Bridging Requirements Engineering and Business Process Management

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Abstract: Requirement elicitation is one of the earliest phases of a requirement engineering lifecycle. However, even though years of research have gone into seeking machine support for requirements engineering, the methods used are still highly manual and the vision of automatic transfer of business analysis requirements into IT systems supporting the business is still far from reach. On the other hand, incepting knowledge for creating AS-IS business processes in enterprise models has been recognized as a hard problem. In the context of a process centric organization, we propose an approach to create AS-IS business process models by automatically transferring requirements to the business process layer. Our aim is to enable carrying business requirements, goals and policies from an inception layer to the operational business process management layer. We place our research in the context of a semantic business process management platform (SUPER) as the support to exploit the output of our research. This paper grounds this research work and proposes a research design for requirement elicitation for producing early-phase business process models that are nearer to the business analysis layer.

1 Introduction

Since the introduction of information systems in the 1960s, enterprises could benefit from automating business processes. Although the areas of business process management (BPM) and information system development (ISD) are closely intertwined, the usage of conceptual modelling differs significantly in both fields [GI01]. BPM prefers to use conceptual models for communication and analysis purposes [AG04], whereas ISD employs business process models during the requirements engineering (RE) phase [MY98]. The first phase in BPM entails creating business process models using a conceptual modelling grammar (e.g. BPMN [OMG08] or EPC [KE92]), which will serve as input for subsequent business process design and transformed into executable models (e.g. BPEL [BPEL07]). Typically, a software engineering project

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[LAAM00] will start with acquiring knowledge from the business in order to understand the current context (as-is- system) and define the target system (TO-BE system), which is referred to as "requirements elicitation", followed by a specification of these elicited requirements in a written document (requirements specification). After verifying whether all necessary requirements (for realizing the TO-BE system) have been included in the specification document (requirements validation), the latter will act as input for the other phases in the system development lifecycle.

Around the year 2001, the paradigm of business process management systems (BPMS) emerged as way-in-the-middle between BPM and ISD [SHAW07]. The holistic view on building new information systems carrying out business activities in application development using business processes was described by Smith & Fingar [SMI04]; inspired by scientific achievements in workflow application development [WESK01, KWAN98], the authors proposed to maintain a business-oriented process knowledge repository, from which software applications can be directly generated. While separating between definition of business requirements and their implementation, the BPMS approach provides means to link both worlds. This vision is backed by industry analyst bureaus Forrester [HEFF05] and Gartner [HILL06], who provide an organisational context to the BPMS technology. Gartner advices to establish a BPM Centre of Excellence (CoE) as a coordination structure between the corporate IT department and the different business departments, and estimates that by 2015, 30% of business applications will be developed by means of BPMS technology [WO06].

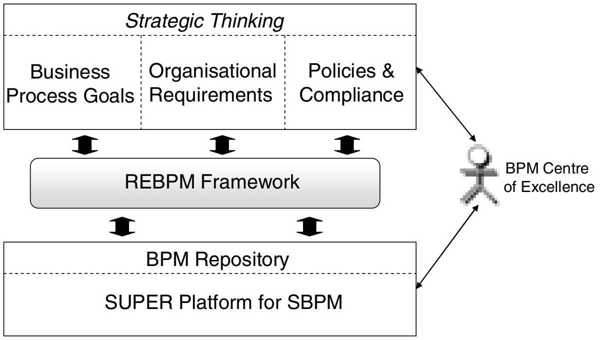

Figure 1: Overall framework

Due to these organisational changes brought by BPM, employees currently working in a BPM CoE need methods to capture organisational and governance facets during knowledge acquisition. The current solutions to meet this need are discussed in several areas of related research, such as methods that transfer goal-oriented RE to BP models [15-17], methods that use enterprise models to obtain business processes [18, 19] and methods that link policies to business processes [EK08]. Unfortunately, these current methods fail to capture the underlying semantics (e.g. ontologically formalized) of these early requirements models. We propose a method that allows BPM CoE employees to specify their strategic thinking needs, formalise it in a consistent way, validate the model semantically and transform this early stage knowledge into business process models (Figure 1).

