9 Modeling Goals and Reasoning with Them

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Abstract. The concept of goal has been used in many domains such as management sciences and strategic planning, artificial intelligence and human computer interaction. Recently, goal-driven approaches have been developed and tried out to support requirements engineering activities such as requirements elicitation, specification, validation, modification, structuring and negotiation. This chapter first review various research efforts undertaken in this line of research and presents the state-of-the-art in using goals to engineer requirements. It then presents a particular goal model, the goal/strategy map, and shows that maps can help with facing the challenge of new emerging multi-purposes systems, i.e. systems imposing variability in requirements elaboration and customization in the requirements engineering process.

Keywords: Goal, Goal modeling, Goal specification, Reasoning with goals, Elicitation, Variability, User, Scenario.

9.1 Introduction

Goals have long been recognized to be an essential component involved in the Requirements Engineering (RE) process. In their seminal paper, Ross and Schuman stated “requirements definition must say why a system is needed, based on current and foreseen conditions, which may be internal operations or external market. It must say what a system features will serve and satisfy this context. And it must say how the system is to be constructed” [77]. Typically, the current system is analyzed; problems are pointed out and opportunities are identified; high level strategic goals are elicited and refined to address such problems and meet such opportunities; requirements are then elaborated to meet these goals. Goals are thus the driving force of the requirements engineering process.

Goal-driven approaches have proved to be an effective way to elicit requirements [64, 76] and also to support a systematic exploration of design choices [41, 74, 90] to check requirements completeness [91], to ensure requirements pre-traceability [26, 66] and to help in the detection of threats [31] such as conflicts [68] and obstacles [41, 64] and their resolution. The leading role played by goals in the RE process led to a whole stream of research on goal modeling, goal specification/formulation and goal-based reasoning for the multiple aforementioned purposes.

This chapter aims first to provide a state-of-the-art review in the three key topics of goal modeling, goal specification and reasoning with goals. Thereafter, we will discuss a particular goal model, the goal/strategy map [73] and show how comprehensive guidelines, drawn from our research and our practical experience,
help to model and specify maps and to reason with them. A special emphasis will be put to demonstrate how goal/strategy maps are well suited to deal with new challenges raised by the emerging conditions of systems development leading to variability in requirements capture and customization in the requirements process. Variability is imposed by the multi-purpose nature of software systems of today. These systems must meet the purpose of several organizations and must be adaptable to different usage situations sets of customers. In contrast, earlier software systems were concerned with the purpose of a single organization and of a single set of customers. Variability is defined in software development as the ability of a software system to be changed, customized or configured to a specific context [87]. Therefore, it can be seen that variability affects both goal models, which must make variability explicit, and the process of goal-based reasoning that must help selecting the right variant for the project at hand.

The rest of this chapter is organized in two main sections. Section 2 is an overview of the state-of-the-art in using goals to engineer requirements. Section 3 presents the goal/strategy map model and its contribution to deal with variability requirements.

9.2 State-of-the-Art Review

According to Axel van Lamsweerde [40], RE is “concerned with the identification of goals to be achieved by the envisioned system, the operationalization of such goals into services and constraints, and the assignment of responsibilities of resulting requirements to agents as humans, devices, and software”. In this view which is largely shared by the RE community, goals drive the RE process which focuses on goal centric activities such as goal elicitation, goal modeling, goal operationalization and mapping goals onto software objects, events and operations. This section provides an overview of research efforts undertaken in this line. It is organized in three parts. The first one provides the “big picture”, the second overviews contributions of goal modeling approaches and the third one discusses their weaknesses.

9.2.1 The Big Picture

This section presents a motivation for goal-driven RE, briefly defines what a goal is and introduces the roles of goals in the RE process and the difficulties encountered in their use.

9.2.2 Motivation for Goal-Based RE Approaches

Goal-driven RE approaches have emerged as a means to overcome the major drawback of traditional approaches, that is, to lead to systems technically good but