



# A language for multi-perspective goal modelling: Challenges, requirements and solutions



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## ABSTRACT

Successful implementation of an enterprise strategy, the reorganization of an enterprise, the successful enterprise-wide adoption of a new enterprise resource planning system, or simply being able to manage the daily operations at an enterprise in general are all common examples of organizational actions that are strongly interrelated with the achievement of goals related to these actions. From the research as presented in this paper, it becomes clear that it is not elementary to clearly formulate goals and to understand how to achieve them. In two use scenarios, it is described how the executive board of a mid-sized bank in Germany wants to achieve their overall goal to increase the bank appraisal. The first scenario deals with determining who is responsible for goal creation and accomplishment, while the second scenario deals with describing a concrete goal system. A domain-specific modelling language (DSML) for designing goal models is proposed that provides solutions for requirements that are derived from the described scenarios. This DSML is coined the 'goal modelling language' (GoalML), which enables the development of goal models from multiple perspectives in order to relate goals with their context and vice versa.

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## 1. Introduction

Organizations are defined as 'goal-oriented social systems' according to the predominant rational conception of the enterprise. Especially with respect to enterprises as specific kinds of organizations this conception is of particular importance. First, it emphasizes the idea of an enterprise as a "rationally constructed artifice" ([1], p. 23). Second, it stresses the pivotal relevance of economic action in enterprises, since the conception of economics is usually defined as a means–end relationship. It seems obvious that strategic planning, managerial decision making and every kind of professional action in a company require the existence of explicit or at least implicit goals. Goals are the foundation of (rational) choice. At the same time, developing and using organizational goals is far from trivial. The problem starts with the very conception of an organizational goal. Before going into more detail, it has to be clarified first that goals have certain functions. A goal function is viewed as the achieved effect by accomplishing a goal and these effects can be different in nature. Such effects are, for example, reaching a decision (see, e.g. [2]), increasing focus (see, e.g. [3,4]), or improving coordination (see, e.g. [5]). However, are such organizational goals simply the goals defined by top management or is "the organizational objective ... indirectly a personal objective of all the

participants" ([6], p. 17)? In any case, the definition of organizational goals needs to account for goals that are not compatible with each other or that are even contradictory.

In an extreme interpretation, the rational conception of the enterprise would recommend to precisely define goals for any kind of organizational action. However, there are reasons to challenge such a recommendation. First, research in Cognitive Psychology indicates a limited ability of most humans to make decisions purely on a rational basis [7]. These findings correspond to Simon's conception of 'bounded rationality' [8]. Second, actual organizational behaviour indicates that organizations often operate without explicit goals. Instead, they may be "saturated with subjectivity, abstraction, guesses, ... and arbitrariness" ([9], p. 5). In addition to that, there are doubts that it is appropriate to develop elaborate plans: The complexity and contingency of organizations and their environment may rather recommend piecemeal engineering or even 'muddling through' [10]. Further studies stress the limitations of the rational conception of the organization. Pfeffer ([11], p. 5), for instance, demands that in addition to pursue a rational path of action, managers should also account for 'symbolic' actions which are aimed at fostering motivation and commitment. In line with that, various authors have stressed the relevance of organizational culture, i.e., of specific values, sense-making, and rituals (see, e.g. [12,13]). Although these critical and well-thought statements object against a pure rational view of the organization, they do not refute the need for creating goals. Instead, they warn against a naive conception of organizational goals. It seems that in managerial practice goals have become even more important during the last years as there is an increasing use of

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performance indicators which are aimed at measuring a degree of goal achievement (see, e.g. [4,14]).

Against this background, our investigation aims at supporting organizations with developing, using, and maintaining goal models. Our work is based on the following assumptions. While a pure rational or even mechanistic view of organizations is inappropriate, the modelling of goals, their interrelationships and possible consequences support an analytical approach to decision making and planning. Goal models also support coherence and consistency of organizational goals, thereby avoiding friction and waste of resources. Furthermore, explicit goals promote clarity and help employees to develop a better appreciation of organizational action. Moreover, goal models may help to prevent hidden agendas and the misuse of ambiguous goals, they are suited to foster sense-making and motivation, and may help to avoid dysfunctional effects of performance indicators. Goal models may also support the assessment of organizational actions and serve as a common orientation for organizational development. At the same time they may be a core subject of organizational change themselves. With respect to building advanced enterprise systems, (semi-)formal goal models enable automated analyses, e.g., to check for consistency with business process models or the use of resources. Furthermore, they may be transformed into code of corresponding goal-oriented control systems. Finally, different stakeholders of an organization are interested in different goals and prefer different levels of detail for describing goals. Goal models that enable different views on an organizational goal system support this need. A goal system is understood to be the structure that is formed after generating relationships between a collection of organizational goals (see, e.g. [15]).

