Operationalizing Coordination of Mega-projects - a Workpractice Perspective

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Operationalizing Coordination of Mega-projects -

a Workpractice Perspective

In this paper we propose a workpractice perspective towards operationalizing the coordination of mega-projects. This perspective matured over several years in development practice at Ericsson, a major supplier of telecommunication products and services worldwide. Key points in the perspective are the management of critical dependencies and the construction of a communal understanding of how to coordinate projects. Coordination is seen as a workpractice, where actors provide coordination to the project. The main conclusion is that the suggested approach enables the coordination of extraordinarily complex mega-projects.

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Introduction

Even though the management of projects has received enormous attention and analysis throughout the years, the track record has been generally poor, especially for the larger and more difficult projects (Morris et al., 1987). Since the 1950's fundamental changes have taken place in the way we work, the technology, customer behaviour, time constraints, use of standard components, etc. These circumstances increase the management complexity, and thus the requirements on coordination.

In the following, we shall discuss how Ericsson has addressed these issues from a workpractice perspective. A workpractice is a socially organized setting where actors / producers produce an outcome for some clients (Schatzki, 2001, Goldkuhl and Röstlinger, 1999). The actors become proficient in their particular areas such as project management, system analysis, design of software or hardware, etc., thus creating his/her own world view from workpractice specific tasks, tools, methods, rules, norms, etc. (Orlikowski, 2000).

In general, most of the actions carried out in one workpractice tend to remain local to that particular practice. However, some actions may influence other workpractices. Due to the complexity of the system, it is hard to anticipate the consequences of a certain action on the development task as a whole. An action, which may appear perfectly feasible in a certain workpractice, may result in unmanageable consequences for other workpractices. Thus, in complex systems' development projects, there is a need for instruments by which actions impacting different workpractices can be managed.

Coordination needs

Coordination is a multi-faceted phenomenon that can be defined in different ways. One starting point may be the definition by Malone and Crowston (1994) as the "management of dependencies among activities". However, experiences from Ericsson, a major provider of telecommunication systems worldwide, indicate that this is insufficient. There may be critical dependencies between functions in the system, between subprojects, between requirements, etc., that must be managed as well (Adler 1999).

In addition, we claim that the following aspects are imperative for coordinating complex development task in turbulent environments:

- Agility – the ability to manage changes during the project.
- Informality - coordination cannot be confined to a rational planning and controlling process only. Informal, spontaneous coordination of actions "on the spot" are equally important. The gap between the design and use of coordination mechanisms must be narrowed.
- Distribution - Coordination decisions should be taken where there is a need for coordination. Unnecessary propagation of such decisions to the total project management level should be avoided.
- Understanding – there should be a shared or communal understanding among all project members of the goals of the project and how every individual's contribution fits into the overall project. In particular, a communal understanding of dependencies is important.
- Operational – methods and tools for coordination should be useful in practice.

The way Ericsson operationalized coordination from a workpractice perspective is through a management method called the Integrated Centric Development (ICD) approach. In the following we describe this approach, report results from applying it and discuss consequences. The research is based on case studies following the suggestions of Yin (1989). A case study database was built up from different sources, including 14 interviews with participants in various roles such as project managers, method and tools coordinators, configuration mangers, etc. In addition, about 50 internal Ericsson documents, meeting notes, etc., were used.

The ICD approach towards coordination

The ICD approach consists of two main processes: the Anatomy-Based Engineering Process (ABEP) and the Domain Construction Process (DCP). A detailed description of ICD is found in Taxén (2006).

The Anatomy-Based Engineering Process

The ABEP appeared at Ericsson in the early 1990s as a response to the need to understand and control critical dependencies when developing complex systems. Experiences from many projects at Ericsson indicate that traditional engineering processes and project management techniques do not address this problem sufficiently. In a changing climate, the project needs to attain some stability to build the project organization around. Critical functional dependencies have proven to provide such stability (Adler 1999).

The ABEP is executed in three steps: *anatomy definition*, *increment planning* and *integration planning*. The purpose of the anatomy definition is to achieve a communal understanding about how the system works. The anatomy is an illustration – preferably on one page – that shows the functional dependencies in the system from start-up to a fully operational system. Here, the term "functional" should be interpreted as the capability a certain system element provides to other system elements. For example, a power source and a bootstrapping procedure are needed in order to enable the operating system of a computer.

