



# Enhancing the Configuration Management capability

*Documented findings from CM FORUM 2011 - 2013*

The basic principles of Configuration Management (CM) are straight forward. As are the purposes and benefits of implementing CM. Nevertheless most organisations seem to experience a huge challenge when implementing and developing CM functions.

Concluding that the challenges were similar in many organisations, Syntell established *CM Forum* in 2011. Since the start, there has been 11 CM Forum workshops hosted at Syntell, Tetra Pak, Volvo CE, Volvo Trucks, Kockums, GKN Aerospace, H&M and knowit. Generally, the workshops participants have had a strategic CM role in their organisation. Each workshop has been built around a theme or a formulated question such as: *Communicating the CM message* or *CM Stakeholders - who are they?* Syntell has acted as workshop moderator and defined themes based on needs expressed by the participants. Some of the conclusions from the workshops have been documented and the accumulated result is presented in this paper.

With this paper we have tried to document ideas and thoughts as to how CM can be developed with hopes that the content will be useful on a practical level. CM theory is not described, instead an extensive list of reading suggestions is included in the appendix.

Enjoy the read!

Tobias Ljungkvist, editor

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## **Workshop participation 2011-2013, White paper co-writing and reviewing**

*Tobias Ljungkvist, Syntell*

*Carina Mårlind, H&M*

*Margaretha Eriksson, Irbis Konsult*

*Ulf Asklund, Inst. för Datavetenskap, Lunds Universitet*

*Anders Olsson, GKN Aerospace Sweden*

*Per Kapfält, knowit*

*Kofi Akosah, knowit*

*Hannes Eknefelt, Volvo Trucks*

*Staffan Mossberg, Volvo Trucks*

*Görel Eriksson, Volvo CE*

*Håkan Sporrang, Kockums*

*Tom Strandberg, Syntell*

## **Workshop participation 2011-2013**

*Ulf Carlsson, Syntell*

*Julian Fox, Tetra Pak*

*Anna Hawkins, ST Ericsson*

*Thomas Hedberg, Kockums*

*Ingrid Holmberg, Kockums*

*Lena Johansson, Tetra Pak*

*Roland Kvist, Volvo CE*

*Jan-Inge Martinsson, Kockums*

*Nenad Mitrowic, ST Ericsson*

*Christian Niklasson, Kockums*

*Asmus Pandikow, Syntell*

*Harald Ripa, ST Ericsson*

*Jonas Rosquist, Kockums*

*Fredrik Silversparre, ST Ericsson*

*Håkan Stenholm, GKN Aerospace Sweden*

*Anna Svahn, Tetra Pak*

*Lotta Wesslén, ST Ericsson*

*Emma Wester, Tetra Pak*

*Jon Westerberg, ST Ericsson*

# Introduction

Configuration Management (CM) theory and practice is to a great extent researched, documented, taught and discussed in today's business community. Several guidelines, management models and standards provide comprehensive descriptions on the objectives of CM and associated activities needed to reach these objectives. CM theory ambassadors have successfully managed to establish well accepted terminology - key CM terms are recognized and considered applicable across various industry sectors.

Yet, organisations with the ambition to improve CM usually struggle with even the smaller steps of development. Reasons for this varies but the bottom line is that CM practice is typically so dispersed (or "spread out") in the organisation and depend on so many stakeholders across the organisation - both horizontally and vertically - that the business case, the solution and the implementation tend either to rise to abstractions or cave under their own complexities. Key challenges identified by the authors of this paper are: How to assess CM development needs, How to communicate the importance of CM to stakeholders and how to implement changes that enhance CM longterm.

The purpose of this white paper is therefore to guide, to support and give input to persons who set out to develop or enhance CM capabilities in their organisation. The paper serves as a source of examples of good practice, tips and tricks and lessons learned regarding

- Getting the mandate to develop CM
- Defining the scope for, and pursuing a gap-analysis
- Communicating the needs and benefits of CM

This paper is aimed towards Configuration Managers, CM policymakers, Quality Managers, Process owners or any other "owner" of CM that need to promote and support the development of CM both to decision makers upwards as well as to the practitioners and stakeholders in the organisation as a whole.

Primarily, the experiences, analysis, conclusions and suggestions described in this paper are based on experiences of CM in large organisations that operate in an international arena, with high level of distributed management and production line and with a complex product portfolio involving a large number of products, components and custom adapted configurations.

The ideas that are put forward in this paper are applicable to all organisations that see the need for more control of managing their products. As such you do not need to fit the description above.

Note that the focus of this paper is not to explain what CM is, since this topic is thoroughly explained in various literature, refer to the Appendix for suggested further reading.

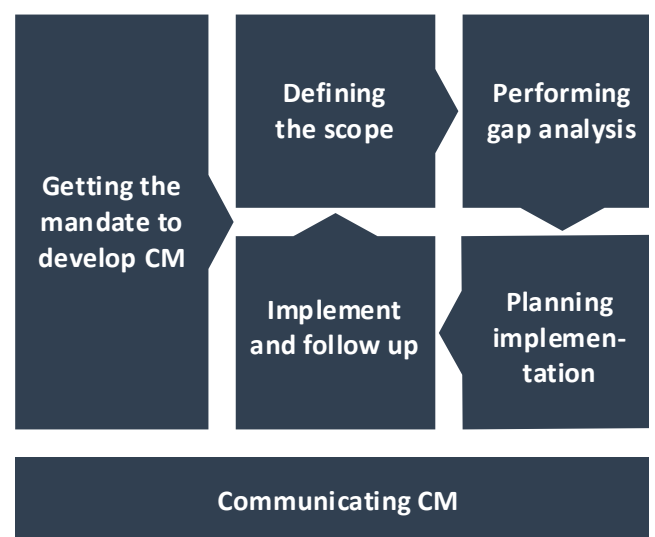


# The steps towards an enhanced CM capability

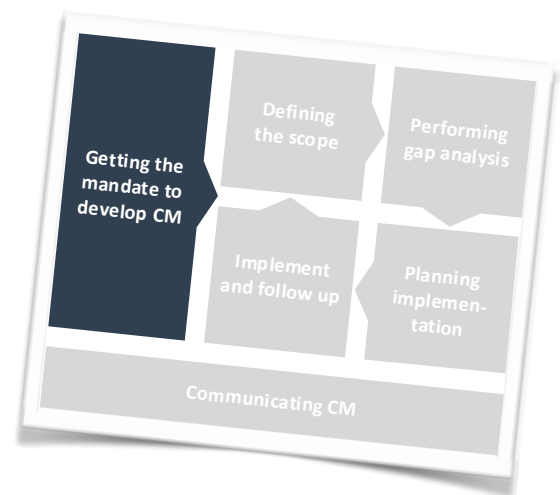
How change is constituted in an organisation vary. All organisations change at a different pace, responding to different factors and with different amount of control. The development of a CM capability will look different every time it occurs. The figure to your right defines a set of activities which offer a structured way to plan the progress of CM capability development.

