>RM/AC.1<br/>RM/AC.3</p> <p>SPP/AB.1<br/>SPP/C.2</p> <p>SQA/AC.1, AC.2<br/>SQA/AC.3<br/>SQA/AC.4<br/>SQA/AC.5<br/>SQA/AC.6</p> <p>RM/V.3<br/>SPP/V.3<br/>SPTO/V.3<br/>SSM/V.3<br/>SCM/V.4</p> <p><i>SSM/AC.1<br/>SSM/AC.10</i></p> <p>SQA/M.1</p> |

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| <p>Marketing and Sales (MS)</p>             | <p>Participates in negotiations concerning</p> <ul style="list-style-type: none"> <li>- commitments as consequences of allocated requirements</li> <li>- changes in commitments</li> </ul> <p>Reviews resource estimates, time schedules, commitments</p>   | <p>RM/AC.1<br/>RM/AC.3<br/>SPP/C.2</p>  |
| <p>Documentation Support Group (DSG)</p>    | <p>Participates in negotiations concerning</p> <ul style="list-style-type: none"> <li>- commitments as consequence to allocated requirements</li> <li>- changes in commitments</li> </ul> <p>Reviews project resource estimates, time schedule, commitments</p>   | <p>RM/AC.1<br/>RM/AC.3<br/>SPP/C.2</p>  |
| <p><i>Subcontract Responsible (SSM)</i></p> | <p><i>Is responsible for that company policy for subcontractor management is followed</i></p> <p><i>Is responsible for</i></p> <ul style="list-style-type: none"> <li>- <i>development and control of subcontractor contract</i></li> <li>- <i>selection of subcontractors</i></li> <li>- <i>control of contract</i></li> <li>- <i>support of the subcontracted products</i></li> </ul> <p><i>Informs the affected groups about technical aspects in the contract</i></p> <p><i>Defines and plans the work to be subcontracted</i></p> <ul style="list-style-type: none"> <li>- <i>select subcontractor</i></li> <li>- <i>document agreement/contract</i></li> </ul> <p><i>Reviews/approves subcontractor's documented</i></p> <ul style="list-style-type: none"> <li>- <i>project plan (SPP)</i></li> <li>- <i>tracking plan (SPTO)</i></li> </ul> <p><i>Informs and negotiates with affected groups of changes to subcontractor's tasks, conditions, commitments</i></p> <p><i>Periodically reviews and negotiates with</i></p> <ul style="list-style-type: none"> <li>- <i>subcontractor's contract responsible</i></li> <li>- <i>subcontractor's technical responsible</i></li> </ul> <p><i>Is responsible for formal reviews of subcontractor's results at specified milestones</i></p> <p><i>Performs acceptance tests according to a documented procedure</i></p> <p><i>Periodically reviews and evaluates the performance in contracted product</i></p> <p><i>Is responsible for that measurement are defined and implemented for SSM</i></p> | <p><i>SSM/C.1</i></p> <p><i>SSM/C.2</i><br/><i>SSM/C.2</i><br/><i>SSM/C.2</i><br/><i>SSM/C.2</i></p> <p><i>SSM/AB.3</i></p> <p><i>SSM/AC.1</i><br/><i>SSM/AC.2</i><br/><i>SSM/AC.3</i></p> <p><i>SSM/AC.4</i><br/><i>SSM/AC.5</i></p> <p><i>SSM/AC.6</i></p> <p><i>SSM/AC.7</i><br/><i>SSM/AC.8</i></p> <p><i>SSM/AC.9</i></p> <p><i>SSM/AC12</i></p> <p><i>SSM/AC.13</i></p> <p><i>SSM/M.1</i></p> |