The gist of ABEP is to design and test the system in the same order as the functions are invoked. In

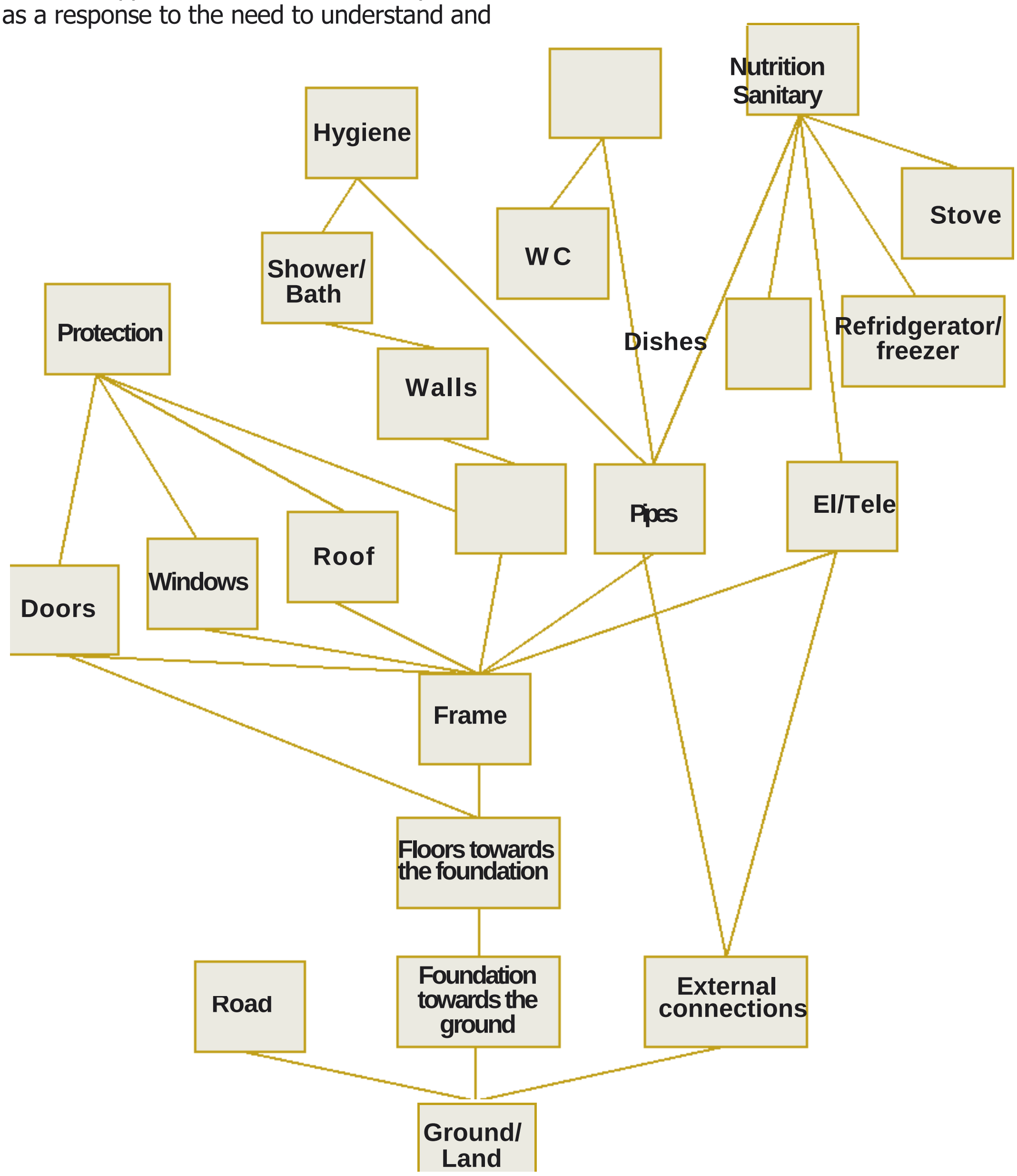

Figure 1. The anatomy of building a house

a metaphorical sense, this can be seen as the order in which the system "comes alive", hence the term "anatomy". In Figure 1, an example of an anatomy of a house is shown. The boxes indicate functions and the lines dependencies. The anatomy should be read bottom-up.

