Abstract: Managing a large-scale distributed engineering project needs skilled, motivated and committed personnel. Unified and aligned working methods are needed. Project alignment is the process of ensuring that key stakeholders share a common understanding of the project mission, goals, objectives, tactics, work processes and plans and have the required competences and skills. Based on current advances in the area of collaborative networked organisations, project management and Internet web 2.0 technologies, we have identified further needs and opportunities for development in the area of Collaborative Project Management. The Project Alignment Booster is a set of software services used to promote collaborative project management. The tool has been developed to suit industrial requirements in the area of large and complicated engineering project management. The paper reports the results of developing a toolkit to support collaborative project alignment.

1. INTRODUCTION

Large-scale one-of-a-kind facilities, like power plants, process factories, ships or communication infrastructure are created through projects. Today, engineering projects are often geographically distributed. In addition to the geographical distribution among the customers, the delivering (project) organisation itself can be widely decentralised. In complicated large engineering projects, the required skills and competencies may not be available in single organisations. Collaboration over organisational and geographical boarders can give access to complementary necessary expertise, which may vary between projects depending on customer requirements, local characteristics, legislation etc.

Enterprise collaboration is the well known and obvious way to provide the needed capabilities in dynamic and distributed environments. To achieve the planned outcome of a distributed project, the collaborative ability and commitment towards the goals among the participants are emphasised (Ollus et al. 2011). Collaborative project alignment is the process of ensuring that project partners share a common understanding of project goals, objectives, used work processes and plans.

Based on a combination of advancement in the area of collaborative networked organisations, project management and Internet Web 2.0 technologies, we have identified further needs and opportunities for development in the area of Collaborative Project Management (CPM), which have been realised as a set of IT services to support CPM. The aim of this paper is to describe these services, which we call Project Alignment Booster. Some first experiences of the booster are also described.

2. BACKGROUND

Collaborative Networked Organisations (CNO) have been the subject of intensive research during the last decade. The research object spans traditional supply chains, collaborative networks and business eco-systems. Several international and EU-funded initiatives, e.g. ECOLEAD, ATHENA and COIN have developed reference models, collaboration platforms and software tools to support CNOs.

The collaboration within CNOs fits into the concept of a business eco-system introduced by James F. Moore already in the 1990s (Moore 1993): “An economic community supported by a foundation of interacting organisations and individuals – the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the eco-system.”

In the European CNO research cluster VOSTER, two main concepts for inter-enterprise collaboration were identified according to the objective and duration of the collaboration (Kurumluoglu et al. 2005):

Network / breeding environment which is a more stable, though not static, group of organisations which have developed a preparedness to co-operate.

Virtual organisation (VO) / virtual enterprises which is a temporary consortium of partners from different organisations established to fulfil a value-adding task, for example a product or service to a customer.

A VO is usually created within a network composed of organisations committed to collaborate. To achieve efficient collaboration, some degree of preparedness and sufficient
preparations are needed. This preparation takes place within the Breeding Environment. The concept of the Breeding Environment is used to characterise the network behind a VO. The Virtual organisation’s Breeding Environment (VBE) represents a long-term “strategic” alliance, cluster, association, or pool of organisations that provides the needed conditions for collaboration. (Camarinha-Matos et al., 2008).

Based on the above definitions, a VO has similarities with a distributed, inter-organisational project, and the business eco-system is one kind of a network. The level of preparedness within the networks may vary. The business eco-systems are usually considered less tight organisations than breeding environments (Ollus et al. 2011).

The ARCON Reference model for Collaborative Networks, created in the ECOLEAD-project, has enhanced previous frameworks for understanding the relationships between entities in a CNO (Camarinha-Matos et al 2008). An earlier reference model is VERAM - Virtual Enterprise Reference Architecture and Methodology (Zwegers et al 2003). The VERAM reference model is based on the Generalised Enterprise Reference Architecture and Methodology, GERAM, which was developed for modelling of single enterprises and has been accepted as an ISO standard (GERAM 2000). In VERAM, this model was extended for modelling virtual and networked enterprises. According to GERAM, the processes of an entity can be distinguished into two different types:
- Service to the customer (creating the value; product or service). The operational processes of a project are of this type.
- Management and control process (coordinating and managing the value creation). Project management belongs to this type of processes.

The processes are interdependent. The more complex and time or cost-critical the operational processes are, the more challenging is the management process. The outcome of a project can be improved either by investing in the project management or by developing the project operations. Naturally, both efficient management and processes are preferable.

