ORGANIZING CIVIL CONSTRUCTION OF THE EUROPEAN XFEL

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Abstract

This paper describes the organizational structures and processes which are established for coordinating civil construction at the European XFEL. Local managements supervise the different construction sites in cooperation with a central team which coordinates the overall effort and provides general services like e.g. documentation, communication, safety and legal advice or change and claim management. Communication processes, workflows for reviewing, approving and distributing construction drawings and formalized change management are defined. Reporting, cost management and controlling procedures are put in place, as well as procedures for maintaining good public relations. All the processes are described in a project handbook, and they are supported and optimized by IT systems, in particular the DESY Engineering Data Management System, DESY EDMS.

INTRODUCTION

At the end of 2008, the construction of the European XFEL at DESY in Hamburg has started. The first phase conducts underground civil construction, including the injector complex, a 100x30x40m^3 underground building containing the injector and large technical infrastructures, the main linac tunnel, a 2.2 *km* tunnel of 5.3*m* diameter, several 4.5*m* tunnels for photon beamlines, and access shafts, caverns for beam dumps, and the experimental hall. The XFEL has three construction sites: one at the start at DESY for the injector complex, one at the end in Schenefeld for the experimental hall (and later, a new XFEL campus), and one at the end of the cold linac and beginning of the photon tunnels at Osdorfer Born.

Figure 2: Aerial view with the layout of European XFEL. The injector complex is located at DESY (right) and the new XFEL campus in Schenefeld (left).

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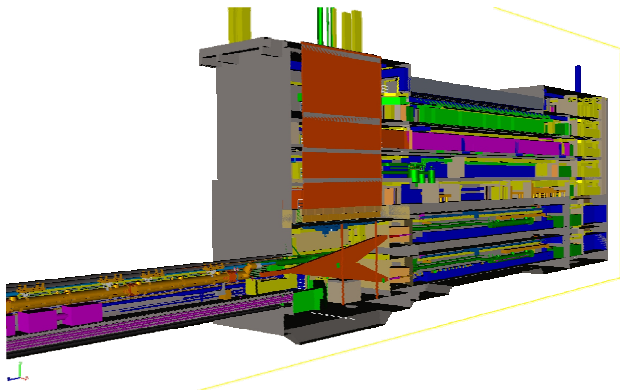

Figure 1: Model of the injector shaft, showing the tight interconnections of civil construction, technical infrastructure and accelerator.

Figure 2 shows the layout of the planned facility. Most of the tunnels have to be constructed under inhabited areas.

ORGANIZATION REQUIREMENTS

Organizing XFEL construction has to cope with a number of challenges, such as:

- The construction sites are widely distributed and not directly accessible from DESY, hence efforts and delays in communication, information exchange and decision making have to be taken care of.
- Civil construction is tightly interwoven with the design and construction of the accelerator and its technical infrastructure. Decisions and changes in civil construction therefore have to be verified with a large number of expert groups from other domain [1]. Figure 1 shows a model of the injector complex building with accelerator and infrastructure which illustrates the dependencies.
- The management organization requires experienced experts, has to be built with new staff and is only needed for a limited period of time.

Because of the size of the project, the distribution of the construction sites and the expected staff fluctuations, a well-defined project organization with well-defined responsibilities and processes is needed.

PROCESS ANALYSIS

A formal process analysis is performed to identify business needs, determine necessary roles and responsibilities and clarify and agree the essential processes. The analysis involves XFEL project management and technical coordination, the work package leaders for the civil construction, external consulting civil engineers, and experts for process

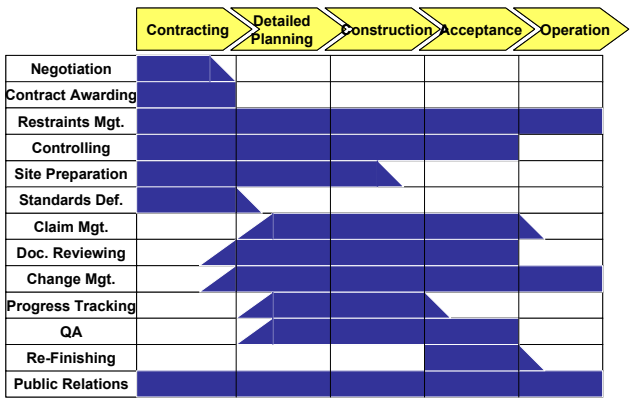

Figure 3: Example from brainstorming session using Metaplan technique (top) to identify major activities (bottom).

organization. It started with a brainstorming session for identifying the core activities (Figure 3). Then, subsequently the major processes are investigated in detail, identifying the core roles, responsibilities and workflows. The process analysis results in an org chart and workflow descriptions, which are collected in a project handbook.

