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Images as Action Instruments in Complex Projects

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Abstract
Images have always played an important role in project management. Project activities are communicated through diagrams such as Gantt, WBS, PERT, and CPM. In recent years, new types of images have emerged in large, globally distributed and complex projects exposed to changing and demanding environments. The purpose of this paper is to make an inquiry into how project management activities are supported by these alternative types of images, and suggest reasons why the more traditional types of images appear to be inadequate during turbulent and complex circumstances. As a guiding framework we employ the Activity Domain Theory and the construct of Activity Modalities. Activity modalities are suggested as basic dimensions of human activity coordination; dimensions that can ultimately be traced to the phylogenetic evolution of mankind. In conclusion we find that the alternative images focus on managing critical dependencies and the integration of system parts. Moreover, these images emphasise common understanding and comprehensibility over formalism and rigour. Finally, the alternative images appear to be well aligned with the activity modalities, thus indicating that future research into the management of complex projects needs to take this finding into account.

Introduction
Coordination and communication are at the core of managing projects. Coordination is necessary to achieve the objectives of the project, and communication is needed to disseminate new knowledge and solve problems between development teams, customers and other involved actors. Almost all projects are embedded in an organizational setting (Engwall, 2002). This increases the need for communication and coordination, especially since most development projects are not detached from the permanent organization as suggested in theory. Rather, they are often interacting with the permanent organization and surrounding projects.

Throughout the years technology has changed tremendously. The speed of our processors has developed exponentially, and the capability of communication technology has undergone the similar rapid development. However, our ability to cope with the complexities that these technological developments raise has not increased at the same pace. Thus, there is a gap between the possibilities that technology offers us and our capability to take advantage of this development. Recent findings from the usage of images to coordinate complex projects may indicate one way of closing this gap.

In projects, images are often used to coordinate and communicate actions. The most common images are Gantt charts, PERT (Program Evaluation and Review Technique) / CPM (Critical Path Method) charts, WBS (Work Breakdown Structure); images that were developed many years ago before the boost of complexity. These images are still useful, but it is also reported that they can become almost unmanageable in projects with many changes (Milosevic, 2003; Maylor, 2002).

In complex development projects, alternative images have appeared in practice. These images are referred to as anatomies (Söderlund, 1998; Adler 1999; Lilliesköld et al., 2005; Lilliesköld & Taxén, 2006), dependency diagrams (Ericsson et al., 2002), release matrix (Taborda, 2004), information flow diagrams (Taxén & Svensson, 2005), and the like. So far,
however, the research community has more or less ignored these new instruments, born out of pressing practical needs to enhance communication and cope with increased complexity.

The purpose of this paper is to investigate why traditional images are not sufficient, and discuss the reasons for the emergence of alternative images. In particular, the paper focuses on analysing what qualities alternative images have that make them attractive in the practice of managing complex projects.

The paper is outlined as follows. First, we sketch the contours of one of the most spectacular projects of its time – the construction of the Golden Gate Bridge between 1933 and 1937. In the following section, this project is used to elucidate the theoretical framework employed in our analysis: the Activity Domain Theory (Taxén, 2003; 2004; 2005). Next, we analyse traditional and alternative images using the construct of activity modalities in the Activity Domain Theory as a “screening grid”. Activity modalities are suggested as basic dimensions of human activity coordination; dimensions that can ultimately be traced to the phylogenetic evolution of mankind.

In the discussion, we synthesise our findings and discuss how these might be interpreted. In conclusion, we find that the alternative images focus on managing critical dependencies and the integration of system parts. Moreover, these images emphasise common understanding and comprehensibility over formalism and rigour. Finally, the alternative images appear to be well aligned with the activity modalities, thus indicating that future research into the management of complex projects needs to take this finding into account.

**The Golden Gate Bridge project**

In order to clarify our theoretical approach we will use the construction of the Golden Gate Bridge (GGB) as an example (Horton, 1982).
Figure 1: The Golden Gate Bridge

The thought of building a bridge across the Golden Gate strait had been a lingering idea ever since the gold rush turned San Francisco from a simple military outpost into a vibrant city. For many years that idea remained an impossible dream, but during the 1920s, proposals for a bridge began to materialize. The challenges were enormous. The Golden Gate is about two miles wide and between 40 and 300 feet deep at the place where the bridge was to be built. Winds and water currents are exceedingly unpredictable, and gusts and gales appear frequently. In the winter the Gate is swept by rain, and in the summer it is mostly concealed in fog.