As BPM CoE employees understand how the business processes actually work, we assert that capturing the underlying semantics of requirements leading to business process models is of added value to these employees.

Employees are capable of understanding strategic information needs of the business side, and have to capture and enforce these needs into a technological platform. Firstly, employees would be able not only to enforce behavioural constraints (such as is done in Formal Tropos (FT) using temporal logic[FUX04]) but also to enforce higher level business constraints such as policies. Secondly, these validated models can be ported (without information loss, as the information regarded as necessary is annotated semantically in the RE models) to an operational Semantic BPM (SBPM) platform (SUPER [SUP08]) that can interpret and reason on ontological annotations made to the BP models. Our approach also considers including organisational aspects relevant for business process models, such as business process goals, organisational structures or policy and compliance requirements in early requirement elicitation. This way, we expect less frequent BP model changes resulting from new or updated business requirements, which would have to be kept track of and implemented by human users. Note that further experimental research will be needed to validate this assumption.

2 Conceptual Solution

Before diving into our framework, which will be called *REBPM* throughout this paper, we will discuss how the lifecycles of RE and BPM could be aligned into a global REBPM lifecycle (Figure 2). Firstly, the RE lifecycle starts with the elicitation of requirements, specifying these requirements into documents and verifying these requirements to discover possible gaps or inconsistencies. Secondly, the BPM lifecycle consists of designing the business process models, configuring these models for a given runtime environment, executing the processes and finally analysing past executions .We propose to unify these lifecycles into one global REBPM lifecycle by connecting RE Validation and SBPM Design by means of an REBPM Transformation step. The scope of our research ranges from step 1 (Elicitation) and step 4 (Transformation) as steps 5 to 8 are supported by the SUPER platform.

In this section, we propose a method for capturing, verifying and propagating strategy-level requirements (see figure 1) focusing on the first four steps of the REBPM lifecycle. Based on the lessons learned in a leading project in the field of formal GORE frameworks, called Tropos, and previous multi-perspective RE research [NIS99], we start by modelling the involved actors (Stakeholders) and the relationships vis-à-vis each other. The Tropos methodology advices to detail the hierarchical structure per actor, containing their goals and tasks (Section 2.1). Subsequently, the hierarchical structure can be enriched with relevant organisational requirements (Section 2.2), which could be checked against existing policies. Different requirement models from different actors could induce inconsistencies, which necessitates validation of all captured requirements (Section 2.3). Finally, the annotated and validated requirements will need to be written to a BPM knowledge repository (Section 2.4). The next sections elaborate on each step of the methodology.

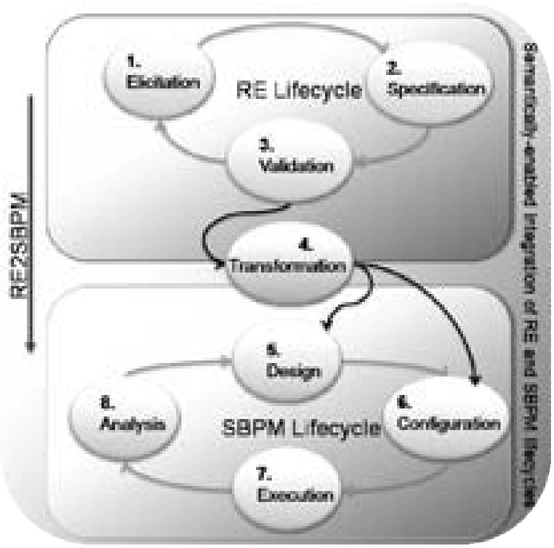

Figure 2: REBPM lifecycle

2.1 Elicitation

In order to acquire knowledge about a high-level business process, we have to identify the participating actors (e.g. John and Marc). After identifying the actors (cf. Figure 3), we have to discover how these actors depend on each other (e.g. John is a production engineer that wants to get Six Sigma certified by inspector Marc).