The starting point is getting the mandate to engage in the capability development. The capability development is then structured into an iterative loop of four main activities: Defining the scope for analysis, performing analysis, planning implementation and implement and follow up. These five activities are underpinned by the sixth: thoroughly planned and practiced communication. We suggest the development process should be iterative, starting with the most apparent needs and gradually expanding the scope.

The following chapters describe the six activities in further detail and offer thoughts on how the activities can be put into practice.



# Getting the mandate to develop CM



How can a mandate for change be achieved? Among many other things it will depend on the organisation's current state and the sense of urgency that can be raised. This chapter suggests some scenario descriptions to be used as comparison and some aspects on how a sense of urgency can be created.

It is often said that people, once having worked with properly implemented configuration management without realizing it, will realize the strengths of configuration management when working in environments where it is not implemented.

Each organisation is different in terms of governance and management, processes and methods, culture and competences. The need for CM is however essential in any manufacturing or acquiring venture and therefore examples of how other organisations work with CM can strengthen the internal case for CM development.

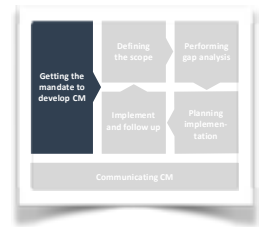
Not knowing the strength or the weakness of the current state in the organisation makes getting the mandate to investigate the need for change even more challenging. Some support can be found in illustrating different CM implementation scenarios as a way to compare the state of current CM capability against other hypothetical states.

Below are three scenarios with various maturity regarding CM and typical symptoms and strategies to develop a better capability.

## **User story - the cost of a missing CM audit and review process**

*A Swedish machine manufacturer struggled to meet the delivery deadline of 300 machines. The internal process for review and approval of deliveries was established but not followed strictly. As a result, not all relevant internal stakeholders in the software department were informed about late design changes, causing the software delivery to be based on documents that were still in status: "in work".*

*The mistake could very well have been detected before the software installation, had there been a Configuration Audit performed before delivery. But unfortunately this was not the case. Instead the incorrect software caused a delivery stop with 500 MSEK tied up in undelivered products, thus severely affecting the cash flow and customer relation.*



## Scenario: A low level of CM

### Focus on: Getting started with CM

The organisation has a low (or non-existent) level of configuration management procedures which barely are known in the organisation. The organisation is distinguished by the following:

- Baselines are established but with uncertainties with regards to their completeness.
- There are records of deliveries and test-reports but no way to know the status after integration. Different versions are tested in development environments and test environments. No record is available regarding the differences between versions, therefore wrong versions of SW components are updated and problems solved in deployment reoccur for the customer.
- The valid information for the product cannot be found or is so spread out over IT-systems and separate file-structures which the consequence that the status of the product cannot be presented. Therefore, activities are executed based on incorrect or outdated documentation.
- Critical attributes such as unique identifiers, versions, date, title, authors and references are missing.
- The authority of design is ambiguous and not clear in relation to the system architecture.
- Design changes are introduced and documented, but there is no systematic way of handling changes.

As a consequence, the projects are uncertain of what has been delivered and the management regards moving in to new markets as a risky venture since this would result in additional product variants that would be difficult to control.

The focus for developing better CM capability should in this organisation be on documenting clear and concise procedures for:

- Which kind of documents or records that need to be established for the product, so that the configuration baselines can be reviewed and approved as completed. This also includes establishing what attributes are required as well as version management of all documents.
- Where to store valid product documentation so that it is easily retrievable whenever needed.
- A common change control process.
- Clarified responsibility and product ownership in relation to the system architecture.



## Scenario: A medium level of CM

### Focus on: Enhancing specific CM capabilities

The organisation has developed configuration management to some extent. The organisation is distinguished by the following:

- Complete information about the product exists and can be retrieved but the time to do this is so extensive that production and delivery times suffer.
- Complete baselines can be established but involve several manual steps that introduce human errors and degrades information quality.
- Traceability difficulties, such as difficulties to trace back the verification of requirements for product release to the valid requirements baselines.
- Rules and routines regarding attributes for documents, formal change, versioning etc. exists but the staff has little understanding of the value of following these rules and therefore there are many examples of short-cuts, missing data etc.
- Rules and routines regarding attributes for documents, formal change, versioning etc. exists but are different (or are implemented differently) across the organisation resulting in misunderstandings and ambiguous status accounting.
- Change boards (CCB) exist but do not include all critical stakeholders/experts resulting in unforeseen consequences of approved design changes.
- There is lack of control of what suppliers do and not do.

The focus for developing better CM capability could in this organisation be:

- Adapting and developing the IT tool's functionality and interfaces to better support the identification, status accounting and change management activities. An example of this could be the functionalities in the requirements database (requirements IDs, verification methods etc.)
- Developing improved understanding in the organisation of CM in general and for the justification for specific rules and routines established in the organisation.
- Developing decision management capability to foresee unexpected consequences of the suggested changes.



## Scenario: A high level of CM

### Focus on: managing CM in increasingly complex environments

The organisation has well developed CM capability, but many improvements can be justified. The organisation is distinguished by the following:

- SW deliveries and test reports are complete and files can be integrated unambiguously due to IT-interfaces that reduce the manual work.
- CM routines and practices are followed by staff but are not harmonized with suppliers way of working with CM. The CM requirements on suppliers are not sufficient.
- Implemented IT tools and data models enables CM effectively with present business situation but the chosen solutions prevents the organisation to effectively engage in new joint ventures, partnerships or mergers due to complicated or not standardized IT- or data-solutions.
- Defined architectures and product breakdowns enables identification and control of configuration items for the lifecycle of current product lines but prohibits innovation, modularization, reuse or increasingly customized product variants.
- The implementations of CM for HW and CM for SW are stable but not harmonised due to the differences in development models for the HW and SW development. Baselines are established but cannot

be planned in a way that effectively support both SW and HW to meet time-to-market requirements.

The focus for improving the CM capability could in this organisation be to:

- Utilize and harmonize the good CM practices across the internal and external organisation.
- Utilize the good CM practices in all phases of the product life cycle, i.e. from requirement management, early development phases, manufacturing, and maintenance (customer services).
- Strive for IT-tool neutral information and data models to enable efficient data transfers and concurrent engineering. Look for open standards applicable to the most critical data.
- Make sure CM requirements are considered in the product architecture. For example, by letting CM participate in architecture teams early in the project.
- Analyze and plan baselines for HW and SW over time to ensure that the development cycles align.



## Creating a sense of urgency

Creating a sense of urgency is crucial to gaining needed cooperation. Point out risks/problems with the current situation, but make sure to stress opportunities. Start honest discussions, and give dynamic and convincing reasons to get people talking and thinking. Arguments should be positive (do not describe the problem, describe the opportunity) and could be based on:

- How correct and consistent information saves time, reduces cost and decreases the risk of last minute changes.

