Change Management in e-Infrastructures to Support Service Level Agreements

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Abstract. Service Level Agreements (SLAs) are a common instrument for outlining the responsibility scope of collaborating organizations. They are indispensable for a wide range of industrial and business applications. However, until now SLAs did not receive much attention of the research organizations that are cooperating to provide a comprehensive and sustainable computing infrastructures or e-Infrastructures (eIS) to support the European scientific community. Since many eIS projects have left their development state and are now offering highly mature services, the IT service management aspect becomes relevant.

In this article we are concentrating on the inter-organizational change management process. At present, it is very common for eIS changes to be autonomously managed by the individual resource providers. Yet such changes can affect the overall eIS availability and thus have an impact on the SLA metrics, such as performance characteristics and quality of service. We introduce the problem field with the help of a case study. This case study outlines and compares the change management process defined by PRACE and LRZ, which is one of the PRACE eIS partners and resource providers. Our analysis shows, that each of the organizations adopts and follows distinct and incompatible operational model. Following that, we demonstrate how the UMM, a modeling method based on UML and developed by UN/CEFACT, can be applied for the design of inter-organizational change management process. The advantage of this approach is the ability to design both internal and inter-organizational processes with the help of uniform methods. An evaluation of the proposed technique and conclusion ends our article.

Keywords: Change Management, SLA, Maintenance, e-Infrastructures.

1 IT Service Management and e-Infrastructures

An e-Infrastructure (eIS) is an environment intended to support the scientific community by providing digital information processing and computational technologies [14]. Examples of eIS are the pan-european network GÉANT, grids and

M. Alexander et al. (Eds.): Euro-Par 2011 Workshops, Part II, LNCS 7156, pp. 124–133, 2012.

distributed high performance computing infrastructures [4]. The common characteristic of these eIS is that they are established as a cooperation of service providers that are delivering a fraction of services to support a common goal.

Until recent it was uncommon for partners participating in eIS projects to endorse service provisioning contracts (Service Level Agreements (SLAs)). SLAs however, are a common instrument for outlining the scope of responsibility of collaborating organizations. According to the IT Infrastructure Library (ITIL) an SLA provides means of assuring a defined level of service quality delivered by a Service Provider [12]. To achieve this kind of warranty, it is necessary to monitor and measure availability and performance of all services against the targets defined in an SLA and to produce a corresponding service report. Information about all relevant assets, their interrelationship, as well as the associated SLAs are stored in a tool called Configuration Management System (CMS) [12].

Now, that some of the projects have matured into established organizations offering sustainable services to the scientific community, they pay more attention to SLAs as the mechanism for guaranteeing the necessary quality of the provided services. Service characteristics commonly addressed in SLAs are assurances about specific levels of availability. To meet the desired availability levels, each participating member has to align its internal operational processes with the global eIS requirements. The challenge here relates to the fact that every participating organization itself is an autonomous entity. As a consequence it can not be assumed, that the operational processes, for instance change management, within each organization are comparable. There might be differences in, for example, the role models, workflows or tools used.

The change management process according to ITIL defines procedures for efficient and prompt handling of all changes and thus is able to minimize service disruptions caused by incidents. Changes associated with a maintenance of an established eIS or the need to enhance it with new features requested by its users are a possible cause of disruptions that result in an outage of one or more services. Since it is common for SLAs to describe required availability parameters, changes can affect these agreements. Therefore, there is a strong interrelationship between the service level management and the change management processes.

The change manager, for example, needs to know the corresponding availability parameters to be able to schedule changes in such a way as to minimize the negative impact on the eIS availability. The service level manager is responsible for generating service reports and thus needs information from the change management about upcoming and past changes that might affect or have affected the availability. All relevant information is stored in the Configuration Management System (CMS).

While ITIL gives a good guidance for establishing IT service management (ITSM) within a single organization, for the alignment of inter-organizational ITSM a new approach needs to be taken. In figure 1 we demonstrate the problem field on an abstract level. As common in eIS projects, participating organizations (depicted as I and Z in the figure) define and follow internal ITSM processes. To facilitate collaboration and information exchange (depicted as A and A')

between the organizations an interface for inter-organizational ITSM is required. Such interface should cover organizational, informational, functional and communicational aspects.