The purpose of the second step, increment planning, is to outline the implementation of the system. The functions are grouped into development and integration steps — increments — in such a way that the functionality of each increment's addition is verifiable. The intention is to parallelize design and testing as much as possible. In Figure 2, a possible increment plan of building the house is shown.

In the third step, integration planning, the purpose is to divide the work between subprojects and establish a communal understanding over what is delivered, from whom, and when. Resources are assigned and dates for deliveries of the increments to system integration are negotiated. For each increment, traditional time and resource plans are made. Here, dependencies between sub-projects are in focus. In Figure 3, an integration plan of the house is shown. As can be seen, the integration plan is tilted to signify a time line, and internal functions in each increment are subdued.

During the project, the integration plan is used as an instrument for communicating the progress of the project. The state of each increment is visualized by traffic-light cues such as Green – On Time, Yellow – Warning, Red – Off Track, etc. Impacts of delays are clearly shown, which gives project management the time to take corrective actions.

At a quick glance, the integration plan appears similar to traditional network plans in the sense that it shows the dependencies between tasks. However, the way the integration plan is constructed very differently from a network plan.

The Domain Construction Process

The DCP emerged in Ericsson around 1997. Its purpose is to construct the coordination of the ABEP. Thus, we acknowledge that coordination is something that needs to be elaborated in order