**“People will find a thousand ingenious ways to withhold cooperation from a process that they sincerely think is unnecessary or wrongheaded.”**

*John P Kotter, Leading Change*

- How controlling customer requirements will improve development.
- How control of changes and a clear baseline strategy will shorten the time to develop new products/variants.
- The benefit of the capability of being able to answer the question: Which is the latest release/version? Who did it and when?
- The benefit of control of information and documents in terms of traceability, correctness, consistency, availability, status, version and history.
- The benefits that come with a configuration item breakdown that offer possibility to modularize the product in a new way or resolve blocking dependencies between system elements.
- Introducing CM as service to customers, partners or sub-suppliers .

Use the identified opportunities to formulate the vision (see also the section about communicating CM).

### Identify potential threats

Describe scenarios showing what could happen in the future. Arguments could be based on:

- How uncontrolled change management leads to low quality of products
- That CM is part of risk management. Investing in CM can be regarded as insurance.
- External requirements on CM (legal regulations, certification, audits etc.)
  - How unclear an inconsistent baselining extends lead times.
  - How low CM capability hinders overall organisational maturity. For instance reaching higher CMMI maturity levels is impossible without having reached the CMMI goals for the CM process.

### Compare and benchmark

Compare your situation with what others are doing (other departments or other organisations).

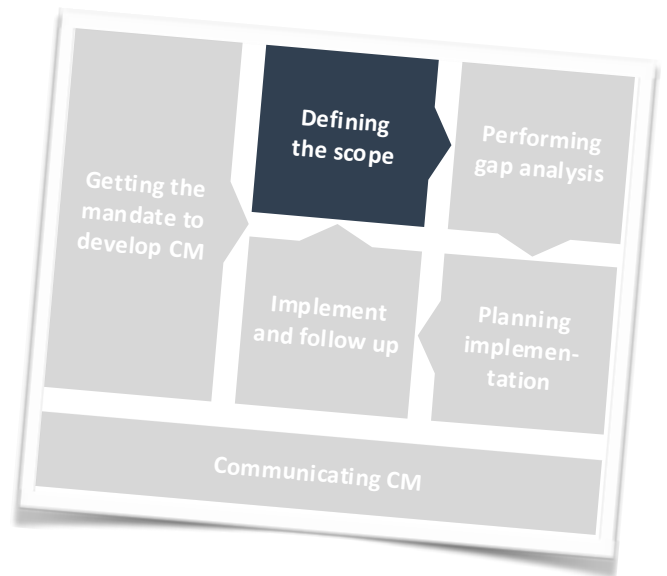
- Request support from customers, outside stakeholders and industry people to strengthen your argument. Involve new CM competence that brings in new or different ideas of what is not working and why.
- Formulate the benefits of CM by adding an inspiring example case to show results from a successful implementation.
- Point at examples of where it went wrong to show evidence on the needs for CM.

## Establishing a team

Strong leadership and visible support from key persons is vital to convincing all stakeholders that the change is needed. The team should involve managers across concerned departments as well as informal leaders and key individuals.



# Defining the scope for a CM capability gap analysis



In general, the purpose of the gap analysis is to understand what the current state is and what the desired state should be. As the current and desired states are identified, a strategy to reach the desired state can be developed. But why is it important to decide scope before pursuing the gap analysis? The outcome of a gap analysis will to a great extent depend on what data (measurements as well as indicators) is collected and the context and the means by which the data is collected. Generally, resource and time limitations constrain how much data can be gathered and thoroughly analyzed.

A conscious decision on the scope for the analysis is therefore necessary for the quality and relevance of the result. Consequently, the decision on scope affects how successful an implementation actually is.

The decision on gap analysis scope should be guided by considering the balance between the targeted capability itself and business needs justifying the capability, keeping in mind that “the right amount of CM” given the business situation is desired. Symptoms in the product development

that can be traced to malfunctioning CM or problems related to CM, would generally suggest that the balance is off. There are most likely capability elements that have more impact on the overall capability as well as specific aspects of the business needs that drive cost and/or value. The sections below offer some ideas about how business needs factors and capability elements can be mapped out for the purpose of scoping the CM assessment. The symptoms or problems identified could be traced to a particular element factor, facilitating the process of narrowing the assessment scope.

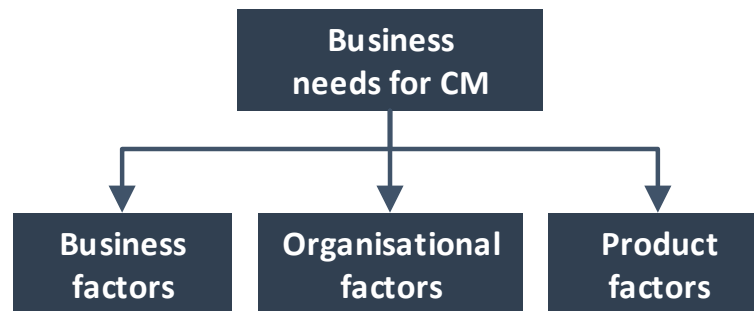
***The decision on gap analysis scope should be guided by considering the balance between the targeted capability itself and business needs justifying the capability, keeping in mind that “the right amount of CM” given the business situation is desired.***





## Identifying the business needs for CM

The needs and limitations for the organisations CM capability can be identified and structured in various ways. One way of structuring needs and limitations is looking at business factors, organisational factors and product factors. Scoping the gap analysis can be done by choosing to study one or several of these factors.



**Business factors** that drive the need for developing CM can typically involve:

- The organisation's goals and business idea, since this in a general sense indicates the justification for CM.
- Customer's, end user's and other external stakeholder's requirements and expectations regarding CM. This includes legal requirements or requirements derived from governmental authority regulation.
- The return on investment against product lifecycle phases, and time in general. Depending on what aspect of CM which will be the focus of improvement, the positive results might be immediate or not apparent before new phases of the lifecycle have passed.
- Requirements related to process and project accounting and compliance. What does the CM process look like? How is it tailored in a specific project? Does the work conform to the processes? Have the necessary authorities been involved?
- Requirements from suppliers and production, i.e. agreements to meet expected quality and effectiveness (price, time of delivery, identification of delivered objects) which in turn set requirements on the supplied information (or exchange of information).
- Factors related to quality assurance requirements imposed on the organisation in its business environment, such as:
  - The quality assurance of processes related to CM.
  - The quality assurance of data being exchanged.
  - The quality assurance of product requirements and requirements management.
- The extent in which CM itself is, or could be a packaged service supplied to the customer as part of the through life support.