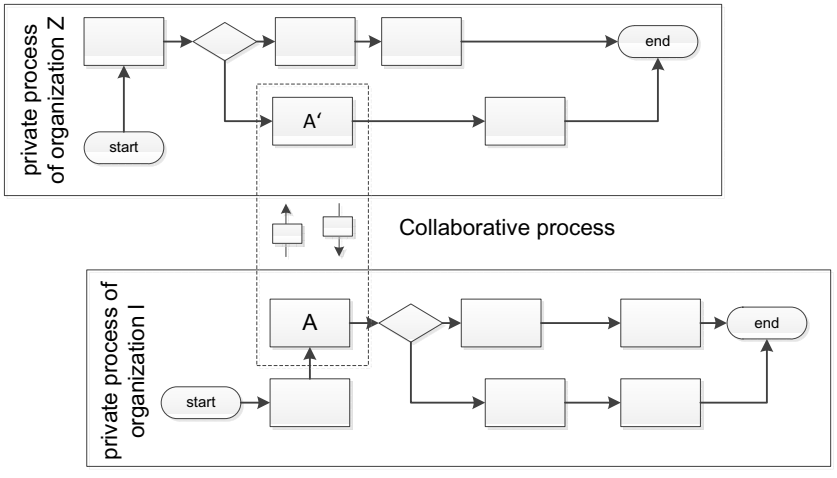

Fig. 1. Collaborative processes and information exchange in the style of [2]

In this paper we will give an overview of our approach to address the challenges in the area of inter-organizational change management (ioCM). Our goal was to design an ioCM process that can be adopted by all partners of PRACE, a persistent European eIS. Thus, our concept incorporates extensions of well-established best practices frameworks like ITIL for inter-organizational use and adapts collaborative standards in the modeling field. In the following section PRACE, a European eIS project, is introduced. Before presenting the major concept areas of the proposed management process, we will give a brief overview of related work in the area of ioCM. For the process design we have adapted the UN/CEFACT Modeling Methodology (UMM), developed by the UN/CEFACT (United Nations Center for Trade Facilitation and Electronic Business) to support the development of inter-organizational business processes [17]. We conclude with an overview of our future plans in section 5.

2 Case Study: e-Infrastructure for High Performance Computing

In this section we describe the importance of ioCM based on the example of PRACE and LRZ. The unique characteristic of this scenario is that both organizations have independently defined their own internal change management processes. Due to the tight integration of the LRZ and PRACE eIS effective coordination of operation and administration activities is required. The challenge

is to establish a collaborative inter-organizational change management process to support the maintenance announcement task within the PRACE environment. In figure 2 the principle set up of the PRACE environment is depicted.

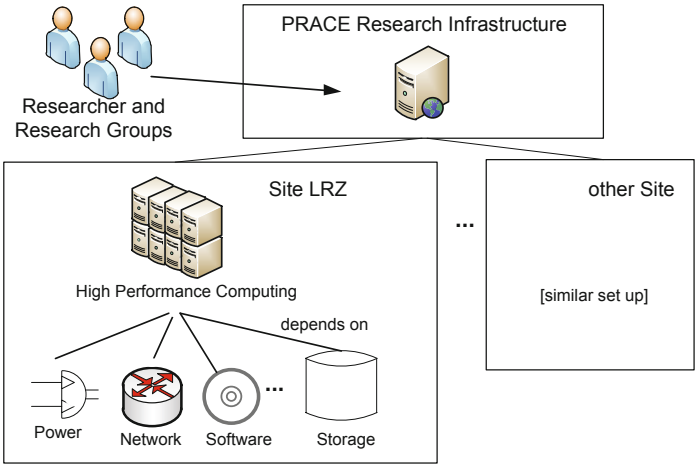

Fig. 2. Small excerpt of the PRACE infrastructure

The Partnership for Advanced Computing in Europe (PRACE) is a European project aimed at deployment and operation of a persistent pan-European research infrastructure for high performance computing. PRACE brings together European HPC centers with the focus on the coordinated system selection and design, coherent management of the distributed infrastructure, software deployment, optimization of applications and promotion of the state of the art application development methodologies. The Leibniz Supercomputing Centre of the Bavarian Academy of Sciences and Humanities (LRZ) is one of the leading German high performance computing centers. LRZ offers a wide range of services, including data storage, visualization facilities and high performance computing among others, to the German universities and research institutes. LRZ is involved in many national and international IT research projects, PRACE being one of them.

