Bridging the Gap between Goals, Agents and Business Processes

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Abstract. Organizational Modeling is a discipline which tries to capture and reason about the distinct dimensions (e.g. structure, strategies and processes) involved in organizations by the means of visual models. In order to be effective, these models must represent in an abstract way, the right set of concepts composing each of the organizational dimension. Our work focuses on identifying and understanding this set of concepts through a foundational ontology. Moreover, we aim at investigating different modeling languages, identifying if (and to what extent) each of them, individually or in combination with one another, adequately covers this set of concepts. In this article, we discuss our work on the combination of *i**/Tropos (representing a goal modeling dimension) with approaches representing the agent-oriented organization and business process domains. Finally, we elaborate on case studies and computational support for the methodologies originated from the combination of these languages.

Keywords: organizational modeling, goals, agents, business processes, foundational ontologies.

1 Introduction

Mainly aiming at staying in business or seeking for higher profits, organizations today need support for fostering innovation and boosting production. This leads to efforts in different directions, promoting, for instance, organizational *reengineering*, in order to improve the way products and services are delivered, and *knowledge management* to keep a constant flow of usable knowledge throughout the organization's points of action. Both for reengineering and knowledge management, it is crucial that organizations develop a deeper understanding regarding their different dimensions, such as *structure*, *strategies* and *processes*. Such an understanding can emerge through *Organizational Modeling*, a discipline which tries to capture and reason about these distinct dimensions by the means of models. In order to be effective, these models must represent in an abstract way, the right set of concepts composing each of the organizational dimension. Our work focuses on identifying and understanding this set of concepts. Moreover, we aim at investigating different modeling languages, identifying if (and to what extent) each of them, individually or in combination with one another, adequately covers this set of concepts.

In [10], we proposed to combine *i**/Tropos with another agent-oriented approach named AORML, so as to result in a thorough methodology to analyze and design agent-oriented knowledge management systems. The idea was to apply *i**/Tropos as an organizational modeling approach to diagnose what kind of support an organization needs to enable knowledge creation and sharing. And then, use AORML to design a system to support these processes.

However, fostering innovation does not necessarily involve a supporting system. Many times, this can be achieved by changing the practices and processes adopted by the organization. This brings us to the area of business process engineering, which focuses on a detailed understanding of the chain of activities that deliver the organization's products and services. However, the existing business process modeling languages stress the temporal order of activities, giving only marginal attention to the strategic dimension (i.e. goals) that motivates these activities to be executed. For instance, the modeling language used in ARIS, the most prominent business process modeling framework, from an industrial point of view, offers a very simple syntax for modeling goals. This syntax basically allows the identification of a few goals and subgoals, connecting them to macro-processes, without supporting in depth analysis, such as *i**'s alternative and contribution analyses. Our current work investigates how to relate goals and business processes by combining *i**/Tropos to ARIS EPC (Event-driven Process Chains), ARIS`s syntax to model processes [1,2].

It is also important to state that both for combining goals and agents and for integrating goals and business processes, we adopt an *ontological approach*, as argued for in this same event two years ago [9]. Foundational ontologies have been proven to create a safe path for (re)engineering consistent and coherent conceptual modeling languages. We hereby rely on a foundational ontology named UFO [8,7], which guides us in the alignment of *i**/Tropos with different approaches. In fact, the utmost goal of our work concerns this ontology, as our research group aims towards the investigation of "the ontological nature of the social entities underlying the agent-oriented modeling paradigm. By doing this with the help of an interdisciplinary approach, we aim at defining a **stable** and **sound formal theory** which can be used as a foundation for agent concepts" [9].

The remaining of this paper states the objectives of our research (section 2), the main scientific results achieved by this work (section 3), conclusions (section 4) and future work (section 5).

2 Objectives of the Research

Our research objectives comprise:

1. Evolving the theoretical foundation for agent-oriented, process-oriented and goal-oriented paradigms and applying this theoretical foundation to analyze, evaluate and integrate conceptual modeling languages.

2. Investigating the relations between the goal domain, the business process domain and the (agentive) organizational structure domain with the purpose of improving the modeling of the organizational strategic dimension.
3. Developing model-driven methodologies, which relies on the combination of existing works and on the evolution of existing solutions for automated support.
4. Applying the resulting methodologies in case studies with the purpose of validating them in practice.

3 Scientific Contributions

The subsections in the sequel bear a correspondence (in a reverse order) to the objectives enumerated in section 2. Due to lack of space, we have decided not to include here a discussion regarding objective 1, namely, the ontological theories providing foundations for our work. Aside from space limitation, the ontological theories themselves as well as their applications are more general than the scope of the workshop. Recent publications related to these theories as well as their applications can be found, for example, in [5,6,7] and [3,4], respectively. However, because these theories crosscut and support the remaining objectives, their role w.r.t. to each of these objectives is discussed in the corresponding sections below.

3.1 Case Studies

With the purpose of investigating the potential relationships between goals and business processes in a real world organization, we have conducted an exploratory study in a Rheumatology Department of a hospital in Brazil. The result of this case study comprehends a set of goal models in *i**/Tropos, each one directly associated with a business process, also fully modeled in ARIS EPC. Such goal and business process models focus on the organization as it is today (*i** early requirements or AS-IS model, in business process modeling jargon). From the point of view of the department where the study was conducted, this result opens up many possibilities for re-engineering and process automation.