**Organisational factors** that drive the need for developing CM can typically involve:

- Requirements related to how personnel must work with CM given the set of roles, rules, culture and management policies.
- Needs for project CM vs. needs for product CM as well as the overall role of CM dependent on how the CM competence is organised. For instance, some organisations separate between strategic CM (establishes CM in projects, develop and maintain CM capability) and operative CM (tends to day-to-day CM activities).
- Requirements related to organisation location, size (how many persons are involved in CM activities), how the organisation is distributed etc., which in turn might affect information availability, collaboration constraints etc.

- Factors related to how CM interfaces with other processes and entities in the organisation and related to the maturity of other processes that affect or depend on CM.
- The organisation's general awareness and knowledge of CM.
- The possibility the organisation has to influence or control stakeholders (such as the customer, the supplier or the operation).
- Availability of information related to CM (product and project data). This includes ease of access as well as the time consumed to verify the accuracy of information not trusted or the status of available information. An additional dimension to these aspect is availability of information in collaborative environments (time consumed to exchange information with external stakeholders).

**Product factors** that drive the need for developing CM can typically involve:

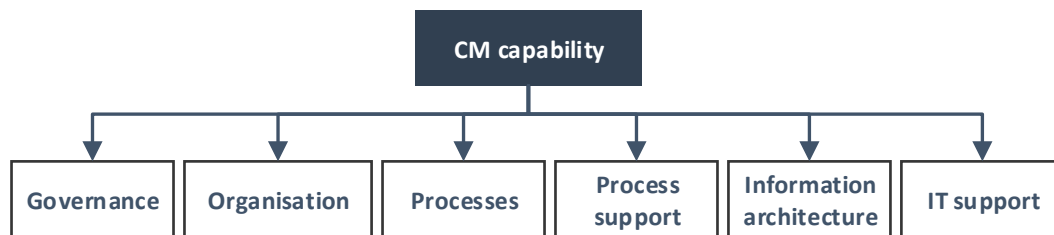
- Requirements regarding the product itself (safety, complexity, modularization and reuse, lifecycles, quality).
- The interdependencies between HW and SW in the product can often drive the challenges in defining a development model which is necessary for planning CM activities.
- Variations in requirements with regards to different user groups and user interfaces which in turn increases needs for variants.

- Requirements related to Product configuration data, i.e. what is included in a release. To what extent is the configuration information, the deviations and the changes accounted for to customers? What are the legal requirements for product information on the product, labeling, packaging etc?
- Requirements regarding product lifecycle support (maintenance planning, technical documentation, training documentation, spare parts, support equipment and facilities).



## Identifying the essential CM capability elements

A capability can be decomposed in different ways. The following set of elements provides a comprehensive view of a capability. Although the elements depend on each other, each element can potentially be analyzed and improved independently, contributing to the overall capability.



**Governance** is about consistent management, cohesive policies, guidance, processes and decision-rights for a given area of responsibility (such as CM) affecting the way people direct, administer or control activities in relation to stakeholders and the corporate goals.

**Organisation** includes the human resources, how roles and responsibilities for CM is organized, competences and competence strategies.

**Processes** are sets of interrelated activities such as Configuration Identification, Configuration Control, Configuration Status Accounting and Configuration Audits.

**Process support** is the description of methods and guidance used to perform the activities in the processes.

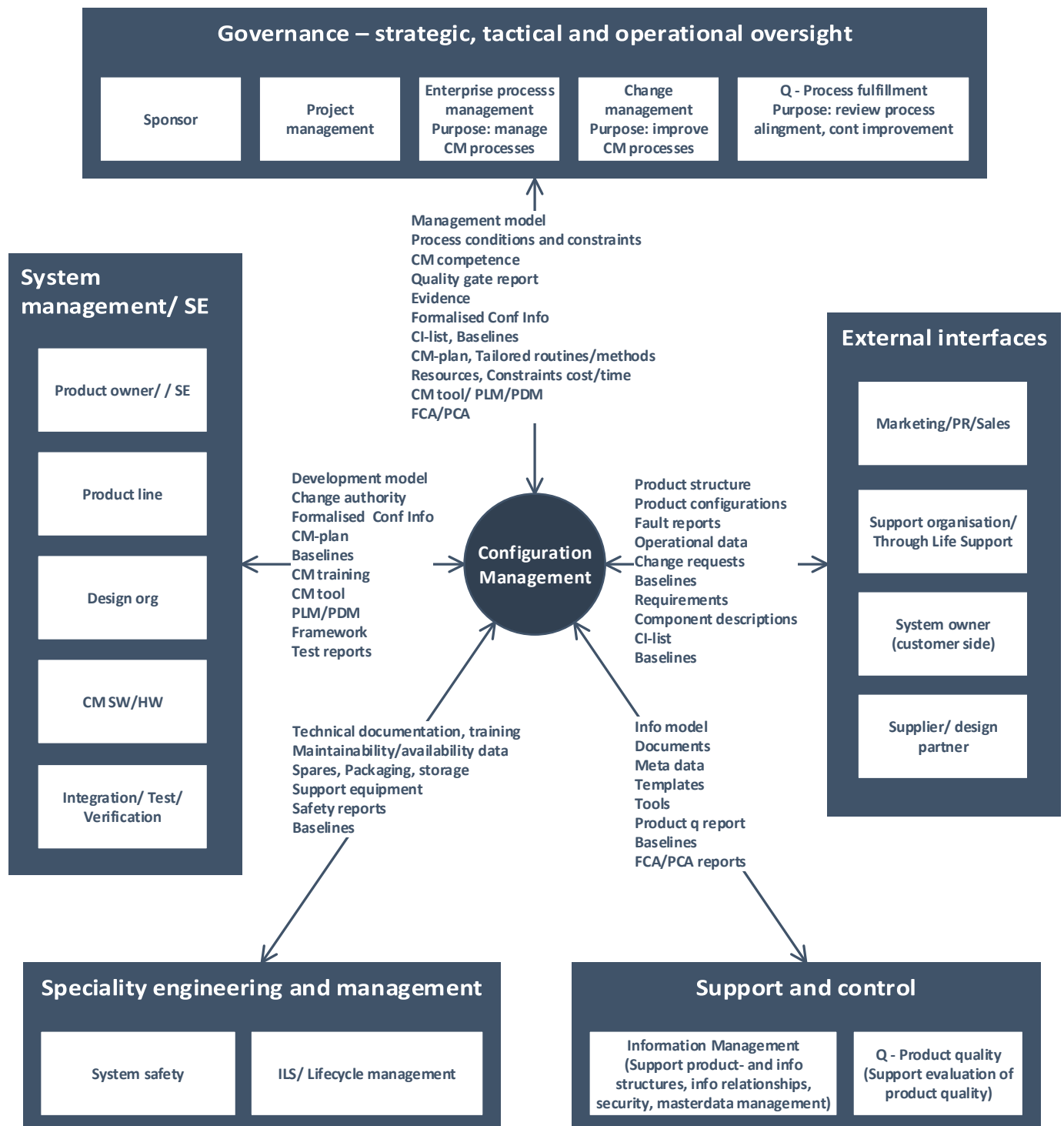
**Information architecture and models** are sets of definitions and rules regarding information objects/elements and their relationships to enable the labeling, structuring and organisation of data.

