

Using collaborative business process models for the configuration of distributed workflow environments

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Abstract: In order to realize collaborative value generation, it is necessary to define and implement collaborative business processes. Models have been proved in practice as an adequate instrument to fulfil this task and consequently models of such processes can be used to plan and steer collaborative business. This paper proposes a model based configuration of distributed workflows based on conceptual business process models. An outside-in approach is followed, where the overall collaboration is first defined conceptually but allows for a de-central implementation. The concept of developing the necessary conceptual model parts and distributed implementation was prototypically implemented using peer-to-peer and workflow technologies.

1 Introduction

An increasing fragmentation is ongoing in worldwide economical structures. Whereas in the past, enterprises tended to incorporate as much value generation as possible within themselves, nowadays enterprises strongly concentrate on their core competencies. In the consequence, the added value is generated by these specialized value units that intensively interact along the value chain order to together generate the intended product. The generation itself is performed through the synchronized execution of associated tasks by different, independent enterprises. Applying the ideas of process orientation to this constellation, this sequence of activities constitutes a *collaborative business process* (CBP) [Wert07]. Actual examples for such CBPs are in aerospace or automotive industry – there OEMs build extensive organizational networks with their 1st, 2nd and 3rd tier suppliers.

In order to manage the collaborative value generation, it is mandatory to manage the CBPs. In this respect, models have been proved in practice as a adequate instrument to fulfil this task and consequently CBP models can be used to plan and steer collaboration businesses. In regards to a lifecycle view on CBPs, they have to be modelled, executed and controlled [WeWa+07].

Since the development of models for CBP is fundamentally different from modelling intra-organizational business processes [LiGr+05], special methods for modelling collaborative business processes are required. However, there are several approaches to construct CBP models [GrLi+06, Werth06]. In the approach described in this paper an outside-in approach is pursued where all participants of a collaborative business possess a CBP model, which specifies all tasks and synchronization information needed to describe the value generation in the network. However, having this information does not mean to be able to realize it. It is necessary to transfer this information into the operations. Thus, from the ICT point of view, CBP models need to be transformed to configure ICT execution system. In our approach, we focus on workflow engines as an archetype for ICT execution systems¹. This paper presents a concept to use CBP models as the base for the configuration of a set of interworking workflow engines. As a result, CBP models specifying a collaborative business scenario can directly be transformed into the collaborative execution environment realizing the demanded behaviour.

2 Collaborative Business Process Models

Collaborative business processes are a special kind of (conventional) business processes. However, they imply special properties that strongly differ from the regular case. First, they are spanning over multiple organizations, because the generation of added value is performed through cross-organizational division of labour. Second, the individual business activities that compose the process clearly belong to a unique organization. Thus, having groups of activities that are processed in a direct sequence, we can state that the collaborative business process is partitioned into a set of these parts where each one is distinctively associated with an organization, fully controlled by it in the sense that it independently executes, administrates and manages it. Therefore those parts of cross-organizational business processes can be characterized as autonomous fragments.

The classical Business Process Management concept consists of three phases: business process design, implementation and controlling [ScJo02]. Business process implementation summarizes all operative steps that are necessary to execute a process which was modelled before. Business process controlling denotes all actions that aim towards measurement and analysis of processes. In the context of this paper, controlling is neglected. The resulting life cycle phases are conceived for a single organization. In the design phase, each process model is changed by a single modeller at a time. During the execution phase, the process is handled by a single execution system within a single organization. However, in collaborative environments, CBPs cannot be regarded as monolithic anymore, since different parts of them are designed, executed (and controlled) by independent organizations [LuBu99]. Consequently the lifecycle abruptly gets very complex and difficult to handle [WeWa+07]:

¹ In fact, workflow engines can act as an external interfacing proxy for all kind of ICT systems.

- The *design* (respectively modelling) task comprises multiple autonomous modellers that act independently and follow different goals. This results in self-contained parts of the collaborative business process. Therefore the process design can rather be characterized as an assembly task of autonomous process parts.
- The *execution* is distributed over different enterprises. Consequently there is no central processing engine. Instead each autonomous process part has its own independent processing engine, so classic workflow concepts and technologies have to be extended to match the new cross-organizational requirements [Schu02].

Thus, in order to efficiently execute CBPs, the CBP models created in the design phase have to be transferred into data that can be used by execution systems. This transformation procedure is the central task in the implementation phase of a CBP lifecycle and is described in the next section.

3 Transformation Procedure

Transferring the concept of business process management for single organizations to cross-organizational environments characterized by the involvement of multiple actors in the different phases requires the shift from a centralized paradigm to a support for distributed environments. For these actors a collective behaviour cannot be supposed. Thus the implementation phase requires new techniques that are different to those of the classical business process management and that incorporate the split activities. Therefore we do not focus on bilateral processing of business processes, but on end-to-end processes with a potentially huge number of contributors. The distributed execution of a business process starts with a common process model that all participants share and that is business oriented, i.e., its content is mainly conceptual and its purpose is organizational management. From this model every participant extracts those parts that he has to execute and augments them with arbitrary information he needs for execution, e.g., refinements of process sub-parts or execution context parameters (cf. Figure 1). Thus the business model is transformed into an IT-oriented workflow model, the main purpose of which is the execution of the contained process. The following section introduces the steps from the conceptual shared process model to de-central, technically detailed workflow models:

1. **Splitting Up the Common Process Model:** All activities in the common process model are annotated with the executing organization unit ("Company X"), or with an organization unit role ("Customer") that can be mapped onto a concrete actor within the execution context. So the common model disaggregates in disjoint process model fragments that are executed by exactly one actor each. Because the process modules, which were composed to the common process model during the modelling phase, have interface descriptions, it is possible to define exactly which goods and which information must be transferred from one actor to another.