The discipline of project management (PM) is well established. Several professional PM organisations have done considerable work in developing guidelines, methods and tools for the PM profession. The best known of these organisations, The Project Management Institute, has defined the Project Management Body of Knowledge (PMBOK®). Professional associations are active and the diversity of Project Management IT-applications available in the market is huge.

In this paper, we use the term CPM more with the meaning “Collaborative Management of Projects” and less with the traditional interpretation “Management of Collaborative Projects” (Ollus et al. 2009). Sharing management responsibilities is seen as one necessary approach to improve performance in global distributed projects (Ollus et al. 2011).

Collaborative Management of Projects involves shared and delegated project management responsibility, often self-organised and trusted approaches, and a non-hierarchical and participative management organisation. CPM requires that the participating organisations and people share a common commitment and understanding of project objectives, requirements and practices, and that the partners have sufficient competencies and skills for the project tasks. This is a challenging requirement even in the case of projects performed in collaborative networks, having created common preparedness for collaboration. It is even more challenging in a global business eco-system with lower preparation levels.

PM software is a term commonly used to cover software targeted to aid the project managers in managing their projects. Available PM software solutions have traditionally focused on scheduling (tasks, durations and dependencies) and resource management (resources, availability, workload and criticality), providing functions for both planning and follow-up.

Based on industrial requirements and from analysing the current state of the art and research progress in the area of CNO, PM and Web 2.0, we have concluded that there is a need for development in the CPM area. Recent development within internet technology, social media, participative co-creation, and Web 2.0 applications enables new modern and viable approaches to support “Web 2.0” applications within CPM, including the ability to build on project partners’ distributed contribution to learning, and to collect rich user experience and shared intelligence. The technology could allow dealing with and creation of content rather than just consuming information.

Strengthening only the project control process is not enough. Also the distributed operational processes must be developed into more inherently reliable processes. Collaborative project alignment is seen as a beneficial approach to support the CPM by contributing to smooth collaboration and decreasing project risks.

The development of a “Project Alignment Booster” is a response to such requirements. The following section describes the rationale for the development and results available so far.

3. COLLABORATIVE PROJECT ALIGNMENT

There is no well-established meaning or definition of “project alignment”. In the current development work, we use the following interpretation: Collaborative project alignment is a participatory activity of aligning the practices, processes, tool usage and competencies of the project partners and stakeholders to fulfill the project requirements, support efficient collaboration and achieve the project objectives (COIN 2010). Project alignment in CPM is even more important as it may involve acting in different working environments, culture, latitudes, languages and even values.
Professional project management literature contains different approaches for project alignment. Box and Platts (2005) present research that has been conducted to develop a model for establishing and maintaining alignment of purpose in business change projects. Lewis (2010) analysed large-scale IT projects and how to align the top project leaders, based on the Birkman Method (Birkman et al. 2008). The Birkman Method is an integrated assessment and report system that analyses and describes individual needs that drive and motivate workplace behaviour. Martins and da Silva (Martins et al. 2008) present a methodology for Process and Project Alignment. It is an approach for Software Process Improvement and refers to the well known SPI improvement methodologies e.g. CMMI (SEI 2010) and identifies shortcomings. The Outset Consulting Group (OCG 2010) provides an own project alignment service. The OCG suggests inclusion of project alignment as a best practice in strategic project management.

Villachica et al. (Villachica 2004) conclude that no performance improvement project should begin without its own alignment phase, meeting and packet. Alignment should furthermore continue throughout the remainder of the project as requirements and organisation changes. Skulmoski and Hartman (Skulmoski et al. 1999) present a “Priority Triangle” approach for Project Alignment. The most important benefit from the triangle is that the project team and stakeholders have a shared understanding of the ranking of the project constraints. Abreu (Abreu 2008) introduces a methodology to measure the alignment of value systems in CNOs. A comparison of the approaches mentioned above can be found in COIN (D4.4.1b, 2010). As a summary, of the reviewed literature, we conclude that project alignment is used for:

- Aligning change-project objectives with business strategy, in change management.
- Alignment of understanding in a project.
- Alignment of organisational and personal goals.
- Aligning value systems
- Aligning projects with success factors.
- Aligning a (software) project with processes. Process and project alignment.
- Program alignment, aligning project objectives within a project program.

The analysed literature mostly concentrates on internal processes within an organisation. Methodologies and models are reported and no software tools have been identified.