**IT-support** includes the hardware and software that build the IT infrastructure.

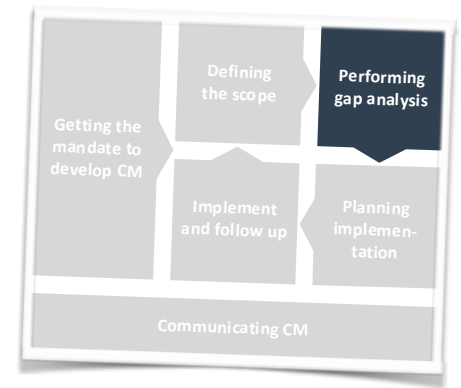


## Mapping out the needs of different interfaces to CM

The figure below suggests some of the most common interfaces to CM in an organisation as well as the purpose of the interface. The figure can be used as a tool to prioritize which interfaces that should be focused on, or to develop a better understanding of needs and constraints.



# Perform CM gap analysis based on scope



A gap analysis can be defined as the comparison between current state and desired state. The analysis is usually signified by

1. Determining and documenting current performance level (What we have).
2. Defining a desired capability or level of performance (What we want to have).
3. Identifying and documenting the gap and developing the requirements to bridge the gap.

Using the illustration from the previous chapter, the gap can be understood as the imbalance between the CM capability and business needs for CM.

Gap analysis theory and methodology will not be detailed in this paper, since a considerable amount of literature on the subject already exists. A gap analysis regarding CM capability could, given the selected scope, be guided by the following:

## Pay attention to the CM interfaces

Use CM Interfaces figure as base for mapping your organisation's CM interfaces. For each entity in the map (can be a process, organisational entity or other stakeholder) the following questions can be considered to facilitate the identification of needs:

- Are there requirements for what objects you need to have under configuration control?
- What requirements exist for change management?
- What requirements exist for status accounting?
- What requirements exist for configuration audits?

- What non-functional (performance) requirements exist regarding the CM-system (performance, cost, fault rate, information quality)?

For each entity, the following questions can be considered to facilitate the identification of constraints:

- What is the maturity level with regards to CM? Use the scenario descriptions above to define levels.
- What is the understanding of CM (benefits, terminology, principles)?
- How much information control can be achieved/obtained by the (sub)supplier?
- What are the financial resources available for capability development?

## Take advantage of established capability development frameworks

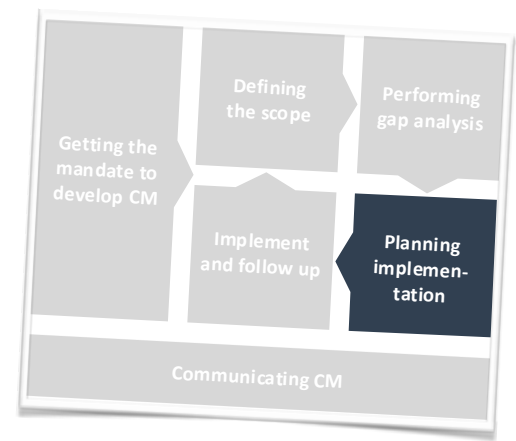
- Make use of the definitions and guidelines in frameworks such as: CMMI, ITIL and PDCA.
- Use standards such as ISO 10007, ANSI EIA 649B, ISO15288 and PMI as starting points for defining CM in your organisation and tailor to your needs and constraints. Use handbooks such as Engineering Documentation Control Handbook as a source of information. See the annex for reading suggestions.

## Combine different methods to collect data

Use a combination of interviews, case studies, literature studies and observations to define exactly where you are and where you need to be. Use the scenario descriptions above to set the ambition level.



# Developing an implementation plan



Below are some ideas to support the planning process.

## Pay attention to the most apparent business needs

Let the business needs be the compass when prioritizing. The gap analysis will most likely point towards many different changes involving management, processes, competence and IT. As stated previously it is important that the changes introduced are balanced against the business needs. Do not forget legal implications regarding safety, accounting for specific data, labeling etc.

## Start with changes on the operational level

Operative changes are often more straightforward in terms of tracking the effect. Avoid planning to introduce new time consuming tasks, find ways of working more effective on ground level and use results to influence management.

## Keep a customer focus

Keep in mind current and future markets for the final product, specific needs of customer adaptation (need and size of organisation).

## Re-use established systems and methodologies as much as possible

Look at what capability bases exists already, is there something to build from?

## Keep the necessary preconditions for CM in mind

The quality of CM is dependent on the quality of Systems Engineering. To support the business operation, the CM activities are dependent on architectures, development

models, processes for requirement management and verification management etc.

## Start with the low hanging fruits

Where can we have best influence or make the biggest difference? Focus on a particular example in the CM Scenarios description (refer to section Getting the mandate to develop CM). Chose a development model for your CM capability that enables you to start small and widen the scope iteratively. Examples of low hanging fruits can be:

- Structuring the process in a generic CM Plan.
- Identifying and structuring examples of CI's.
- Revising current and potential IT-tools for architectures/ structures, document management and change control.
- Developing/improving templates for change proposals, CCB, etc.
- Developing/improving guidelines and instructions of current practices in the organisation.

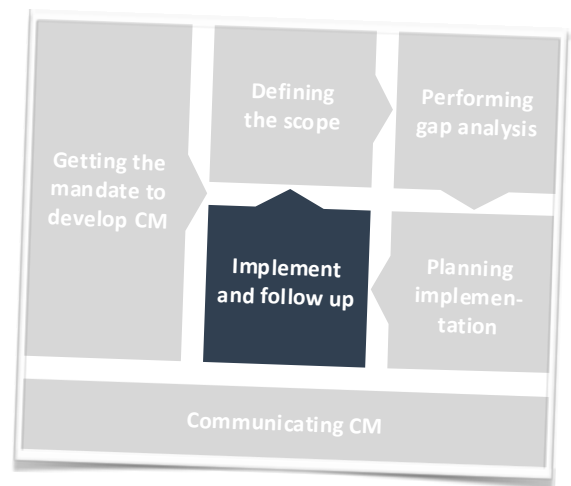
But, make sure to look beyond the simple and quick fixes. If all the focus of the change is on the low hanging fruits, there is a risk that the mandate for change stops there.

## Identifying a Pilot project

Make sure the pilot projects you choose have a good possibility to succeed in terms of changing. The pilot project should:

- Involve a smaller group of people.
- Have the "right amount of issues" that are possible to address.

# Implementation and follow up



How do you successfully follow the implementation plan towards the vision? Below are some key tips to remember.