The change management processes defined at LRZ are based on the industry standards, such as ITIL and ISO20000. The processes define organizational roles, specify tasks and responsibilities and outline workflows that have to be followed for implementation of an infrastructure change. Figure 3 shows the `Test`, `Plan` and `Implement` phases of the LRZ's change management process. Other phases, such as `Approval`, `Authorization` or `Rollback`, are omitted for reasons of brevity.

Let us consider a situation in which LRZ has to upgrade one of the backbone routers. This change will have a major impact on the LRZ infrastructure and will result in a downtime of IT services offered by LRZ. As such, following the

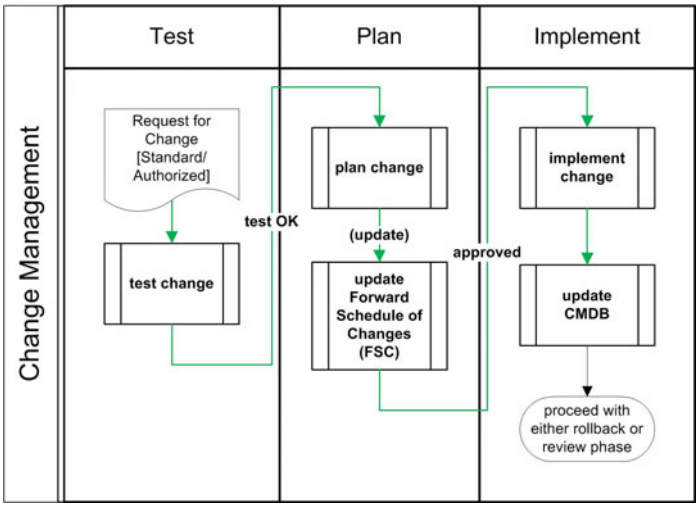

Fig. 3. Excerpt of the LRZ change management process according to [13]

change management process, the router upgrade will be thoroughly documented and tested. The implementation date will be discussed with all affected parties and selected such as to minimize the impact on the LRZ infrastructure.

The change will also affect availability of the PRACE eIS since services hosted by LRZ, one of the partner sites, will be temporarily unavailable. However, since LRZ and PRACE change management processes are independent, the change will not be coordinated with the PRACE management and operational staff. Under some circumstances, PRACE might not even be aware of the changes implemented by its partners. Lack of coordination between PRACE and its partner sites can, potentially, result in a large scale disruption of the PRACE eIS. To avoid this negative impact on the eIS and facilitate information exchange and coordination of activities the change management processes implemented at LRZ have to be integrated with the corresponding internal processes defined by PRACE.

3 Related Work

While many articles covering the area of change management are available, hardly any related work is addressing change management in eIS. In [16] there is a discussion on inter-organizational change management in public funded projects. But in this article the authors mainly focus on the sociological aspects like the need for communication between the public and the participating project partners. Aspects of inter-organizational ITSM are not considered in this paper.

Also in [11] communication is identified as one vital concern in e-Government projects. Within their analysis the authors concentrate on the structures that

need to be established to foster changes in sense of innovations within the domain of e-Government. For that the key issues are identified as communication concept, competencies of stakeholders, the ambiguity of goals and the collaborative form as such. The authors believe that methods of enterprise architecture will provide support for such kind of projects.

In [7] change management is, as well, stated to have the strongest relationship with the inter-organizational information and communication technology. Thus the advise is to invest in the organizational change management, i.e. dedicate resources and change management communication. There is no recommendation on how the inter-organizational change management process can be established.

Although, hardly any article is addressing ioCM processes within eIS, there are technical platforms in place that are able to implement inter-organizational workflows, which are the technical representation of specific processes as for example in [10]. In [5] cross-organizational workflows are implemented based on contracts between the cooperating partners, while [1] is concentrating on the interaction protocols between the collaboration partners and uses semantic web technologies for their implementation. These approaches can be used as a technical foundation for the SLA-based inter-organizational change management process as we specify it in the next section.

4 Design of an Inter-organizational Change-Management

To develop an interface for the ioCM process within an eIS project, the infrastructure requirements need to be captured and the corresponding models need to be designed. For that we are adopting the modeling method UN/CEFACT Modeling Methodology (UMM) that has been originally developed in the B2B environment for supporting the international trade [17]. This method is based on the Unified Modeling Language (UML), which has been proven to fit best for inter-organization workflow modeling [3]. The advantage of using UMM is that it is a standardized method that enables information exchange in a technology-neutral, implementation-independent manner. As such, the collaborating partners can share the common models independent of the locally selected implementation technology. We adapt the UMM to our scenario and demonstrate that it is possible to address both the requirements of the local private process as well as the global project goals by using the same methodical approach.