With respect to supporting the creation of goal models our work is based on two key decisions. First, a goal model represents relevant goals as well as relationships between goals. However, analysing goals without accounting for measures and constraints does not make sense. To satisfy this demand, we suggest goal models to be an integral part of enterprise models, which provide relevant contexts, such as: Descriptions of resources, business process models or models of the IT infrastructure (see, e.g. [16]). Second, while it is possible to model goals with a general purpose modelling language (GPML) like the Unified Modelling Language (UML) or the Entity-Relationship Modelling (ERM) language, we decided for a domain-specific modelling language (DSML). This is for three reasons: Using a GPML would require a modeller to reconstruct relevant concepts such as various kinds of goals from scratch, which would compromise modelling productivity. Furthermore, a DSML would include specific constraints that prevent modellers to a certain degree from creating fallacious models. Finally, a DSML enables the use of a specific concrete syntax, which fosters comprehensibility. The presented DSML, named goal modelling language (GoalML), has been introduced first in [17], on which this paper further builds.

The paper is organized as follows. At first, we will outline a method for designing the GoalML in Section 2. Second, we will illustrate the benefit of goal models by presenting two use scenarios in Section 3. The scenarios also serve to prepare for the subsequent analysis of requirements a goal modelling language should satisfy. A respective analysis is conducted in Section 4. Against this background, the design of the DSML is presented in Section 5. It extends an existing method for Multi-Perspective Enterprise Modelling and comprises a meta model as well as a concrete syntax. Subsequently, the proposed DSML is compared against related work in Section 6. Finally, the conclusions and an overview of future research are presented in Section 7.

## 2. Outline of a method for designing the GoalML

Modellers are supposed to create domain-specific models more efficiently than it would be possible with a GPML. It is based on reconstructing language concepts from technical terms used in the respective domain of discourse ([18], p. 28). In this sense, the GoalML is a DSML that enables

the design of goal models as well as of some aspects to be accounted for during the process of defining goals.

Designing a DSML itself is a challenging task. At first, analysing the technical language characteristics for a targeted domain may be demanding, because it may lack coherence and consistency, which is definitely the case for the terms used to describe goals. On the one hand, this relates to the existence of various terms that are somehow adjacent to the term 'goal', such as: 'Target', 'motive', 'objective', 'norm', 'destination', 'aim', and 'purpose'. On the other hand, it will usually remain unclear, whether such a term is intended to represent a particular instance, a type or even a meta type. This is a distinction that is of crucial relevance for designing a DSML. Second, analysing the requirements a DSML should satisfy is particularly challenging as oftentimes prospective users do not have a complete picture of what such an artefact should include. To cope with these challenges, a method for designing DSMLs [19] that has been successfully used in different projects (see, e.g. [20,21,17]) was applied for developing the GoalML. The method proposes to use the process model shown in Fig. 1 as a guideline.

In this paper, we mainly focus on the clarification of scope and purpose, on the analysis of requirements that are specific for a goal modelling language, and on the language specification and design of the graphical notation. The overview of the state of the art in goal modelling presented in Section 6 is seen as an evaluation activity as other approaches presented in that section are evaluated against a set of characteristics that are typical for goal modelling languages. The analysis of requirements for DSMLs in general and the development of a modelling tool are not part of this paper. More information on general requirements that would concern DSMLs in general are found in [19]. The result of the first phase should "outline a convincing motivation and rationale for designing a DSML" ([19], p. 140). This motivation and rationale are in fact presented in the introduction of this paper. As the process model shown in Fig. 1 is a macro-level model, it is possible to zoom in on some phase to achieve the micro-level process model of that phase. This would further clarify the results as described in this paper with respect to the phase 'analysis of specific requirements' and zooming in on that phase results in the micro-level process model for that phase as shown in Fig. 2.

To address the challenge that prospective users might not be able to imagine what a DSML could do for them, the method emphasizes developing and analysing use scenarios. They are based on illustrating a DSML by presenting prospective users with diagrams that are created with a first draft of concepts and a preliminary concrete syntax. They allow conveying to users how diagrams of the targeted DSML could look like and what kind of tasks they might support. With that kind of support users can develop questions or problems to be addressed with respective diagrams together with analysts, thereby suggesting further requirements the DSML should satisfy. The extent of the requirement analysis that had been conducted to develop the GoalML makes it impossible to present it in this paper in detail. Therefore, we choose a different approach. The use scenarios presented in the following section are presented using the final concepts and notation of the GoalML. They give the reader an idea of the DSML to be developed. At the same time, they should illustrate how diagrams with a preliminary notation were used to elicitate the specific requirements presented in Section 4.

Scenarios that illustrate the use of a previously developed DSML support the evaluation of that DSML, since they allow to analyse whether and how corresponding requirements are satisfied by the DSML. Such an evaluation based on the introduced use scenarios should include stakeholders of the proposed language, where users of course play a key role.

## 3. Use scenarios: goal modelling and analysis for a bank

In this section, two use scenarios that illustrate the need for a multi-perspective goal modelling approach as a result of applying the first

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