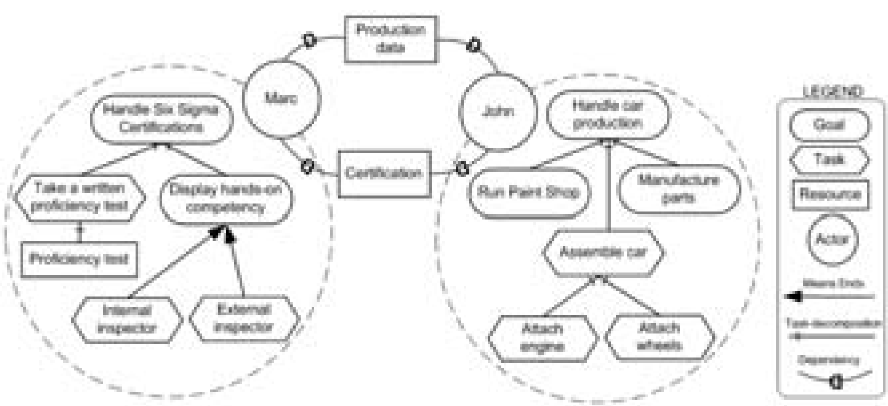

Figure 3: Knowledge acquired about actors and their goals

Following the Tropos methodology, the next step is to model a breakdown of the internal goal structure per actor. A *goal* node in the i* [YU95] tree shows that there are alternative ways of achieving the goal, but *no specific instructions* are given how to achieve the goal (e.g. display the hands-on competency during six sigma certifications).

A *task* node shows that we *specifically* know what to do but there are *constraints* on how to do it (e.g. having an external inspector checking the hands-on competency). A *resource* node shows that there is a need for a certain resource (e.g. finding the proficiency test). Furthermore, means-ends links point to alternative means to reach one end (e.g. the hands-on competency can be checked by an internal or external inspector), and task-decomposition links allow to refine tasks in terms of other intentional elements (e.g. assemble car could be refined into attaching the engine and adding wheels onto the car). Note that Figure 3 the environment of the system-to-be during this early RE phase, not the actual requirements of the system.

2.2 Specification

During the specification, a modeller uses a graphical modelling environment to create the elicited i* model (as displayed in Figure 3). As we need powerful formal techniques to translate goal models into business process models, the modelling environment will automatically transform the graphical i* representation into Formal Tropos (FT) specifications [FUX04]. Assuming that the necessary organisational ontologies are loaded into the graphical modelling environment, the modeller should attach (by dragging-and-dropping) ontological annotations onto the graphical i* elements, which again will be automatically written in the underlying Formal Tropos specification. Taking the SUPER ontology stack as inspiration, we consider annotations Business Role, Business Function, Business Domain, Business Process Goal and Business Policy. The result of these steps are fully annotated FT specifications, containing references to relevant strategic thinking needs. Applied to our car manufacturer example, Table 1 briefly illustrates these annotations.

i* Concept	**Annotation**
Actor ‘Marc’	Business Role ‘Six Sigma Certifier’
Actor ‘Marc’	Business Function ‘Quality Control’
Goal ‘Handle 6S Certifications’	Business Domain ‘6S Terminology’
Goal ‘Display hands-on competency’	Business Process Goal ‘Display hands-on competency’
Dependency ‘Certification’	Business Policy ‘Separation of Duty’

Table 1: Example annotations

2.3 Verification

Based on the experience of Nissen and Jarke [NIS99], all captured requirements should be validated and inconsistencies should be tracked. The formalised validations have to support the creative process of gathering requirements by pointing out where possible errors are situated and by stimulating the Business Analyst with proper feedback. For instance, although we modelled the Business Policy ‘Separation of Duty’ between Marc (with Business Role ‘Six Sigma Certifier’) and John (with Business Role ‘Production Engineer’), no policies have yet been enforced. The rules defined by Business Policy ‘Separation of Duty’ state that the person who runs the six sigma certification should differ from the one running the examined production factory.