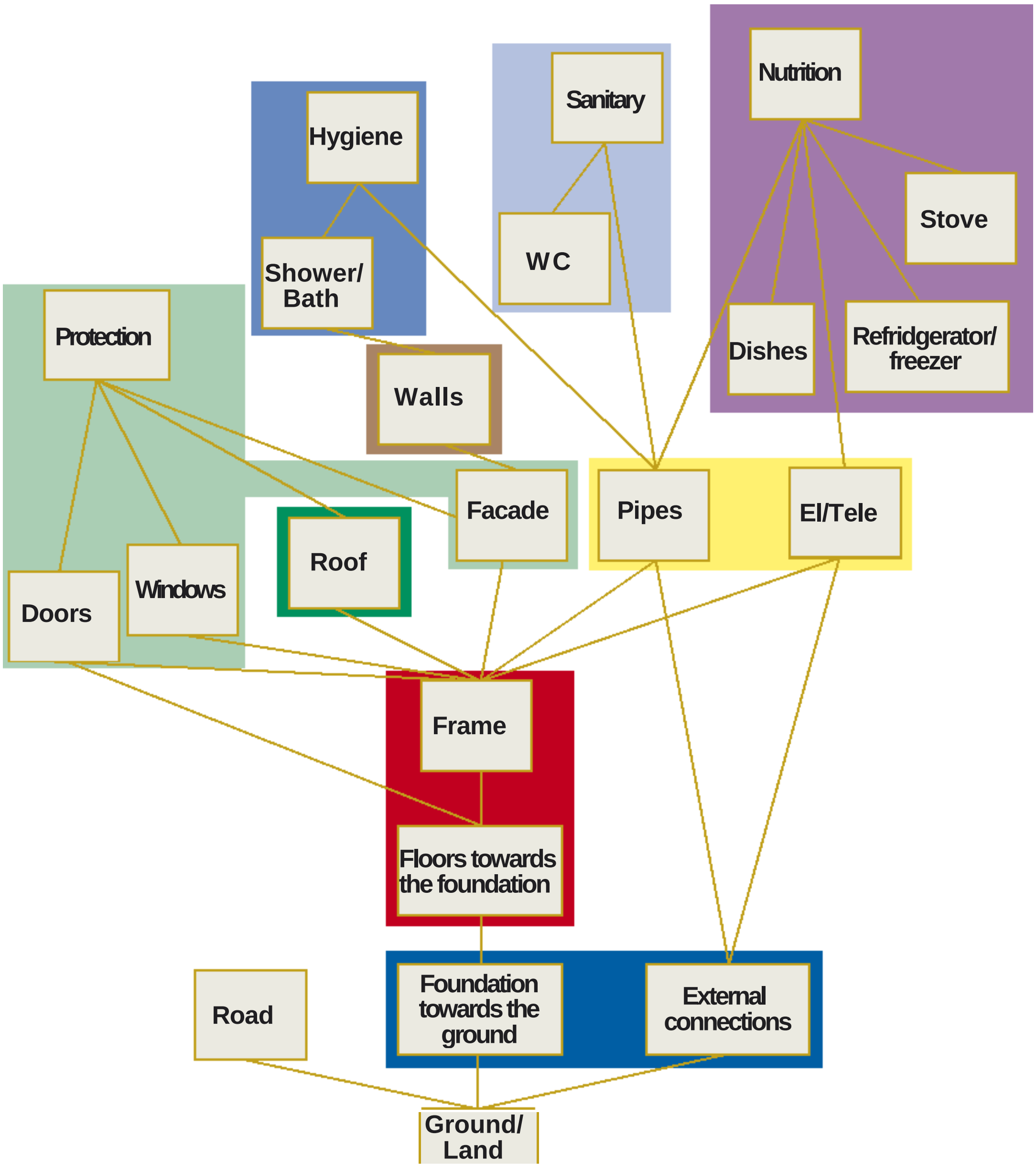

Figure 2. Increment plan.

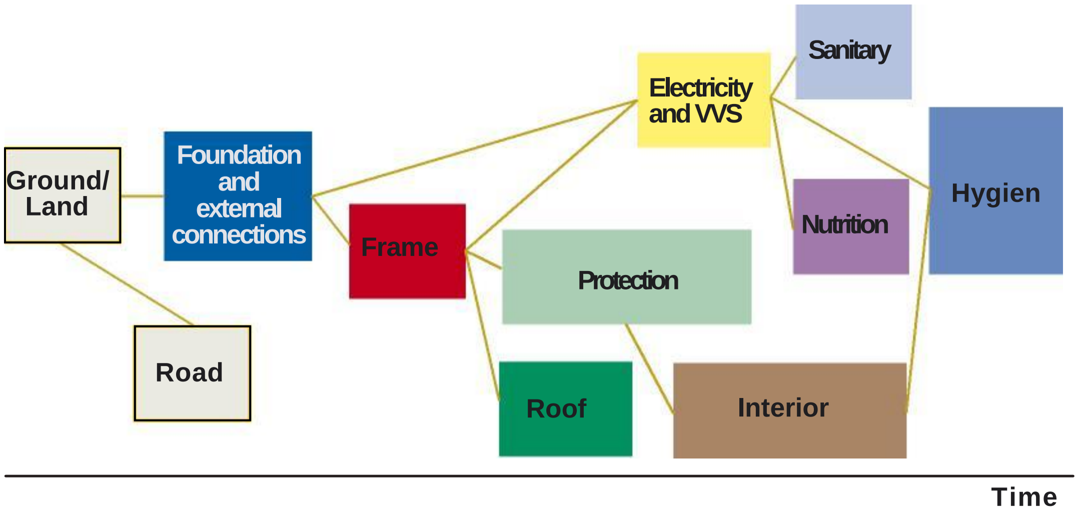

Figure 3. Integration plan

to become operational.

The point of departure is to regard system development as a network of workpractices, each contributing to some part of the overall functionality. Coordination is seen as an adjoining workpractice called the *coordination domain*, the purpose of which is to provide coordination to the system development workpractices (Taxén, 2003). The coordination domain shares some design items with the other workpractices. However, the items are characterized differently depending on the context. For example, a text describing a requirement item is irrelevant in the coordination domain. Here, other things like identity, revision, state, attributes, etc., are relevant as well as how requirement items are related to other items such as products, customers, test cases, deliveries, etc.

The construction of the coordination domain has three main targets. The first one is a *context model* that describes which items are relevant for coordination and how these are characterized and related to each other (see Figure 4). The boxes signify relevant items. Most of these have icons associated with them in order to increase the visibility of the model. The lines indicate relationships between the items. In addition, a number of other properties are defined in the model such as attributes, state sets on items and revision control rules (not shown in Figure 4). The item in focus, the anatomy, is shown in the centre of the model (ANATOMY ITEM). This particular context model expresses the communal understanding at Ericsson in 2002 about what needs to be managed in order to coordinate the anatomy-based engineering process. Over time, the model is continuously updated due to new coordination demands, new