Developing the exploratory study in a real organization has given us the opportunity to test and question many of the techniques generally associated to goal elicitation, such as interviews and active observation. After applying these techniques, we noted that most of the goals had a process-like nature, instead of capturing the intentions behind the tasks of the stakeholders. Moreover, some of the business processes were unrelated to strategic goals, which suggested that a large number of goals had remained unidentified. The solution to this problem involved the application of Non-Functional Requirements (NFR) catalogues. In our case, NFR catalogues are not used in the scope of system development, as in its original proposal. Conversely, it is applied to elicit goals that directly impact the organization's business processes. The application of the catalogues has shown to be very interesting because it enables reasoning about the organization from a more strategic point of view. This can be confirmed by the elicitation of goals which referred to quality attributes either for the business processes or for the organization as a whole. In that respect, the catalogues employed in this case study provided guidelines for identifying these attributes in a systematic way. The main scientific contribution resulting from this case study is a methodology to elicit goals and business processes [1,2].

We have also conducted a second case study exploring the mutual interaction between goal models in *i**/TROPOS and business process models in ARIS EPC. This second case study took place in the context of a Brazilian (multi-national) large organizational of the energy (petroleum and gas) sector. As discussed in our previous paper [9], it is important that the same business process and its composing activities can be seen at different levels of granularity in different phases of the process, from conceptual modeling to implementation. An example of this situation took place in the aforementioned project. In that case, it was required that a workflow specification should be derived from a large business process model. However, the requirement was to implement a more abstract version of the initial conceptual model, i.e., a version of the latter model captured in a higher level of abstraction. In order to do that, one is required to construct a more abstract version of a process in a bottom-up fashion, i.e., by (among other things) creating macro-activities which will be composed of a number of the original ones. Now, a question begging issue here is: how do decide which activity will be part of which macro-activity? The solution found in that project was to elicit *i**/TROPOS goal models that were decomposed into a level so that each activity in the original process could be associated to a goal. By doing that, we could construct the macro-activities in the more abstract process model by creating a systematic alignment between the goals decomposition structure and the process composition one.

3.2 Relating Goals and Business Processes

As a result of the hospital's case study (section 3.1), we observed that establishing the relations between goals and business process is far from straightforward. This can be accounted by the fact that goals may be formulated at various levels of abstraction and precision. To solve that, we propose using a *Goal Taxonomy* [2] to deepen our understanding about the goal domain, before establishing the relationships between goals and business processes. Goal taxonomies have been applied in system requirements elicitation to guide the discovery of goals and requirements, and their subsequent implementation in the target system. In the scope of BPM, a goal taxonomy is important because the different types of goals impact on the structures of business processes which support them. For example, some goal can be associated with one sole business process in order to be satisfied. Alternatively, another goal requires several business processes to execute simultaneously in order to be satisfied. Our major reason for proposing such classification is to reflect the different ways goals can be satisfied according to their participation in relations with business processes. This was crucial to enable the alignment of goals and business processes.

Moreover, besides understanding the goal domain, other concepts are important to help us align goals and business processes. Concepts such as agents, intentionality, commitments, among others, also have an impact on how goals and business processes are related. The semantics of these concepts can be well understood with the use of UFO [8,7]. UFO provided us with a common ontological foundation for goals and other enterprise elements, enabling us to understand how these elements relate. The resulting alignment between goals and business processes was only possible due to this understanding.

3.3 Relating Goals and Agents

In [10], we proposed ARKnowD (read "Arnold"), a methodology which combines *i**/Tropos and AORML to develop knowledge management systems. ARKnowD's life cycle is composed of four activities, namely requirements elicitation, requirements analysis, architectural design and detailed design. These activities may be iteratively executed up to the point that the solution is modeled in enough detail to enable implementation. *i**/Tropos is applied in the first three activities while AORML covers the forth one.

Inspired by the Model Driven Architecture (MDA) initiative and guided by the UFO ontology [8], we developed some transformation rules which map *i**/Tropos into AORML. This guarantees a smooth transition from architectural to detailed design, guiding the developer on the use of the methodology, and facilitating automatic model transformation from one activity to the other [11].

Preliminary work has been done on delivering automated support to ARKnowD [10]. By applying metamodel transformation, using our transformation rules, we started to integrate AROML into an *i**/Tropos modeling tool named TAOM4E (http://sra.itc.it/tools/taom4e/). This work allowed an *i**/Tropos actor diagram to be transformed into an AORML agent diagram. We are currently busy to provide transformations from *i**/Tropos's diagrams to the remaining AORML models, so as to deliver a modeling tool which enables full design using ARKnowD. This will also allow code generation using the JADE framework, thus also supporting system implementation. In this context, we are also investigating how to generate, from the AORML model, a database model which can be later transformed into SQL, hence also delivering a database to support the agent-oriented system under implementation.

4 Conclusions

Distinct modeling approaches have been designed over the years and by different communities with the aim to address the different dimensions of organizations, such as structure, strategies and processes. In this paper, we described the objectives and main scientific contributions of our work on offering theoretical support for evaluating and engineering combinations of some of these approaches. Moreover, we briefly discuss the application of these combined modeling solutions in real-world scenarios as well as the development of computational tools to support them.

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