The description of the need for and use to be made of such compliance checks is given in [EK08] in the context of BPM. Our work here is analogue to [EK08], but placed in the context of early requirements.

2.4 Transformation

After capturing the high-level requirements and refining them into detailed tasks per actor, annotating them with organisational and policy information while tracking inconsistencies, the acquired knowledge should be written to a BPM knowledge repository. Distinguishing semantic repositories from non-semantic tools, the ones being semantic are both IT-oriented (accompanying the process engineer towards configuring and deploying BPs) while at the same time providing anchor points to domain and strategy level models through ontologies (e.g. SUPER [SUP08]). This knowledge can also be reused during analysis and optimization phases on a stronger business-oriented level. Non-semantic tools are either being strategy-crafted and cover a whole enterprise model but only offer limited integrated IT support (e.g. ARIS[1] [SC00]), or are overwhelmingly IT oriented and primarily seek to put BPs in production environments (e.g. ORACLE BPEL Manager[2]).

FT construct	**BPMO construct**
Actor	Actor & Element from BusinessFunctionsOntology
Goal	Process (Top Goal) / SubProcess (Children)
Task	GoalTask / WebServiceTask / ManualTask
Softgoal	Element from BusinessGoalOntology
Resource	Element from BusinessDomainOntology
Entity	Element from BusinessDomainOntology

Table 2: FT2BPMO Concept Mappings

When applying the Formal Tropos specifications to the semantic BPM repository called SUPER, we will employ the transformations proposed by Decreus & Poels [DE00]. The authors use the Business Process Modelling Ontology (BPMO) language [SUP08] as the central integration layer to connect Formal Tropos to, of which the mappings can be summarized in Table 2.

```
instance HandleSixSigmaCertifications memberOf Process
   hasName hasValue "Handle Six Sigma Certifications"
    hasActor hasValue Marc
    hasWorkflow hasValue MyWorkflow
    hasBusinessFunction hasValue Ontology_BusinessFunction#ExaminationCentre
    hasBusinessRole hasValue Ontology_BusinessRole#SixSigmaInspector
    hasBusinessProcessGoal hasValue Ontology_BusinessGoal#Honesty
    hasBusinessDomain hasValue Ontology_BusinessDomain#SixSigmaTerminology
```

Figure 4: example FT2BPMO output

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[1] www.aris.com
[2] http://www.oracle.com/technology/bpel/index.html. .

For instance, when we apply these FT2BPMO mappings to our running example, we obtain (partially) an output as displayed in Figure 4. The i* goal to handle six sigma certifications could be annotated with information about the Business Function, Business Role, Business Process Goal and Business Domain. Future work should focus on extending the complete Formal Tropos grammar to include all mappings and concepts shortly discussed in this paper.

6 Conclusion

This paper has presented a research design for coping with the lack of methodological and tool support for *automated requirement propagation from strategy thinking layers into business implementation layers* as well as support for elicitation of AS-IS BP models. We showed that both scenarios were not yet tackled by current research in a satisfying manner. The setting regarded is that of a BP-oriented enterprise, where value-creating activities are modelled and executed based on BP models. This work claims that using goal-based requirement engineering methods for early-phase requirement elicitation makes it possible to create valid (with regard to business requirements) BP models, thus providing more control over the behaviour of the enterprise. The results presented here are of a conceptual nature and neither do we give a formal extension to the RE methods yet, nor do we provide tool support for the proposed approach. Nevertheless, this work lays the ground to a software prototype based on the findings presented for automated generation of enterprise models and semantic BP models out of formal strategy-level requirements. In particular, the implications of this work for early-phase modelling of goals, strategies, policies, and compliance guidelines will be key to showcase the added value of our approach.

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