As a sidebar: Not everything in XFEL construction is new. For example, some experience could be transferred from the construction of subway lines with underground stations, which face some similar challenges.

ORGANIZATION

Figure 4 shows the organization chart for the construction of the European XFEL. It consists of local managements for the different construction sites and activities under the supervision of a central coordination team. The central team consists of the chief construction supervisor and supporting staff for dedicated activities such as for example legal advice, controlling, change and claim management, accounting and contracting.

The organization distinguishes supervisors and managers: Managers organize the daily business at the different construction sites, while supervisors oversee the construction efforts and take general responsibility. Separating these roles enables outsourcing of management activities and this way providing the necessary flexibility for staffing (e.g. short-term up- and down-sizing of the team according to current needs),

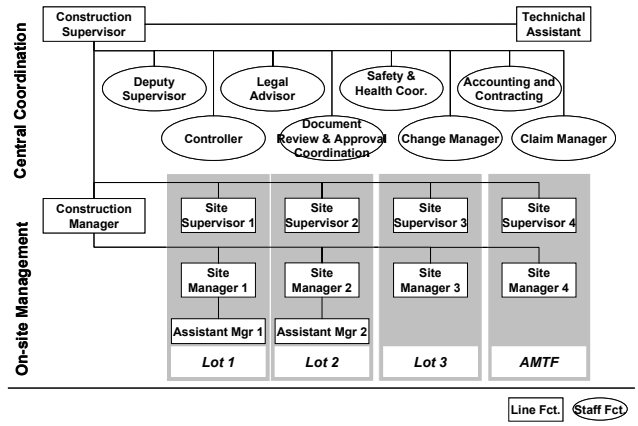

Figure 4: Organization chart for the construction of the European XFEL, showing central coordination and local on-site managements.

while keeping responsibility and decision making in-house.

EXAMPLE PROCESS DEFINITION

This section provides an example process description for one of the key processes, the review and approval of construction drawings.

DESY has provided CAD models and construction drawings of the planned buildings and tunnels to the construction companies as part of the contracts. While these materials are precisely defining the project, the constructors nevertheless have to further detail the drawings for implementation. Prior to construction, the drawings have to be accepted by DESY and reviewed and approved by public administration. Hence a process is needed for reliably and efficiently receiving, reviewing and approving drawings.

The review and approval process involves several roles and groups: The constructor prepares and submits a drawing to DESY. At DESY, the central "Document Review & Approval Coordinator" inspects the plan for formal correctness and routes it – depending on the type on content of the drawings – to the relevant reviewers. The reviewers provide mark-ups, then drawing and mark-ups are presented to the approver (usually the chief construction supervisor), who has the final decision on approval or rejection. Once a drawing is accepted by DESY, it is forwarded to public administration, where a similar review and approval process takes place (which is out of scope for this organization).

