

Analysis of Business Process Traces and User Intentions for Evolution of Enterprise Models

PhD research proposal

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1 Introduction

1.1 Motivation and Problem

The Model-Driven Architecture provides a framework for design and development of enterprise information systems, ensuring downstream traceability and alignment between the high-level business goals, their supporting business processes and their implementing technological components (Fig.1). While improving efficiency and ensuring control over process execution, business process automation limits process flexibility and capacity to react on the evolving context. As a result, in a real execution environment, process participants often deviate from the process scenarios prescribed by the automated process supporting systems. While some deviations are introduced by inadvertence, the others are deliberate: they express **user intentions to adapt the process** to the evolving business context.

Upstream traceability between the process execution traces, introduced adaptations and their motivating user intentions provide the ground for **analysis and evolution of the business goals** in response to the business context.

Conformance between the designed and the executed processes on the *operational level* is largely discussed in the literature. In this work, we focus on the alignment between the business goals motivating the designed process and the intentions motivating its executed counterpart defined on the *intentional level* (Fig.1). We propose to establish the bottom-up traceability between the business process execution traces and the user intentions applying an intention mining technique. We will use conformance checking and formal analysis to study alignment between intentions and goals. This analysis will be further used for assessment and redesign of the enterprise models. For this thesis, we formulate the following research problem:

How to guide the enterprise model (re)design with the bottom-up analysis of the business process execution traces?

1.2 Project Overview

This project will focus on development of a holistic design approach that extends a traditional Model Driven Architecture paradigm [10] with the bottom-up traceability and conformance checking. Figure 1 illustrates the main elements of this project. Here, the Process Adaptations are identified as deliberate deviations from the designed Business Process Model based

on analysis of the Process Execution Traces. The user intentions behind the identified process adaptations indicate the *gap* between the designed business goals (specified in the Goal Model) and the process execution environment. This work will address this gap, developing techniques and tools for formal analysis and conformance checking between the business goals and the user intentions.

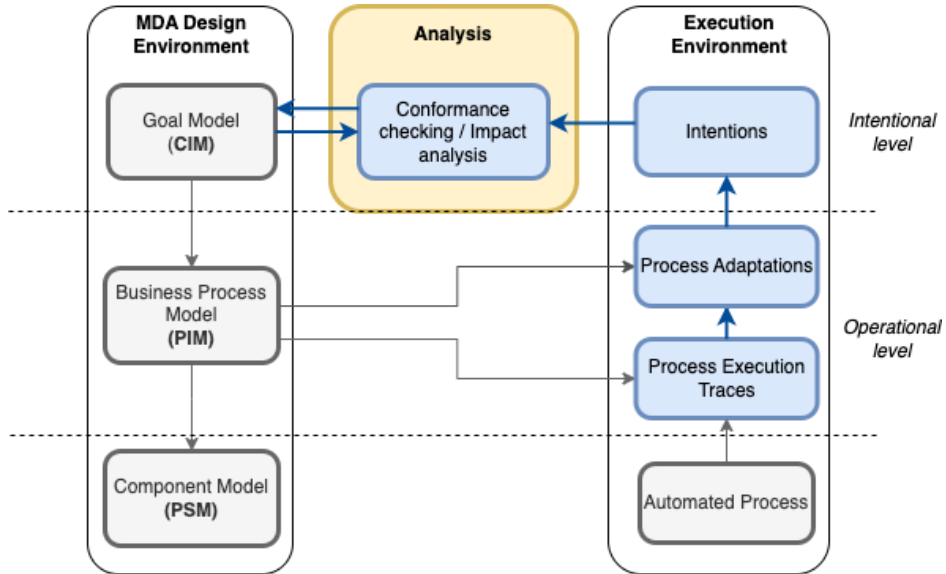


Figure 1. TEAEM: Introducing Intention analysis and Conformance checking to MDA

This work follows up on our earlier publication, introducing TEAEM [15] - an approach for Technology-Aware Enterprise Modeling. It is strongly connected to the ongoing PhD thesis of Ramona El Ally, who focuses on intention mining from the process traces, and related to the ongoing PhD thesis of Eddy Kiomba, who develops the tool for constraint analysis in feature models. The works of Oscar Pastor at the Universitat Politècnica de València on MDA contribute to this proposal and will be further discussed in the Related Work section.