After more than a decade of fighting financial problems, political oppositions, obstructions from ferry boat companies, resistance from the War Department and other obstacles, the construction of the bridge began January 5, 1933. The first step was to build the two anchoring blocks for the cables on both sides of the strait, each of them weighting 50,000 tons. The next challenge was to construct the two piers that would hold the then highest bridge towers in the world. The north pier on the Marin side was placed on dry land close to the shore and fairly straight-forward to build. The south pier, however, was to be built in the sea about 1100 feet from the San Francisco shore. A ring of concrete had to be constructed around the pier, protecting it from the unrelenting tides of the Gate. To this end, a new technique had to be devised for placing charges to blast the rock at 100 feet below the surface. The excavation was carried out from the deck of a barge under constant assault from high winds and waves.
With the piers at place the two towers could be constructed from sections of steel, bolted together and fastened with heated rivets. In 1934, the northern Marin tower was completed in ten months. Benefiting from the experiences of this, it only took 101 days to erect the southern San Francisco tower. During the construction of the towers, the red lead paint of the steel had to be replaced by iron oxide due the poisonous effects of the lead. At one point in time, an earthquake caused the San Francisco tower to sway from side to side, luckily without causing any damage.

The next step was to get the cables in place. Two catwalks, that is, narrow footbridges across the Gate, were constructed from pilot cables. With these catwalks in place, the cable spinning began in 1935. Enormous spinning saddles were mounted on top of the towers, spinning wires into strands, finally completing the 7650 feet long suspending cables in 1935.

The final step in the construction was to cross the gate with a steel-supported concrete highway. Steel-sections were inched out symmetrically from each tower at both directions to counter-balance the weight. In order to increase the safety, a trapeze net was placed below the steel sections to prevent workers from falling into the roaring Gate. With the steel-sections in place, the concrete road-way was poured in rectangular slabs. Finally, on May 27, 1937, the Golden Gate Bridge was open. One of the most daring projects of that time was completed.

An integrating theoretical framework

Usually, projects are described in terms of plans, resources, tools, organizations, etc. In essence, project management (PM) is about enabling all these things to jointly contribute to achieving the objectives within given financial and time limits. However, with increasing turbulence and complexity, the ability to get an overview of the project and make sense of how all pieces fit together, is severely aggravated. Vital interdependencies may be lost in myriads of details. To this end we shall propose an integrating theoretical framework, which may be used as a “screening grid” for attending the essential features in a fragmented world.

The point of departure is the concept of “enactment” as formulated by Orlikowski:

“[The enactment view] starts with human action and examines how it enacts emergent structures through recurrent interaction with the technology at hand” (Orlikowski, 2000)

In constructing something like the GGB, certain means have to be used: raw material, tools, information, processes, methods, rules, and so on. However, as pointed out by Orlikowski, these means do not become resources until enacted; they must be embodied in the minds and bodies of the actors. An artefact, like a hammer, does not become a tool unless someone recognizes its purpose and learns how to use it. Moreover, coordination implies that there is a shared or communal side of enactment; it cannot be confined to individual aspects only. Enactment then, brings about two kinds of manifestations – embodiment in the actors and resources in the activity the actors are engaged in.

Thus, we evoke meaningful and useful resources through action. Conversely, we can coordinate our actions only when the world stands out as meaningful and in some sense shared to us. This line of inquiry has been developed in Activity Theory (e.g. Kaptelinin & Nardi, 2006), and further elaborated into the Activity Domain Theory (ADT) by Taxén (2003; 2004; 2005). The essential features of ADT are as follows.