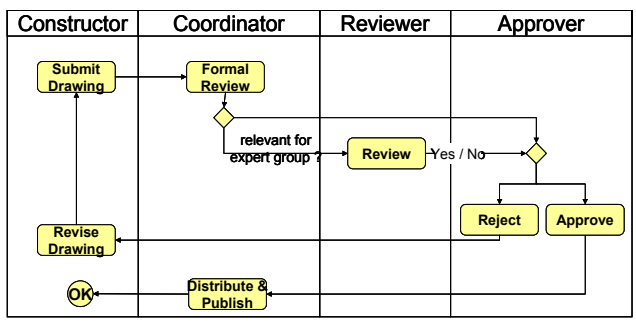

Figure 5: Simplified description of review and approval

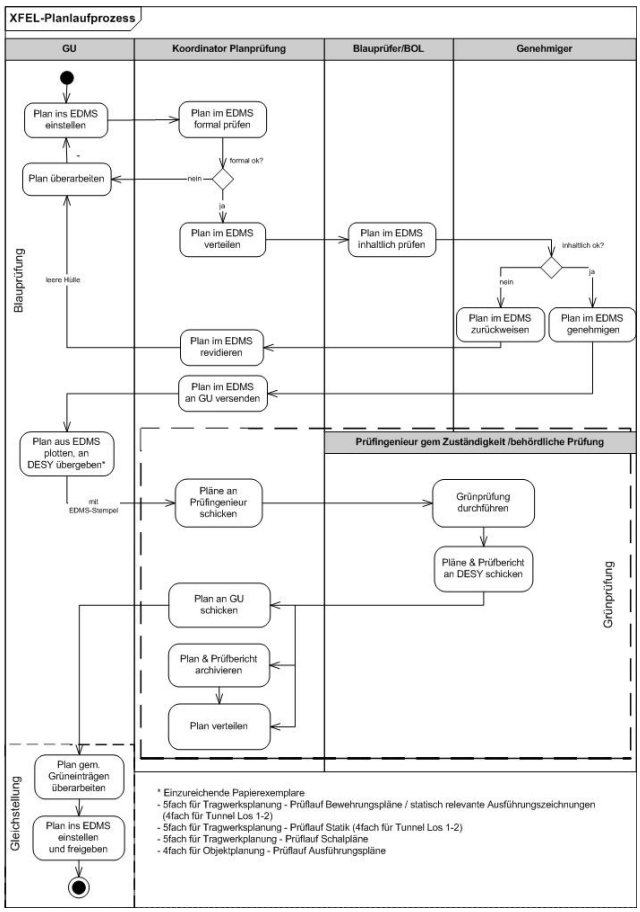

Figure 6: Process definition for drawing review & approval.

Figure 5 shows a simplified illustration which is suitable for explaining the process, the involved roles and their key activities and responsibility. But for a successful process implementation, more information is needed. For example, the construction contract defines maximum durations and delays for some activities and sub-workflows, and it has to be precisely shown where in the process such activities start and end. Also, the number, type and quality of documents which are exchanged need to be specified. This information is again provided in the project handbook. Figure 7 shows an example for an extended process description which is suitable for defining performance indicators such as e.g. delays and processing times.

Similar definitions are created for all the processes which were identified in the process analysis.

TOOLS

Dedicated information systems support the processes enable efficient work with minimum delays and high reliability and reproducibility. For example, the DESY Engineering Data Management Systems (DESY EDMS [2]) is coordinating and tracking the review and approval process and providing web-based access to drawing for everybody in the project (Figure 7). Other activities, for which dedicated systems are or will be introduced,

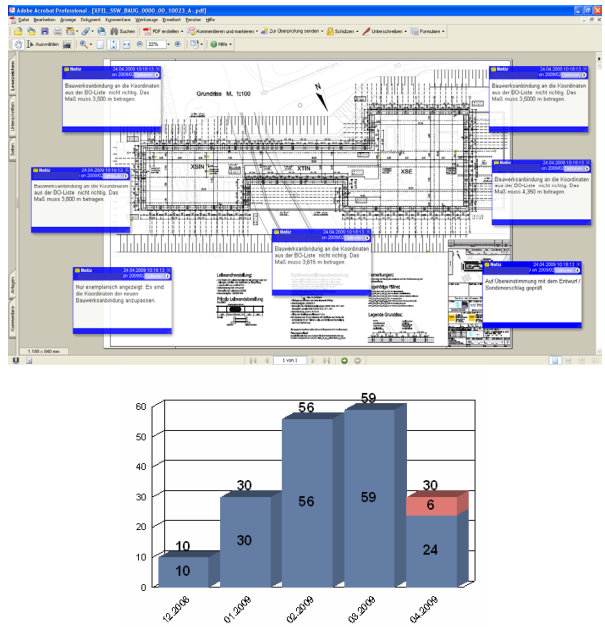

Figure 7: Examples for process support by information systems: Several reviewers provide mark-ups on a drawing in parallel (top), a report shows how many drawings have been received when and whether their processing is complete (bottom).

include issue tracking, general reporting and cost controlling.

EXPERIENCE

Most of the organization, i.e. roles and processes, for coordinating civil construction at the European XFEL, are successfully established. Process analysis and definition were well-received by the participants. They helped developing a common understanding of the effort, and clarify responsibilities and interfaces among project team.

The EDMS and other systems are somewhat orthogonal to the traditional culture in civil construction, which focuses on paper and persons, resulting in some initial reluctance to work with such systems. Trainings and initial support including coaching on the job were provided to ensure familiarity with the systems throughout the project team, and it then soon became obvious that the systems are essential for coordinating the processes and keeping the complexity under control, especially with respect to the specific challenges of the project. Furthermore, the systems are a good vehicle for ensuring that the processes are executed as agreed.

REFERENCES

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