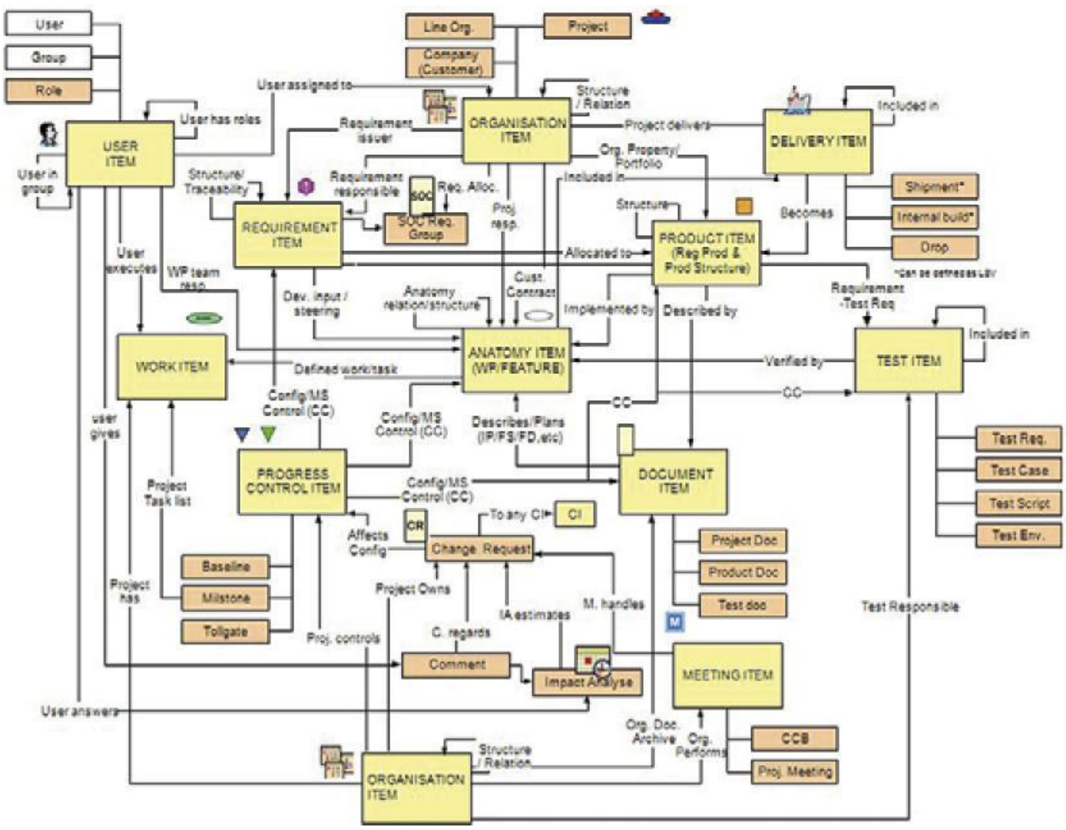

Figure 4. Context model from Ericsson (2002).

knowledge acquired in the domain construction process, etc.

The second target is *information system (IS)* support for coordination. This is achieved by recurrent implementations of the context model in the IS. The final target is *communal understanding* about the context model and its implementation constructed. Taken together, the outcome of the DCP is a socially constructed reality, which aims at providing coordination of complex system development tasks.

Some coordination effects from ICD

ICD was implemented in full in the development of the 3rd generation (3G) of mobile systems at Ericsson. This project was a major challenge. The requirements were unclear, the 3G standard was not settled, the project was large and globally distributed, the technology was at the cutting edge, etc. This situation was expressed by the total project manager as follows in 1999:

"The total technical changes being implemented in this project are enormous. Such changes are needed in order for Ericsson to get a world-leading product first to market. Using traditional methods then the scope of change implemented in single steps will be too large and can not be managed."

From earlier experiences it was clear that the ABEP was indispensable to use. Moreover, the increased demands on coordination resulted in a decision to use the DCP and a specific information system supporting coordination: the Matrix Product Data Management system (Matrix, 2006).

Some of the projects in the 3G development were very demanding. For example, one of the most complex nodes in the 3G system, the so called Mobile Switching Centre node, was developed during turbulent circumstances by 27 sub-proj-ects distributed over 22 development units in 18 countries. Two main coordination domains were constructed: one in Stockholm, Sweden and one in Aachen, Germany.