## Empower others to act the vision

Put in place the structure for change, and continually check for barriers. Removing obstacles can empower the people you need to execute your vision, and it can help the change move forward. Meet continuously with management to pick up on problems and obstacles. Typical obstacles have to do with time, resources or lack of knowledge.

## Identifying indicators

Short term wins depend on having identified good indicators to measure and follow up, such as:

- The number of deviations.
- Lead times for specific activities.
- The number of closed changed proposals.
- The number of bugs.
- The number of loops (if iterative/agile methods are used).
- The number of change requests.
- The amount of quality issues reported by the customer.
- Identification of system of interest and breakdown of configuration items, interfaces etc.

- New features or functions enabling CM (enhanced functionalities in CM-tools, new templates for change proposals, new roles or staff functions etc.)

## Promote short term wins

Reward the successes as soon as they occur by emails, intranet, newsletters or key performance index boards or even by throwing a cake-party. The CCB is an important instance for following up progress of the overall change management.

## Pay attention to feedback

Be open to feedback. Take part in existing forums to pick up ideas and viewpoints. Make sure to display the goals/objectives and continuously show what has been accomplished.

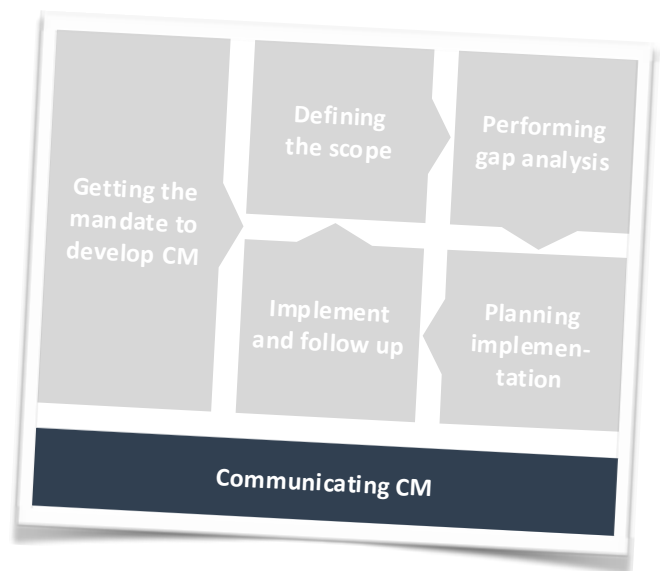
# Message and communication

## Establish a vision

A clear vision can help everyone understand why they are asked to do something. When people see for themselves what is to be achieved, then the directives they are given tend to make more sense.

Develop a short summary (one or two sentences) that captures what you "see" as the future of your organisation. The vision could explain: Where do we want to go? Why change? What are the consequences if nothing changes? Some suggestions on themes to build the CM vision around are:

- We want to sell our product cost-effectively!



- With existing resources by means of reusing existing solutions.
- A solid grip on all the changes that are introduced for the product.
- The same process on all sites.
- Securing quality, lowering costs, reducing time and resources by 20% before the end of 2014.
- Always access to the correct product data.
- Control of configuration items – predictability in releases.
- 30% less faults at our customer.

The vision should be defined in a way that corresponds to the indicators set in the implementation plan.

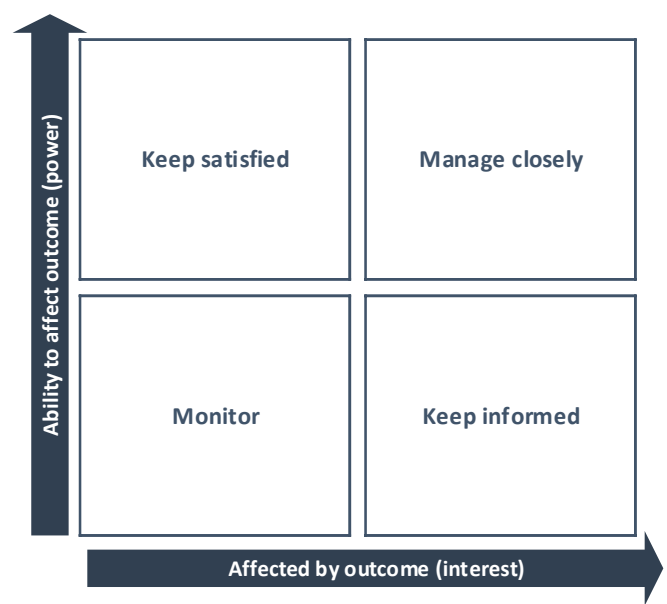
**Translate the vision into terms of “What’s in it for me”**

Apply your vision to all aspects of operations – from training to performance reviews. Tie everything back to the vision. Ask stakeholders: How would you want to change your way of working to start moving towards the vision?

Take advantage of key persons to translate the vision to their area of work (what would the vision mean for design department, marketing, test, etc.) Make sure the leaders (executives, team leaders, project managers, system owners and informal leaders) are on board by informing, engaging communicating how the day-to-day activities will be facilitated and how others will benefit from the efforts.

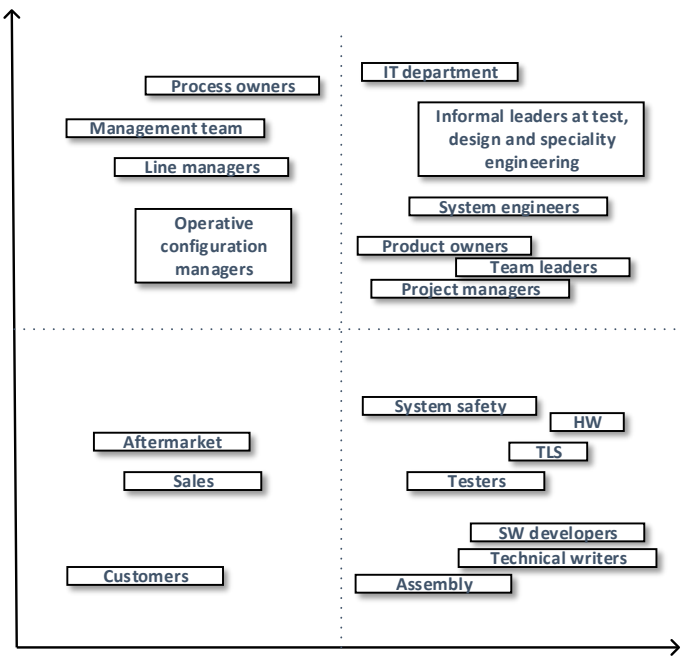
**Communication planning**

Your message will have strong competition from other day-to-day communications within the organisation, so you need to communicate it frequently and powerfully, and embed it within everything that you do. Use a communication matrix like the one below to map who to communicate with and how.



The vertical axis measures the stakeholder’s ability to affect the outcome (i.e. the power the stakeholder have) and the

horizontal measures the extent to which the stakeholder is affected by the outcome (i.e. the interest the stakeholder have). Note that power as well as interest can be positive or negative. Note also that stakeholders, once they have been mapped into the matrix as in the example below, very well can shift to a new part of the matrix as the change processes evolves.