A basic insight is that meaning construction and knowledge creation are always contextual:
“All productive knowledge is linked to and dependent upon an organizational context. In order to understand learning and accumulation of knowledge in an organization, it is necessary to define the content of the organizational context.” (Jensen, 2005)

In ADT, this context is called the *activity domain*. In the activity domain, actors are socially organized in order to produce something that is needed in society. The existence of the activity domain is motivated by the need. Moreover, there is always something that the activity is directed to – the *work object*. The motive and work object are determinants for the meanings and resources enacted. In the GGB project, the overall activity domain is quite naturally the project itself. The motivation for the project is obvious: to be able to transport people and goods efficiently across the Gate. An additional motive was to reduce the unemployment after the Depression. The work object is of course the bridge itself.

In ADT, contextualization is one of several *activity modalities*. An activity modality denotes a fundamental dimension in human activity along which communal meaning and resources are enacted. Besides contextualization, the other modalities are as follows (Taxén, 2003; 2005):

- **Spatialization** denotes a spatial dimension that enables communal meaning of what entities are relevant, how these entities should be characterized and related to each other, and in what state or condition they are. Examples of spatialization in the GGB project are blue-prints of the bridge, maps of the bridge and its land connections, etc.

- **Temporalization** denotes a temporal dimension that enables communal meaning about actions and the dependencies between them. In this sense, temporalization corresponds to the definition of coordination given by Malone & Crowston (1994): “Coordination is managing dependencies between [actions].” (p. 90). An example of temporalization in the GGB project is the project plan, expressing the sequence of actions needed in order to complete the bridge.

- **Stabilization** denotes a stabilizing dimension that enables communal meaning about what actions are considered valid and useful. Stabilization is manifested as norms, values, habits, routines, methods, rules, standards, domain specific languages, etc. Without stabilizing elements, coordination is impossible. Examples of stabilization in the GGB project are safety regulations, units of measurements, construction methods, etc.

- **Mediation** denotes a mediational dimension that enables communal meaning about tools and instruments by which actions are accomplished. Mediation, which can be material and semiotic in nature, is a key concept in activity theory (e.g. Susi, 2006), and refer to the idea that humans always put something between themselves and their work object. Examples of mediation in the GGB project are dynamite, dredgers, pneumatic tubes, spinning saddles, derricks, and so on.

- **Transition** denotes a transitional dimension that enables communal meaning about how activity domains interact. Transition is manifested several ways. One is the outcome from one domain, which may be the prerequisites of another domain. Other manifestations are mappings and translations between domain specific meanings. An example of a transitional element in the GGB project would be the contract between main project and the cable spinning sub-contractor, Roebling & Sons, who had a long experience from spinning cables for bridges.
The construct of activity modalities is an attempt to capture distinct, albeit mutually interdependent modes of human activity coordination. The phrase “activity modalities” is deliberately coined to connote with sensory modalities, thus indicating that activity modalities ultimately may be traced back to the phylogenetic evolution of mankind (Taxén, 2006b). The constitution of our cognitive and neurophysical system is such that we experience coordination of our activities in the dimensions given by the activity modalities. In plain language, this may be expressed as follows:

- Human action is always situated (contextualization)
- Humans need to orient themselves spatially (spatialization)
- Actions are carried out in a certain order (temporalization)
- Rules, norms, etc., signify valid actions (stabilization)
- Humans always put something between themselves and their work object (mediation)
- Activity domains need to interact (transition)

In summary, the structure of the ADT may be illustrated as in Figure 2:

In the following, we shall make use of the activity modalities as a guiding framework for analyzing traditional and alternative images in PM.

**Traditional images**
The dominant methods and images (WBS, Gantt, PERT & CPM) for planning a project were developed in the late 1950s. These images show graphically the sequence of, and the relationships between the individual work tasks required for the completion of a project.