2. Apart from goods and information, the execution of the whole process devolves from one actor to another at an interface. Therefore it is necessary to define how the control of the process is transferred. At process junctions it may be even possible to split up process control or join multiple execution threads again.
3. Augmenting the Process Fragments: Execution of a process fragment usually requires considerable prearrangements on the part of the executing actor. Therefore the process fragment is first transformed from the modelling language into an executable language. Since the business process model is business oriented, it usually does not contain information about execution parameters, e.g., an IP address of an interface or authentication credentials for an ERP system. So it must be augmented with these missing execution parameters during or after transformation to the executable language. After that, the process fragment is contained in an executable workflow model.
4. Usually the common business process model disaggregates into multiple process fragments, each of which is transformed into a single workflow model. These workflow models are deployed to the respective IT systems then, which are finally configured with the contained information.
5. Executing the Process: Figure 1 shows how the whole top-level process is implemented by executing the workflow models of the process fragments which it consists of. After configuration of all involved systems this happens automatically, i.e., without interaction with individual process instances.

For step 3 we propose the use of Event Driven Process Chains (EPC) for design time modeling and the Business Process Execution Language for Web Services (BPEL) for the workflow configuration. As described in [ZiMe05] in a first step technical EPC models aligned to the BPEL syntax have to be derived in order to specify the interactions between the parties. Since BPEL can represent both a graph based and a block-oriented control flow (e.g. a containing a While loop), nearly all control flow elements of EPC can be transformed to BPEL. If the EPC functions represent interactions (e.g. “receive message”, “send message” etc.), they can be transformed to corresponding BPEL activities, if an EPC function represents an activity not captured by the BPEL syntax an individual Web Service has to be created that will be invoked by the BPEL process. In [ZiMe05] further details regarding the transformation of EPCs to BPEL are described.

Since the whole process is executed fragment-wise by multiple separate systems, there must be transition points from one system to another where execution is finished or suspended at the source system and perpetuated at the target system. This transition has two different aspects: data flow and control flow. Data transfer between separate IT systems is widely used already, e.g., between departments within a single organization. However, the transfer of process execution control and context via push and pull mechanisms is not common. Especially in split and join situations, e.g., when a simultaneous execution of multiple process parts on multiple systems begins or finishes, the process context must be duplicated and merged accordingly. During execution, performance data is gathered as a means for the next step: the controlling phase.

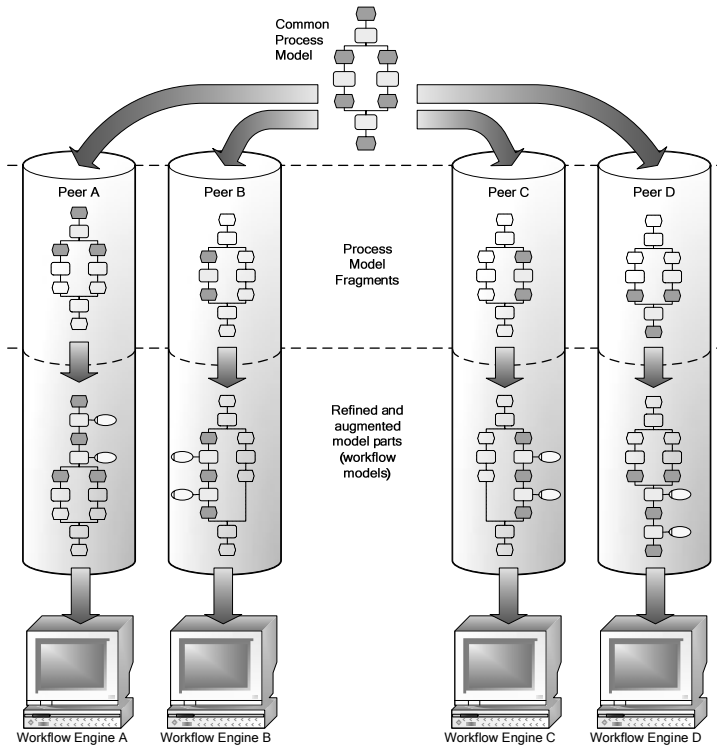


Fig. 1: Transformation procedure for collaborative business process execution

4 Conclusion and Outlook

In this paper, we have presented a concept for using CBP models for the configuration of distributed workflow environments including 1. distributed modelling, 2. execution and 3. controlling, that is already widely-implemented. In particular we addressed and ensured the continuous IT support of all three phases, the decision autonomy and secrecy demand of the participating organizations during the process.

The concept was prototypically implemented in the project “P2E2 – Peer-to-Peer Enterprise Environment” using peer-to-peer and workflow as base technologies [WeLo07]. Within this project we created two demonstration scenarios coming from the finance and the logistics sector. Though we succeeded to create an ICT supported approach to transfer CBP models into execution environments, this task still required a significant ammount of human support. Additional research is needed to explore more information that is not included in the CBPs models but can be gathered from other sources to further automate the transformation itself and reduce the manual work.

Currently the concepts created in P2E2 are extended in the R4eGov project², where model-driven, SOA focused CBP development is pursued based on combinations of outside-in (deriving internal processes from CBPs) and inside-out (combining existing internal processes to a CBP) approaches.

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² www.r4egov.eu