2 Background

Model Driven Architecture (MDA) is a software design approach that provides a set of guidelines for structuring specifications expressed as models, supporting traceability and business-IT alignment. MDA defines three primary types of models: *Computation Independent Model (CIM)* represents

the system’s requirements and business context without detailing the structure or processing; *Platform Independent Model (PIM)* specifies the system’s structure and functionality but abstracts away the details of any specific implementation platform; *Platform Specific Model (PSM)* provides the technical details on system implementation using a particular technology or platform.

The PhD candidate working on this project will use the following techniques and tools to address the defined research problem:

- Business Process Modeling (e.g., BPMN) for process specification
- Goal Modeling (e.g., i*, MAP) for business goals specification
- Process mining for executed process discovery and analysis
- Intention mining for identifying intentions behind the executed process adaptations
- Formal specification and conformance checking for analysis of inconsistencies between business goals and the intentions expressed by the process participants.

3 Related Work

Methods and approaches for enterprise system design grounded on MDA are discussed in research literature for several decades. Alignment between enterprise models at different MDA abstraction levels is addressed in [14, 6, 17, 19]. Numerous works focus on validation and analysis of alignment between business processes and goals [5, 4, 1]. Formal methods are proposed for alignment verification in [16].

The team of Oscar Pastor at the Universitat Politècnica de València, Spain, addresses the MDA design at their numerous publications. In particular, to acknowledge the constantly changing business environment, integration of organizational strategy and structure into MDA is addressed in [12]. In [13], a semi-automated *strategy-to-code* approach that integrates organizational, business process, and information system modeling is introduced. This approach is grounded on LiteStart modeling method [11] and ensures traceability across modeling levels. We consider a fruitful collaboration with this team while working on this project.

TEAEM approach that will be developed further in this thesis is presented in [15]. In this article, we consider the bottom-up propagation of the constraints expressed in a goal model and a feature model in order to support the evolution of goal model. In this thesis, we will focus on analysis

of business processes and the user intentions behind the process execution. The inconsistencies between the user intentions and the business goals will be analyzed in order to drive the evolution of the enterprise model, including goal model, process model and component model.

The CRI team has been working on process mining techniques for around twenty years, focusing particularly on intentional process mining techniques [7]. Ghazaleh Khodabandelou's early work demonstrated the feasibility of inferring an intentional model from user traces [8]. Elena Epure and Ramona Elali have also shown that it is possible to use heterogeneous sources such as text documents [18] or sensor data [2] to obtain an intentional process model. The use of these techniques allows for defining the intentions behind users' actual behavior based on their traces.

4 Prospective Research Questions

- In the first part of this research project we will examine the implications of user intentions on enterprise models. It can address the following research questions: *How the user intentions are identified? How the user intentions are taken into account for enterprise model (re)design?*
- The main part of this project will focus on analysis of the alignment between the business goals (defined a priori) and the user intentions (identified a posteriori). Here, we propose the following guiding research questions: *What are the existing techniques for reasoning about intentions? How the relations between goals and intentions can be formalized? How the alignment between goals and intentions can be analyzed?*
- The third part of this project will concentrate on the interpretation of misalignment. The following research questions can be addressed in this part: *How the misalignment between the designed business goals and the expressed user intentions can indicate the change in the business environment? What are the implications of this misalignment? How it can trigger the business model evolution?*

5 Methods

5.1 Systematic Literature Review

Systematic literature review methodology [9] will be applied in the first part of this thesis in order to examine the existing body of knowledge and define the gaps in the areas including:

- Intention modeling, specification and analysis
- Intention driven enterprise modeling
- Conformance checking in goal modeling

5.2 Proof of Concept

During this thesis, the PhD candidate will work on development of a concept and a prototype of a tool for automated reasoning about user intentions and their implications on the enterprise model and goal model in particular.

Formal specification and conformance checking techniques will be implemented. Further integration with already existing methods and tools for goal modeling, process modeling etc. will be required in order to support a (semi) automated analysis. Proof of concept methodology [3] will be used in order to elaborate and evaluate this prototype.

5.3 Experimentation / Case study

Through this work, the PhD candidate will work on the approach for Technology-Aware Enterprise modeling (TEAEM) [15], focusing on analysis of alignment between the business goals (defined a priori) and the user intentions (identified a posteriori). Applying the approach on the real example will be an important part of this project. The PhD candidate will conduct a case study in order to validate the approach and the developed artifacts.

Other research methodologies will be determined by the PhD candidate. Each research question and methodological step will be validated via academic publications.

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