The focus of this paper is on the alignment between different organisations and on the need for IT support for aligning CPM. To realise Collaborative Project Management, the project partners need to be able to take responsibility both for their own work and for their collaboration and communication with other partners in the project. The objective of collaborative project alignment is to ensure that the understanding, competencies, processes and practices of the different organisations participating in the project are aligned with the project needs and customer requirements. As the requirements may be project-specific, a partner capable for one project may not necessarily be capable for another project. The project alignment aims to identify the alignment gaps and to define the measures that should be taken to fill the gaps.

![Figure 1. Inputs and outputs of Collaborative Project Alignment.](image)

In addition to partner information, another source of information for alignment are the requirements of a specific project. These may depend on the project size, complexity and novelty, but also on the customer requirements, tools to be used etc.

In the collaborative project alignment activity, the alignment status of the partners is identified. If there are gaps between the requirements and the status, actions to strengthen the alignment are needed. The actions may include additional training, collaborative definition of working practices, modification of the project schedule or specific risk management efforts. A good level of alignment often implies participation in a learning processes. The gap identification should be performed at the beginning of the project but if there are many gaps, the identification should be repeated during the project. The benefits from using such an approach are manifold, from decreased costs and risks to increased quality and customer satisfaction.

![Figure 2 displays the positioning of the project alignment “steps” in the environment of a business eco-system and projects.](image)
management means are not the same ones as in a single organisation (Toelle, 2004).

The analogy between the VBE/VO paradigm and CPM is obvious. The “Business Eco-System” area in figure 2 represents a more static part and the “Project Specific” area represents the temporary and dynamic parts. Accordingly, projects are launched within Business Eco-systems. The necessary project alignment preparedness is established already prior to the launching a project. The project specific alignment can then be established and detailed during the project life cycle.

Figure 2. Positioning the project alignment “steps” in the Business Eco-system

4. THE PROJECT ALIGNMENT BOOSTER

Project alignment support is being developed in the European FP7 IP COIN project 216256 as part of Innovative Enterprise Collaboration services. The developed “Project Alignment Booster” (PAB) is a part of the larger COIN System. The COIN project sees Enterprise Collaboration (EC) and Enterprise Interoperability (EI) as different concepts, which cannot be merged but that they are so interdependent and simultaneously present in every networked enterprise, that they can be really considered as the two sides of the same coin (COIN).

EC comes from a business perspective and identifies the process of enterprises – to set up and manage cross-enterprise win-win business relations in response to business opportunities. EI originates from the IT world and identifies a capability of enterprise software and applications to exchange information and to mutually understand the information exchanged at the level of data, applications, processes and enterprise models involved.

A PAB software tool has been developed, as a part of the EC services. The PAB is a set of software services used to promote project alignment. As mentioned earlier, collaborative project alignment aims at aligning the practices, processes, tool usage and competencies of the project partners. It is about agreeing in a participative fashion how to organise project plans and work processes. To build and increase the project alignment level, there is a need to analyse the working experience, competencies and capabilities at project partners. The project alignment demands are compared with the partners’ alignment status. Based on an evaluation of missing alignment capabilities a suitable development programme can be established. A central element is the alignment model.

The PAB software has been implemented as a prototype system. Currently the prototype contains a set of project alignment services through which the above indicated steps can be achieved. The first four steps, in figure 2, are supported by:

- Configuration of alignment model – service
- Project alignment profile – service
- Partner alignment profile – service
- Project alignment deviation – service

The purpose of the Configuration of alignment model service is to populate and maintain the structure and content of the project alignment model. The service enables a participative configuration of general and project-independent processes, skill and maturity levels and other items. The application domain, specific working methods and processes change slowly over time and can thus be configured prior to launching any projects. The PAB users are actors in the Business eco-system. The defined model structure is generic enough to allow configuration of all types of project used in the Business Eco-system.

The Partner alignment indicator service is used by project partners to self-evaluate and update their alignment profile. The organisations can update their alignment profile prior to launching a project, after launching a project or after taking an action to improve a partner’s capability.

The Project alignment profile service involves the shared definition of project-specific work processes, tool requirements, applied technologies and their levels. The service is applied to identify required engineering maturity levels in the project and to define the project work processes and checklists, tool requirements and applied technologies based on customer requirements and project scope. The function is performed early in the project life cycle. The definitions can be updated as the project advances.

The Project alignment deviation service performs a gap analysis, for example to identify missing capabilities, and offered skills and resources that do not matching project demands. Additionally potential risk due to resource and competences mismatch or scheduling problems can be detected. The service is used throughout the project life cycle as project demands can change over time and partners’ capabilities develop.