For implementing an interface within our scenario the following design goals have to be met (structured according to the dimensions organization, information, function and communication model according to [6]):

Organizational Model: The organizational model addresses the operational and organizational structure of the organization. In case of an eIS, cooperative structures, roles and groups are modeled. In figure 4 the cooperating partners LRZ and PRACE and their corresponding roles like Change Manager or operational staff are shown (for more details see [15]).

Information Model: The information model contains information about configuration items (CIs) and their interrelationships. In [9] we have already

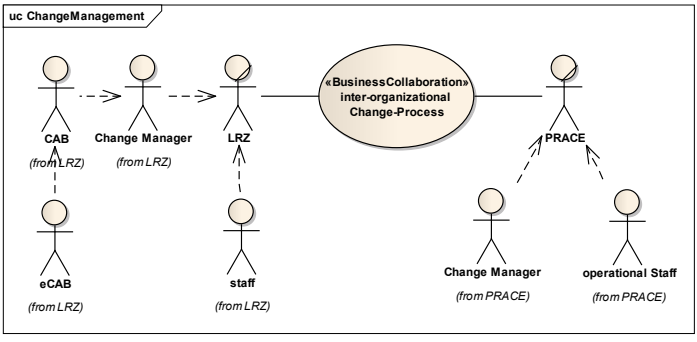

Fig. 4. Partner View inter-organizational Change Management process

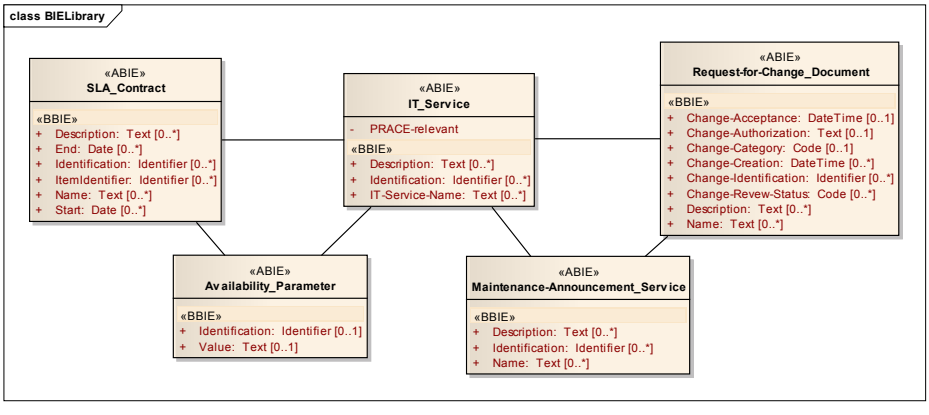

Fig. 5. Information Modell for MAS

described the development process of an inter-organizational information model, which we are using here as well. For integrating the Maintenance Announcement Service (MAS) within the already established local change procedures the corresponding information model will have to be extended. In Figure 5 some parts of the resulting model are shown. The IT-Service entity needs to be enhanced with an attribute that marks the relevance of changes to the corresponding inter-organizational services. In our case the attribute is called `PRACE-relevant`. If there is a change on a CI that has the setting `PRACE-relevant = yes`, then the changing of this CI have to be announced with MAS. For this, there is a further CI needed for the description of the MAS contents as can be seen in the figure. As described above, the information system containing the details about the CIs is called CMS, in the inter-organizational setting a corresponding inter-organizational CMS (ioCMS) has to be in place.

Functional Model: Local processes are autonomously designed; they need to be extended by appropriate interfaces. Our analyses of the above use case resulted in the conclusion that MAS has to be integrated into the LRZ internal step of planning activities (c.f. section 2). As a part of the planning activity a decision regarding the activity's scope should be taken. If the value of the flag is yes, i.e. `PRACE-relevant = yes`, the planned activity affects the PRACE e-Infrastructure and the MAS process has to be started. Otherwise the local process of LRZ should be followed. The main outcome of these planning activities is an updated Forward Schedule of Changes (FSC). Figure 6 outlines a small excerpt of this integration. In case the MAS process is launched, the corresponding communication mechanisms have to be in place as described below.