**WBS**
A WBS is often performed as the first step in the planning process. It is a deliverable oriented grouping of project elements that organizes and defines the total scope of the project – work.
not in the WBS is outside the scope (PMBoK Guide, 2000). By breaking the work down into smaller elements there is a belief that risk and uncertainties are reduced, since each level provides a greater probability that every activity will be accounted for. In its graphical format, it is obvious why the WBS is often describes as a project family three (Milosevic, 2003), hierarchically displaying interim and end project deliverables (see Figure 3):

![Figure 3: A WBS diagram](image)

Although a variety of WBSs exist, the most common according to Kerzner (2001) is a six-level indented structure. The top three levels are called the Managerial levels: 1) Total program/project 2) Project 3) Task. The following levels are referred to as Technical levels: 4) Subtask 5) Work package 6) Level of effort. Project managers normally manage and provide status reports at the top three levels (ibid.).
**Gantt**

Even though this is the oldest formal scheduling tool, it is still widely used. The Gantt chart uses bars to represent activities or tasks (see Figure 4). It shows when the project and each activity start and end against a horizontal timescale (Milosevic, 2003). The chart is a useful tool for planning and scheduling projects, as well as monitoring the progress of the project.

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Description</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do preliminary market analysis</td>
<td>2007-07-02</td>
<td>2007-07-02</td>
</tr>
<tr>
<td>2</td>
<td>Do preliminary manufacturing study</td>
<td>2007-07-02</td>
<td>2007-07-06</td>
</tr>
<tr>
<td>3</td>
<td>Develop preliminary product design</td>
<td>2007-07-03</td>
<td>2007-07-09</td>
</tr>
<tr>
<td>4</td>
<td>Evaluate and select best product design</td>
<td>2007-07-09</td>
<td>2007-07-09</td>
</tr>
<tr>
<td>5</td>
<td>Develop detailed manufacturing plan</td>
<td>2007-07-10</td>
<td>2007-07-12</td>
</tr>
<tr>
<td>6</td>
<td>ETC</td>
<td>2007-07-12</td>
<td>2007-07-13</td>
</tr>
</tbody>
</table>

Figure 4: A typical Gantt chart

**Network diagrams**

A network diagram represents project activities as nodes or arrows, determining which of them are critical in their impact on project completion. CPM is one of the more common network diagram techniques for analyzing, planning, and scheduling projects. CPM is similar to another common network diagram technique called PERT (see Figure 5), but while the activity duration estimate in CPM is deterministic, PERT uses a weighted average to calculate expected time of activity duration (Milosevic, 2003).

Figure 5: A typical PERT diagram

A driving force behind developing a network diagram is to highlight interdependencies between activities. Initially this was also the major discrepancy between Gantt charts and network diagrams. This divergence has however disappeared over time, since Gantt charts have incorporated inter-activity dependencies. Just like the Gantt chart, all major PM
software tools provide CPM/PERT chart notations. And just as with Gantt, CPM/PERT charts exist in several versions, allowing different modelling possibilities.

Except for the layout, the main difference of CPM, as compared to the Gantt chart, is that time is stated relatively. Moreover, tasks are equipped with information not only about the duration, but also with early and late start and finish (relative) time. Furthermore, slack time, i.e., the time span of independency, is expressed for every task. Slack time, in turn, facilitates the identification of the project’s critical path.

Analysis of the traditional images
The traditional images are developed for management to obtain control of the work to be performed. The task to create shared understanding of the work to be done, and take decisions regarding changes, were not in focus when these images were devised. Such actions were meant to be taken by one or a few key persons responsible for the work. Thus, the images primary motive is to control planned actions rather than support the project to align with moving targets and emerging, fuzzy goals.

It can be observed that both Gantt and CPM diagrams display a typical form of “doing something with something”, for example, “Develop preliminary product design”. A verb and a noun indicate that two activity modalities are at play here: spatialization (the noun) and temporalization (the verb). The Gantt diagram and the network diagrams have a strong temporal character as indicated by the horizontal axis. However, the dependencies between the spatial elements are not shown, for example between “manufacturing plan” and “product design” in the example diagrams. Such dependencies, which indeed constrain the freedom in laying out the order of activities, must thus be kept implicit in the minds of the main actors. In essence, this means that vital dependencies might remain concealed in the project, something that quite naturally may have severe consequences.