Agile planning

In situations characterized by uncertainty, instability and complexity, coordination mechanisms must be designed for change. In ICD, two types of changes are managed. One concerns changes due to customer preferences, development faults, system improvements, etc. This type of changes may impact functions in the anatomy, increments in the integration plan, and time and resource planning in the integration plan. The positive effects of ICD in this respect are illustrated by the following statement (R: respondent, I: Interviewer):

"R:... you need to have a quick process of re-planning, stabilizing again and communicating a clear picture that this is what is going to be on the build [the SW load module in the system]..... "

I: So in some sense the tool and the procedure have been valuable?

R: "Yes, I think so, very valuable" (Project manager)

The other type of change concerns the evolution of the coordination domain. This is also supported by the ICD:

"If a trouble report has been found in this block, you have to make sure that in previous versions or later releases, that you correct the same fault. Then, ok how the hell are we going to follow up on this? And then, we entered an extra measure attribute to the block type. ... It is implemented within 5 minutes and also rolled out in the same speed almost." (Methods and tools coordinator)

Informal coordination

Informal coordination is also supported by the ICD, which is evident from the following statement:

"I think that the tool allows us to have a better understanding of impacts of own parts on other parts and the other way around. ... The need for coordination was more or less identified by the tool. They could equally see, OK I'm working on this work package [the term used for increment in the 3G development], which are the other work packages involved and how does that relate for them to other work packages and so on. " (Project manager)

Distributed coordination

The anatomy and the increment and integration plans can facilitate more distributed coordination by encouraging actors to coordinate their actions directly without time-consuming propagation of decisions to higher levels. This is further supported by having all coordination items stored in one information system:

"Yes, what is the great benefit is that you have one common place where all the project area stored the information. It means that a lot of the coordination, which previously went via the main project, now can go directly." (Project manager)

Communal understanding of dependencies

The ICD supports the management of all types of dependencies needed for coordination. This enabled the construction of communal understanding about the project in its entirety:

"Before, every role maintained a piece of information it was responsible for. But in the end [...], they should build an overall picture and what Matrix enables us to get, this full picture, also to cross the border and see "aha this is information somebody else in another role thinks is connected to this one" that is a complete picture of the overall view and not just the limited view the person is responsible for. That is the main benefit I think." (Methods and tools coordinator)

Operational

The main effect of the ICD approach is that extraordinary complex development projects can indeed be coordinated. This is amply expressed in the following quotation:

"Especially for the execution part I think we would not have been able to run this project without the tool. I think if you simply look at the number of work packages, the number of products that we have delivered, the number of deliveries that we have had, if we

would have to maintain that manually, that would have been a sheer disaster." (Project manager)

Discussion

The ICD approach has proven its capability of supporting the management of extraordinary complex mega-projects. At Ericsson, the approach has allowed the company to move away from the traditional ways of managing projects towards creating what might be called a self-organizing project environment. This approach is now standardized at Ericsson.

The ICD approach brings about some disadvantages or risks that must be controlled. The functional focus in the ABEP may result in insufficient attention to performance and other characteristics of the system. More persons from various disci-plines need to be involved from the beginning in developing the anatomy and its associated plans. Too much parallelism in developing and verifying the different increments cannot be managed. Experienced designers may start working on the most problematic functions instead of following the inherent order of developing functions in the ABEP.

The DCP implies that the communal understanding of coordination evolves during the project. The positive side of this is that new needs can be implemented more or less on the spot. The drawback is that the implementation in the information system might turn into a patch work design. At one point in time it was necessary to do a complete reconstruction of the implementation in one of the coordination domains at Ericsson. Moreover, the "daily build" way of working increases the stress on the users of information system, since the interface and functionality of the system changes frequently.

Conclusions

We have discussed a workpractice perspective towards coordination. The main conclusion is that this perspective provides insights of how to coordinate extraordinary complex development tasks in turbulent environments. The different parts of the Integration Centric Development – the Anatomy Based Engineering Process and the Domain Construction Process – are important instruments to manage and gain control in self-organizing types of projects. The Anatomy Based Engineering Process provides the project with the right focus and the means for communication. The Domain Construction Process provides the projects with the tools to keep track of dependencies, requirements, work-packages, changes, etc., that are necessary in order to avoid the chaos that can occur in self-organizing projects. Thus, the workpractice perspective and its operationalization as the Integration Centric Development approach are useful ways of coping with complexity in managing mega-projects.

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