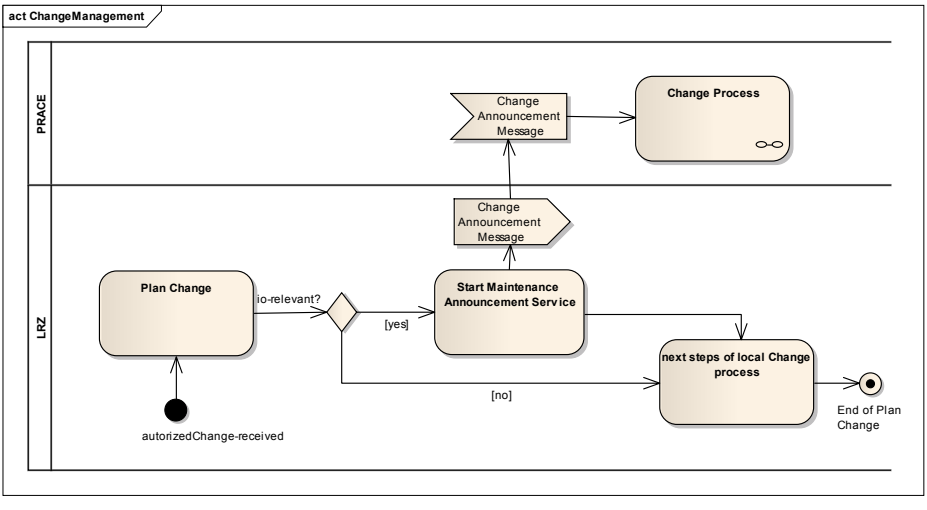

Fig. 6. Process Area: Maintenance announcement integrated in local procedures

Communication Model: The goal of the first integration stage is to enable the propagation of change announcements from a PRACE execution site to the global PRACE service platform. For that, messages have to be sent from the site's information system to the global PRACE platform via a push mechanism. Since PRACE does not have an adequate ioCMS in operation at the moment, the initial MAS implementation will be based on web services. The MAS framework and data exchange interfaces will be deployed at LRZ. The corresponding technical specification will be shared with all PRACE execution sites in order to evaluate the framework in their environment. With a growing maturity of the inter-organizational ITSM process we are expecting that also bi- and multilateral communication channels supporting complex interactions between various stakeholders will be necessary in the future. For instance, if PRACE needs to coordinate the maintenance tasks across multiple partner sites. Therefore, we

will further evaluate the inter-organizational workflow systems as discussed in section 3 for the application in our scenario.

5 Summary

In this article we have presented a framework for inter-organizational change management and described an application scenario based on an international e-Infrastructure (eIS) project. The goal of change management is to establish mechanisms for coordination of activities for maintenance of existing and implementation of new services in an eIS. Change management provides means for exchange of information about planned, ongoing and completed changes that affect availability of eIS components and thus is essential for successful Service Level Management (SLM). In the majority of eIS providing services to the scientific community the areas of SLM and change management still receive very little attention. However, since eIS projects are becoming mature in their service offering, the overall ITSM needs to be professionalized.

To address the challenge we have applied standards, both in the modeling and ITSM fields, to our problem domain. The selected standards include the UMM modeling method, developed originally for B2B environment and adopted to inter-organizational provider networks and the ITIL process framework. This methodology has a number of advantages. International, well established standards can be applied to the design of both the intra- and inter-organizational ITSM processes. models that result from this approach can be easily shared and applied by all partners within an eIS, which we will demonstrate in the future by implementing a model repository accessible to all eIS partners. Having defined the design concepts, we are going to implement them in the PRACE environment described in our case study. In the following stages of our work we are intending to implement our framework in other eIS projects we are involved in. Within this article we have focused on the operational process of change management. Even though, at present, not every of the collaborating partners within the eIS project has implemented basic ITIL processes, we think, that there is a high potential for standardization, which we will present in [8] based on an analysis of the ITIL adoption rate of three different eIS projects.

Acknowledgement. The authors thank the members of the Munich Network Management Team for valuable comments on previous versions of this paper. The MNM-Team, directed by Prof. Hegering and Prof. Kranzlmüller, is a group of researchers from the University of Munich, the Technische Universität München, the German Federal Armed Forces University in Munich, and the Leibniz Supercomputing Centre of the Bavarian Academy of Sciences and Humanities. The web server of the MNM Team is located at http://www.mnm-team.org/.

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