Another observation is that WBS images appear to display several modalities in one image. The break-down structure is a typical expression of spatialization; regardless of the fact that the entities happen to be activities (see Figure 3). At the very top, the boxes seem to signify contexts of work division, something which is closely related to the transition modality. Towards the bottom of the figure, there is a clear indication of a sequence of activities, that is, a temporal dimension. Moreover, the naming of each work package shows the same structure as in the other diagrams: a verb and a noun. Thus, from an activity modality point of view, WBS images are based on unclear semantics, where several modalities are, so to speak, projected onto the same, two-dimensional image. This may severely aggravate the development of communal understanding about the project in more complex situations.

Even if several modalities can be traced in the diagrams, there is no indication of how these modalities are interrelated. Suppose, for example, that a customer discover during the project that he needs an additional functionality in, say, a telecom system. This might impact functions deeply buried in the system. Without a clear view of the spatial dependencies between functions, it is impossible to re-plan the project. Thus, the traditional images are weak on displaying dependencies between different modalities.

These observations are underlined by other findings. In its original form, the Gantt diagrams did not include dependencies. However, in most Gantt software tools today, dependencies between activities are included in the diagram. This indicates an increased attention of the importance of dependencies. Moreover, several drawbacks of traditional images have been
reported. Network plans looks convoluted and perplexing to first-time users. Even though they have a strong temporal character, most network diagrams do not have a time-scale (except Time-Scaled Arrow Diagram that is the only CPM method displayed against a timescale), and is thus appears timeless for the untrained eye. Another drawback with PERT and CPM in terms of complex system development, is the underlying assumption of a given functionality of the finished product. This may give a delusive impression that only time and resources need to be controlled.

Concerning changes, Gantt chart and network plans easily become too complex. In fact, it has been reported that updating and maintaining network plans and Gantt charts can be overwhelming for very dynamic projects (Maylor, 2002; Milosevic, 2003). If the diagrams become larger than one page, they are not useful for communication or discussions. The diagrams are good for static environments, but less useful during ever changing circumstances.

**Alternative images**

In this section we will analyze the alternative images *system anatomy, increment plan* and *integration plan* (Söderlund, 1998; Adler 1999; Lilliesköld et al., 2005; Lilliesköld & Taxén, 2006). These images were devised in the early 1990s as components in the so called Integrated Centric Development approach at Ericsson; a major supplier of telecommunication products worldwide. This approach still in extensive use at Ericsson and has recently started to spread outside the company. In addition, we will discuss the *dependency diagram* used at ABB, a company that supplies high-voltage distribution systems on a global basis (Ericsson et al., 2002). These alternative images have been found useful in practice but have so far not been subject of theoretical inquires.

**System Anatomy**

The motivation for the system anatomy is the need to create a common architectural view of the capabilities of a system for all stakeholders involved. The underlying idea is that an image is easier to agree upon than a traditional two-hundred page specification where everyone is left to create their own interpretation. The anatomy shows the dependencies between major functions or capabilities in the system, from the most basic ones to a fully operational system. An example of an anatomy of a processor is shown in Figure 6:
Figure 6: The system anatomy of a processor

The anatomy is created in workshops where the mindset should be: “if you ‘power-on’ what happen then and then.” This question is repeated until the end functionality is reached. The image may be more or less correct; this is not crucial. The decisive point is that actors can work and solve their part of the problem on the basis of the image they have.

Increment plan (work package plan)
The key point in the Integration Centric Development approach is to implement the system in the same order as the capabilities are needed according to the anatomy; hence the concept of “anatomy” as an indication of how to “breath-life-to-a-system”. The development is done in increments, which in fact are more or less equivalent to work packages in a traditional WBS.

The motivation for the increment plan is the need to find a common view of how to implement the system. The capabilities in the anatomy are grouped into increments in such a way that the resulting sub-system after each added increment can be verified. In line with the metaphor of the anatomy, this could be apprehended as defining the major ‘organs’ in the system. As a matter of fact, this second step is called “Organic Integration Planning” at Ericsson. In Figure 7, an increment plan for the same processor as in Figure 6 is shown:
When defining the increment plan, design and testing are parallelized as much as possible. The plan describes in what order increments need to be completed to ensure smooth progress. The structure of the plan is determined by a number of circumstances such as the system architecture, available resources, customer feedback, complexity of functions, geographical proximity between resources, joint functions testing, and so on.