**Use clear and consistent language and terminology**

Identify if/how CM-terms have multiple meanings or mean different things for different persons or departments. Support translation tables and the establishment of common definitions.

Avoid unnecessary complicated terminology as much as possible. Try to use standard terms.

**Attempt to give an idea of the return on investment**

Changes in organisations are costly. Communicate that the change process is to be regarded as a long term investment which will improved efficiency and transparency and reduce costs.

# Conclusion

Common to all CM Forum participants has been the struggle to meet the necessity of an enhanced CM implementation in their organisations. Although coming from different industry sectors, the participants have also found they share the same basic principles of CM and the same challenge: to establish effective CM functions which have a wide recognition and acceptance in the organisation.

With this paper we have tried to document ideas and thoughts as to how CM can be developed, with hopes that the content will be useful on a practical level. We have attempted to cover the whole change process from successfully communicating the need for CM to implementation and follow up. Hopefully you can take some of the ideas with you to your own CM capability enhancement. As the challenges of perfecting CM will continue, so will the exchange of ideas and experiences in the CM Forum.

## Appendix A - Advice on multilevel Change Control Boards (CCB)

The Purpose of a multilevel CCB structure is to control changes to configuration items for a Product platform, in development projects, and sub-projects in an integrated way.

### Have regular CCB meetings

Reserve recurring meeting, 1 hour every second week / every week. If there are no Change Requests submitted, the meeting is cancelled. Appoint CCB participants:

- Chairman (should be the Product owner)
- Secretary (should be the CM responsible)
- Subject Matter Experts (Product specialists and other experts needed)
- Software CM
- Representatives other groups affected by the change.

A Line CCB has participants from Product Management: Chairman, Secretary and product segment specialists, Project Managers, and Customer Support representative. A Verification representative and other groups affected by the change are invited when needed.

### CCB meeting format

The CCB is a Decision meeting about Change Requests (CR) to a product or part of a product and therefore does not allow discussions. If necessary, limit to maximum 5 minutes per CR, if meeting agrees.

Use a fixed Agenda:

- Presentation of participants and meeting rules (if needed)
- Open Change request in the CR log – follow-up
- Decision (what, why, when, by whom)
- New Change Requests since previous CCB
- Decision (what, why, when, by whom)
- Summary of actions

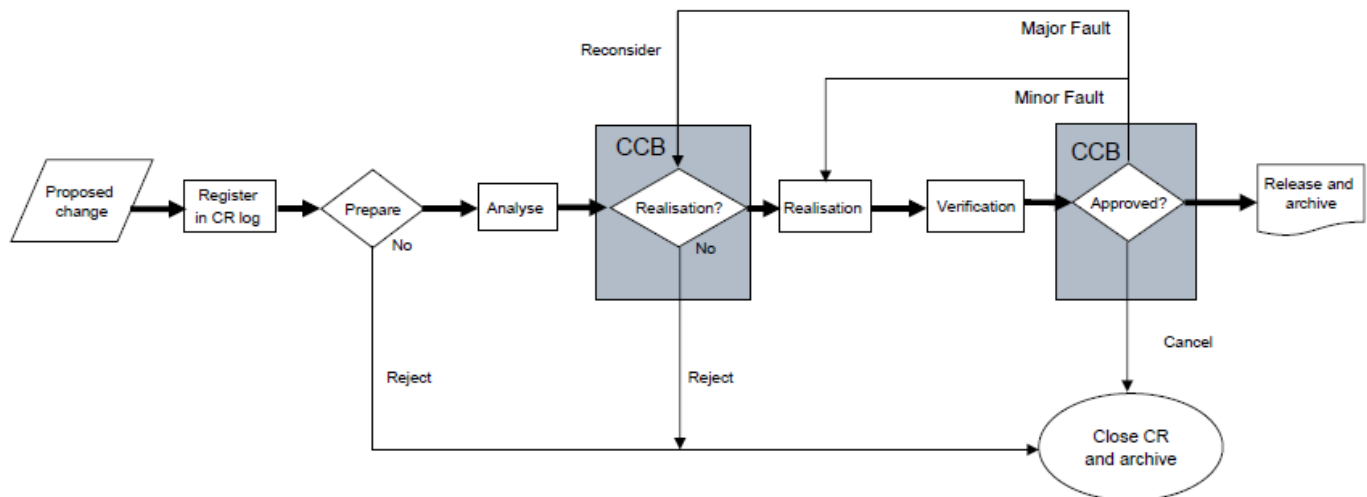
During the CCB-meeting, the secretary (CM) takes notes about who were present and the decision (approved or rejected CR).



After the CCB meeting the CCB Secretary summarises the CCB decisions and sends them to concerned parties, updates the CR log, updates documents and Configuration Items as decided.

CR Sources can be external, i.e. from suppliers and field reports on errors or broken parts, and internal from projects and sub-projects.

### Schematic CR Flow



### Responsibilities

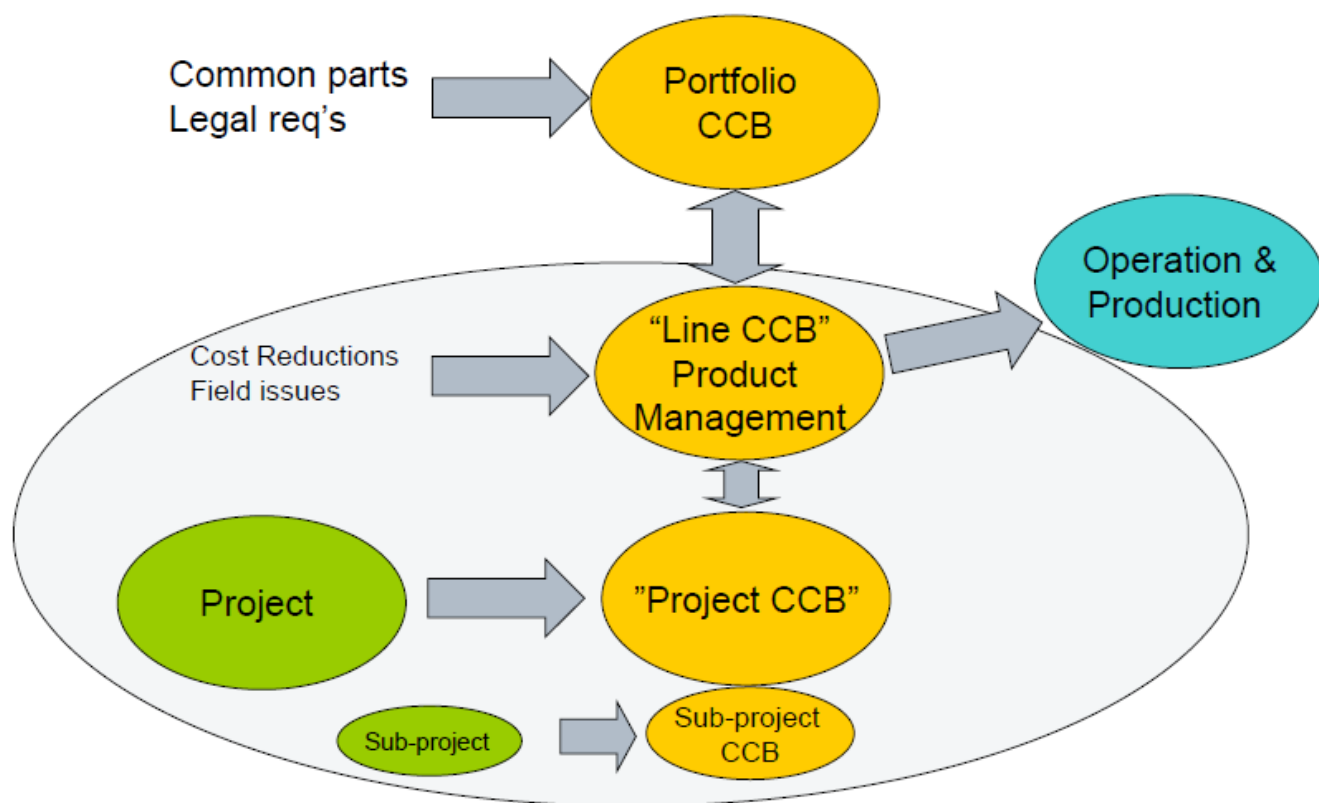
The Product Management organisation owns the Change handling process.