Currently no services have been implemented for the fifth step in figure 2. It is up to the project partners to develop their collaboration alignment capability and status.

5. EXPERIENCES

The developed PAB software has been evaluated in a global engineering company. The company is active in the pulp and paper, energy and infrastructure engineering domains. It employs over 7000 experts in about 50 countries and has project experience from more than 100 countries. The total size of a typical pulp and paper mill engineering project, which represented the first evaluation cases, is in the range 100–1000 million Euros, involving engineering design work of 1–10 million Euros. The business eco-system consists of 10–30 different organisations (owners, suppliers, engineering
consultants, authorities etc.), which are globally distributed to the most competent and cost-efficient project partners available.

The company builds its future success on state-of-the-art engineering IT solutions deployed over an efficient network of partners. Project partners and participants must be able to communicate and announce their skills, knowledge and other intangible assets. Communication and sharing of this knowledge is the path towards a social and participative working process for the project. Well-aligned processes can be achieved through a “Web 2.0” type approach for CPM. By using the PAB, the company seeks to promote agreed and shared work processes and operational procedures, thus increasing social and participative project execution.

The evaluation work started by collecting “elements” that need to be aligned. The identified elements were grouped and the alignment model was configured based on the grouping. The enhancement of the model started from a predefined “generic” engineering domain alignment model, which was further modified to become a specific model for this particular “pulp and paper” eco-system. The needs of the eco-system specific model were identified in discussions with project managers and engineers. The following list is a short extract from the model and illustrates typical groups of alignment elements:

- Project Management Tasks
- Collaboration and networking readiness
- Work process
- Engineering discipline
- Systems and Technology
- IC-Tools usage
- Communication
- Organisation Culture
- National Culture
- Language skill
- Checklist

Existing Maturity Models such as the Capability Maturity Model Integration (CMMI) from the Carnegie Mellon University Software Engineering Institute (SEI, 2010) have been one starting point. According to the SEI, CMMI helps “integrate traditionally separate organisational functions, set process improvement goals and priorities, provide guidance for quality processes, and provide a point of reference for appraising current processes.” Each alignment group and their sub-groups can be associated with a scheme of levels. The schemes define levels at which the alignment can be performed. For example “Automation Engineering” work can be performed at four levels: 1 – Basic, 2 – Novice, 3 – Expert and 4 – Innovating; and “Self monitoring readiness” can be on three levels: 1 – Low, 2 – Neutral and 3 – High. A special type of alignment elements are the “Checklists” that can be only on 2 levels: 0 – Open and 1 – Completed. The model is fully configurable and can contain descriptions of any number of alignment element levels and the related processes. Examples of “Checklist” type alignment elements can be seen below:

- Project scope definition
- Detailed schedule
- IT Usage plan
- Tools and software plan
- Communication management plan, external
- Communication management plan, internal
- Coordination with customer planning
- Change in management plan
- Security plan
- Sustainability objectives
- Document management processes
- Inspection and approval process
- Progress monitoring method
- Progress monitoring responsibility
- Engineering Area Interface definitions
- Quality Management
- Site specific conditions.

The benefit of using the PAB tool in the pulp and paper distributed project environment are:

- Shared and unified views on how to reach project objectives.
- Shared and aligned working methods and processes, including agreement on how to conduct and perform engineering work and how to use engineering software tools, and identification of learning needs.
- Identification of required external skills and knowledge.
- Providing a checklist for e-PM collaboration activities.
- Raised awareness of potential risks and scheduling weakness.
- Positioning and comparing project partners’ attitudes and organisational cultures.

6. CONCLUSIONS AND FORESEEN FURTHER DEVELOPMENT

Globally distributed projects and large and complex products require improved collaboration and smooth processes between different organisations. This paper has presented one approach, collaborative project alignment, to ensure that the project partners have a similar understanding of the project goals and practices and sufficient capabilities to perform their tasks and participate in the project management. Also a software tool and an alignment model have been developed to support the approach.

The motivation for the development came from industrial needs. Practical experiences of project managers were used to identify the main elements needed for the alignment. The pilot users considered the developed service beneficial and gave some proposals for further development. One area of development is making data input easier.

The management and population of the alignment model could be further developed. A path forward is using knowledge and semantics-based techniques. A knowledgebase consisting of project alignment elements suitable for different project domains can be collected into an ontology, which is specialised for eco-system specific...
alignment models. Partner skills, capabilities and competencies could then automatically be assessed based on their public information, web pages and company’s specific documents (Angelucci et. al. 2010).

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