**Integration plan (project plan)**

The motivation for the integration plan is the need to control what is delivered when, and from whom. When the plan is created, resources are assigned and dates for deliveries of the increments settled. For each increment, traditional time and resource plans are made as well. The integration plan also clarifies the receiver of each internal delivery. Thus, it focuses on the dependencies between subprojects. In Figure 8, an integration plan for the processor is shown. It can be seen that this plan is a ‘tilted’ variant of the increment plan, hence signifying a time line:
The focus in the integration plan on dependencies and deliveries between subprojects clearly shows the impact of a delay in the project, since all the internal deliveries are in some way related to the delivery of the final system to the customer (Anderstedt et al., 2002). Thus, the plan provides the project with early warnings of delays, and gives the project manager ample time to take corrective actions. On the surface, the integration plan looks similar to a CPM-diagram. However, the integration plan and the CPM-diagram are derived in a completely different ways.

Dependency diagram
The motivation for the dependency diagram was the need to coordinate deliveries from various sub-contractors in a global development project, where the subprojects were required to work independently from each other (Eriksson et al., 2002). The dependency diagram shows the most important system functions, products, sub-projects, and integration activities in one image (see Figure 9).
On the vertical axis, the diagram shows the different product development activities as part of the system solution. The circles represent events in terms of releases, each one marked with the date of delivery and whether the delivery is part of an “alpha” or “beta” release. The arrows indicate dependencies between the releases.

The dependency diagram served as a base for managing the overall project time schedule and controlling internal deliveries. The intention was to highlight the impact of subprojects’ delays on the common project schedule. A striking observation was that previous attempts from the total project manager to plan the sub-projects in detail had failed. With the introduction of the dependency diagram, the detailed planning was handed over to each sub-project.

**Analysis of the alternative images**

In all the alternative pictures there is an obvious integrative perspective with a clear focus on the product that is to be delivered to the customer at the end. Moreover, these images also highlight critical dependencies of different types. Further, each image appears to be aligned with a dominant activity modality. The system anatomy has spatial structure since only static dependencies between capabilities in the system are shown. The increment plan shows the dependencies between increments, which can be conceived of an activity domains. Hence, the integration plan is aligned with the transition modality. The integration plan has an
obvious temporal character since there is a horizontal time axis in the image. The dependency diagram shows two dominant modalities: temporalization along the horizontal axis and transitions between sub-projects / domains on the vertical axis. Moreover, the three images in the Integration Centric Development approach are related to each other through the common basis in the anatomy. Thus, the dependencies between modalities are clearly seen.

**Discussion**

We have analysed traditional and alternative images used in PM. Our analysis departed from the concept of enactment and utilized the construct of activity modalities as a guiding framework. Some of the findings are:

- Traditional images are focused on control rather that action and coordination.
- Alternative images are focused on dependencies and integrations, and emphasize comprehensibility and informality over formality and rigour.
- Both the WBS and the increment plan in the Integrated Centric Development approach use “work package” as the unit for planning and monitoring projects. The purpose is to arrive at a reliable estimation of the work effort and to assign suitable units of work that may be distributed to project teams. However, the ways in which the work packages are defined are quite different. The increment plan is based on dependencies between capabilities in the system to be developed. This is lacking in the traditional WBS.
- The Integrated Centric Development approach utilizes a consistent set of images, each addressing / emphasizing a particular activity modality.
- The transitional modality in the dependency diagram emphasises the dependencies between deliveries from each sub-project. The internal affairs of each sub-project are not relevant on the total project level, only the coordination between deliveries according to the common denotation expressed in the dependency diagram. Thus, the diagram acts as an instrument for balancing coordination efforts on a central level with local, independent and internal coordination in the sub-projects.

In general, the alternative images are strongly associated with action. The images are not only used for reporting purposes – they are used as instruments for anticipating possible actions and foreseeing the consequences of these actions. The anatomy in the Integrated Centric Development approach and the dependency diagram are in fact the central coordinating instruments in extremely complex projects. The action aspect of traditional images is much less evident.