A CCB has authority to decide on changes of technical requirements, steering documents, prototypes, scope and planning of introduction of products, and configuration of the final product, as well as coordination between project and sub-projects.

The CCB members analyse a Change Request regarding the technical Solution "Form - Fit - Function (FFF)", "Quality, Delivery, Cost, Feature" (QDCF), Time, and Effects on other Configuration Items.

Business aspects are related to "Form-Fit-Function (FFF)" and changes affecting FFF like material of a component/object, interfaces (e.g. change in mechanical & SW interface), physical dimensions, flexibility, mechanical properties, SW related aspects like protocol, version or parameters.

Changes affecting, QDCF (Quality, Delivery, Cost and Features) are scoop changes, time plan displacement, quality issues like problems with verification, and budget changes.

**A Multi-CCB structure**

## Appendix B - Useful literature and standards

Title	Author	ISBN	Notes
Product Data Management and Configuration Management	Crnkovic Ivica, Askund Ulf & Dahlqvist, Annita	1-58053-498-8	Academic CM, advanced level
Implementing ITIL Configuration Management	Klosterboer, Larry	0-13-138565-8	Good introduction to change management.
Implementing ITIL Change and Release Management	Klosterboer, Larry	0-13-815041-9	Good coverage of change management and release management.
Configuration Management the missing link in web engineering	Dart, Susan	1-58053-098-2	Good coverage of web-CM and variant management, applicable on in general.
Adopting configuration management for agile teams	Moreira, Mario E.	0470-74663-9	CM and agile development
Practise Standard for Project Configuration Management	PMI	1-930699-47-6	CM from a project perspective
Towards Product Structure Management in heterogenous Environments	Svensson, Daniel	ISSN 0346-718x	Ph.D. Thesis with focus on structures
Configuration Management Principles and Practice	Hass, Anne Mette Johanssen	0-321-11766-3	Takes the reader through the basics of CM, many practical examples.
Configuration Management Best Practices	Aiello, Bob & Sachs, Leslie	0-321-68586-5	Takes the reader through the basics of CM, many practical examples.
Configuration Management	Vincent, Gary L.	978-1448698127	The basics of CM.
Best Practise for Service Support	ITIL	0-11-330015-8	CM according to ITIL
Transparent CM - how to get there	Lyon, David D	0-9661248-0-4	Includes the basics of Product Data Management.
Engineering Documentation Control Handbook	Watts, Frank B	0-8155-1595-1	Comprehensive take on CM with focus on document management.
Configuration Management metrics	Watts, Frank B	0-08-096445-4	A complement to "Engineering Documentation Control Handbook"
Practical CM best Configuration Management Practices	Lyon, David D	0-7506-4724-8	Many practical tips
Practical CM best Configuration Management Practices	Lyon, David D	0-7506-4724-8	Many practical tips
Practical Configuration Management	Mikkelsen & Pherigo	0-13-240854-6	Many practical tips
A guide to Configuration Management	Leon, Alexis	1-58053-072-9	SW-CM
Managing the change: Configuration Management and Change Management	Haug, Olsen, Cuevas & Rementeria	3-540-41785-0	SW-CM

Title	Author	ISBN	Notes
Configuration strategies and Rational ClearCase, a practical introduction	White, Brian A	0-201-60478-7	SW-CM
configuration management	Berlack, H. Roland	0-471-53049-2	SW-CM
Antipatterns and patterns in Configuration Management	Brown, McCormick, Thomas	0-471-32929-0	SW-CM, common problems and how to handle them.
Content Management for Dynamic Web Delivery	Hackos, JoAnn	0-471-08586-3	Web-CM
Web content Management, a collaborative approach	Nakano, Russell	0-201-65782-1	Web-CM
Configuration Management the missing link in web engineering	Dart, Susan	1-58053-098-2	Web-CM focused, but with many ideas and checklists for CM in general.
Configuration Management i Teknikinformationens tjänst	Editors Lena-Maria Öberg and Margaretha Eriksson		An anthology about CM in Swedish

Standard	Note	Extensiveness
SS-ISO 10007:2004	A standard for CM. Widely used within Defence Ind, very high level, very open.	12 pages
ISO 15288:2008	A standard for SE. Widely used within Defence Ind. Places CM in an SE context. Refers to ISO 10007:2004.	1 page (chapter 6.3.6)
ANSI EIA 649-B	A standard for CM . Some examples in Defence Ind. Ericsson part of developing. More practical oriented than ISO 10007:2004. Refers back to ISO 10007:2004.	65 pages
AQAP 2110 Ed3 (2009)	A standard for QA. Have minimal requirements for CM. Refers to STANAG 4159, STANAG 4427 and ACMP 1-6.	2 paragraphs (chapter 7.7)
STANAG 4159 Ed2 (1992)	NATO collection of standards and detailed requirements for CM.	-
STANAG 4427 Ed2		
ACMP 1-6		
MoD Standard 05-57 Issue4 (2000)	Mod standard and detailed requirements for CM.	57 pages
ASD S3000L v1.0 (2010)	A standard for LSA. Contains a CM approach for ILS and LSA.	27 pages (chapter 4)
CMII revG (2013)	A standard for CM. Released from CMII Reserach institute. Broad scope but no particular foothold in Defence ind.	20 pages