A conspicuous difference between traditional and alternative images is that traditional images seem to “compress” different modalities into a single image. The alternative images, on the other hand, appear to “decompress” these modalities in such a way that each image displays a dominant modality without detaching interdependencies to other modalities. It is as if the alternative images are more congruent with the modalities than the traditional ones. If the activity modalities indeed represent dominant dimensions in human activity developed during the biological evolution of mankind, this would indicate that the alternative images are more resonant with the way our cognitive system experiences and constructs the world.

The construction of the alternative images is a social accomplishment. The images turn out slightly different depending on the composition of the group of actors developing the images. Moreover, these images are constantly revised during the project due to various reasons such
as changed requirements, new insights, improved ways of working, errors and mistakes, etc. This indicates that the actors involved are indeed enacting the images; they are turning the images into action instruments while simultaneously constructing a communal understanding of the use of these instruments. Thus, the enactment process goes beyond mere learning where actors are passively appropriating the use of already existing artefacts. Consequently, the call for focus on learning in projects (see e.g. Pollack, p. 272) is a necessary, but not sufficient condition for managing complex projects.

It is sometimes claimed that only theoretical research can advance the state of PM (Turner, 2006). Other researchers have taken the opposite stance (Blomquist et al., 2006). Our findings are quite clear on this point; innovations in PM are always derived from pressing needs on the practical battlefield. It is virtually inconceivable that the alternative images would have emerged in academia. From an activity domain point of view, this is quite natural since the enactment process is inherently tied to the work object and the motive of the domain. However, theoretical research has an important role to play in analyzing and explaining events, and making informed suggestions on how to transfer findings to other contexts. Also, theoretical development may indicate ways of improving practice. Thus, the interplay between theory and practice should be the solid ground for advances in PM.

An extensive inventory of the PM literature by Pollack (2007) indicates that there is a shift in PM from the “hard” paradigm to the “soft” one. The hard paradigm denotes a focus on stability, predefined goals, control, reductionist techniques and the project manager as the ‘expert’. Up till now, this has been the prevalent paradigm in PM. However, more and more evidence is being gathered, pointing towards the conclusion that the hard paradigm cannot cope with turbulent environments, unstable conditions, moving targets, learning ‘on-the-spot’ and so on.

An indication of how to approach a more soft paradigm is given by the ability of the alternative images to cater for what might be called “federative control” or self organizing teams, enabling the total project manager to coordinate only what is necessary. At Ericsson, where the anatomy concept has been used, it has been possible to transcend from a traditional PM approach to a more self-organizing approach (Taxén, 2006). Thus, the alternative images may be one set of instruments for advancing the shift from the hard paradigm to the soft one.

However, according to Pollack (ibid.), PM appears to lack a coherent underlying theoretical basis that would illuminate the path towards a softer oriented paradigm. We suggest that the Activity Domain Theory may provide such a basis. There are several reasons for this rather bold claim. First, any theory addressing complex projects must acknowledge the fact that PM is about coordinating different organizational units working on diverse work objects and enacting dissimilar meanings and resources. Thus, there must be a construct corresponding to the activity domain in the theory. Second, the soft paradigm is inherently related to human and social issues. We claim that theories addressing such issues must eventually take a stand on meaning construction and activity. Finally, the theory must provide guidelines on how to operationalize its theoretical constructs, that is, the theory must become an instrument in itself by which it is possible to make a difference in practice.

To summarize, the our findings indicate that future inquires into managing complex projects should be directed towards exploring instruments that are aligned with dominant modalities, however, without detaching the mutual interdependencies between these modalities.
Conclusions
We have investigated the striking observation that extremely complex projects are coordinated and monitored by, in principle, very simple images. In dynamic environments, there is a need to focus on common understanding and dependencies. Images are one way to achieve this. However, it appears that traditional images are inadequate for this purpose. The alternative images are quite distinct from traditional ones. They have emerged in practice but have until now been sparsely treated in the PM-literature or ongoing research. Our findings indicate that alternative images display dominant activity modalities and their interdependencies. This is most distinct in the Integration Centric Development approach at Ericsson. The main conclusion is that the management of complex projects needs to attend to the activity modalities and device instruments aligned with these.

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