Eliciting Goals and Softgoals - How to Perceive the Intentionality at the Beginning of the Journey

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Abstract: Software requirements activity, in the organizational context, is about addressing the business information problem; discover the needs for improving the situation and consequently specify the software requirements. Goal-Oriented Requirements Engineering (GORE), aims to better understand the information problem by looking at organizational actors' intentionality (goals and softgoals) first. Eliciting goals and softgoals within an organizational context is a difficult task: since, among other things, it demands skills and time. This paper describes one strategy for eliciting goals and softgoals that still relies on software engineers' skills and time, but it simplifies the process. We propose the use of a software tool to support a systematic process to mitigate the chances for goals to be missed regardless of the experience and skills of the software engineers involved in the project.

Keywords: Goals Elicitation, GORE, Goal-Oriented Requirements Engineering, Requirements Engineering, MAS, Multi-Agent Systems, iStar, ERi*c Method.

1. Introduction

The goal concept has come to play a critical role in Requirements Engineering. In Requirements Engineering, goals are considered a significant construct. Various researchers consider GORE one of the best ways to produce quality software [12] [13]. When referring to intentionality, we believe that goal modeling has a key role.

Our strategy uses goals, both hard goals and softgoals, in the same way used by the iStar Framework [11] and the NFR Framework [2]. In order to avoid freestyle text in goal naming, which allows a goal to be represented as a function or an action, we adopted pre-defined syntactic frames that have the purpose of driving the requirements engineers to represent stakeholder's intentionality. We have developed a tool to support goal elicitation in the context of previous work [6]. In this work, we present the tool and a strategy to apply it to elicit both hard and softgoals.

This paper uses "the toll road control system" (TRC System) [4] [8] [9] [10] to

illustrate the proposed strategy. Section 2 describes the AGFL (Actor Goals from Lexicon) strategy concepts using the AGFL tool prepared to facilitate the job, its concepts, and it shows, in a simple way, the central ideas of the AGFL strategy for perceiving the intentionality and how the process is carried out. An in-vitro experimentation run by UERJ students is portraited. Section 3 concludes stressing the continuity of the requirements process.

2. AGFL Strategy Concepts

The AGFL Strategy provides activities to guide goals and softgoals elicitation. Figures and examples illustrated in this Section were extracted from an in-vitro experiment conducted with undergraduate students. They were divided into 4 groups of 3 students for preparing this experiment work of modeling TRC System.

The first activity of the strategy is "***A - Build Lexicon"***. The strategy adopts the Language Extended Lexicon (LEL) [5] as an anchor, building on LEL´s strength, which is to facilitate the comprehension of contextual terminology while providing semantics associated with the vocabulary. LEL (Figure 1) captures the application vocabulary elements and classifies (classification) them as either a subject (someone who does the action Fig.1-a), an object (something that receives the action Fig.1-b), a verb (the action Fig.1-c) or a state (a result of the action Fig.1-d). Each symbol (Name) will contain one or more sentences written with minimum vocabulary to express the meaning of the term being depicted (Notion). Each symbol will contain one or more sentences specifying the "Behavioral Response" associated with this symbol. Behavioral responses express the connotation of the symbol and can be understood as **actions** that will occur due to the existence of this symbol. The LEL is supported by a Tool [1]. Figure 1 (a, b, c, d) is a partial description of the TRC LEL.

Name:	Authorized driver
Notion:	- **Driver** or **vehicle** that belongs to special force or **toll road administration**.
Classification:	subject
Behavioral Response:	→ Receives **authorization**, as a **free pass**, for traveling in the **road**. → Hopes to have a good trip on the **road**.
Synonyms:	Authorized vehicle

Name:	toll plaza
Notion:	- Building or facility in which a **toll** is collected.
Classification:	object
Behavioral Response:	→ Used to **control the operation**. → Structures for which **tolls** are charged include **toll road**, toll bridges and toll tunnels.
Synonyms:	toll station, toll gate

Name:	Violate
Notion:	- To do something that is in opposition to pay a **flat fee**.
Classification:	verb
Behavioral Response:	→ **Ticket** indicates a traveling violation or be lost = **ticket violation**. → The **driver** would typically pay the maximum amount possible for travel on that **road**.
Synonyms:	

Name:	Vehicle is authorized
Notion:	- occurs when one **vehicle** receives an official **permission** for traveling without pay.
Classification:	state
Behavioral Response:	→**Operator** must justify **authorizations** to the **administration**. → The **vehicle** must be identified.
Synonyms:	

Figure 1 – Example of four types of LEL symbols - Toll Road System

The lexicon is of fundamental importance to understand the vocabulary. It does help the requirements engineer (RE) with the context knowledge and capture semantics from the application language in use. Eliciting behavioral responses for each symbol plays a special role since behavioral responses will drive the second activity of our process (B - Extract Goals).

The activity ***"B - Extract Goals"*** requires that the RE recognizes goals and softgoals and organize them by actors.

For recognizing goals, we build on Eric Yu´s observation: ***"A goal is a condition or state of affairs in the world that an actor would like to achieve"*** [11], the strategy basic idea is: "*actions change states and states are goals*"[1]. This concept is used in Actor Goals from Lexicon – AGFL [6]. The AGFL considers the kinds of **actions** revealed by LEL and performed inside the selected context.

LEL SYMBOLS are related to ACTIONS. ACTIONS have the ability of changing STATES. STATES are GOALS.	***One CONCRETE ACTION changes one STATE. One FLEXIBLE ACTION adds a QUALITY ATTRIBUTE.***

Behavioral Responses (**BRs**) in LEL symbols mention **actions** which happen in the organizational context. Two kinds of actions can be observed: concrete actions and flexible actions. A concrete action changes one state into another, and a flexible action adds a quality attribute to a state.

Oliveira [7] states that "A *concrete action* either occurs inside or outside the Software System, and it also has to bring any concrete result, that is there was a state change (buy, pay, sell, hire, calculate, and plan are examples of concrete actions) looking at it from the RE point of view". Oliveira [7] defines *flexible action* as a complement to a *concrete action, by bringing a quality characteristic to a given state*. Hence, if there is an action, it will be either concrete or flexible. Oliveira qualified the term flexible based on the same interpretation used to define "softgoals" [3]. *Flexible actions* lack precision, and the execution of the action may depend on interpretation of the agent performing the action (analyze, evaluate, check, control, verify, and validate are examples of *flexible actions*). Since actions change states, identifying the motivation (why?) behind each action is the key point in AGFL:

When one *concrete action* is found ➔ the action will define a *goal*.

When one *flexible action* is found ➔ the action will define a *softgoal*.

❑ Authorized driver "RECEIVES" authorization for traveling.	(concrete action)
❑ Authorized driver "HOPES" to have a good trip.	(flexible action)

This activity (B - Extract Goals) is connected to the C&L Tool [1] for picking all BRs (actions) expressed in the LEL for defining the kind of each one as concrete or flexible. The example (in activity A) has eight BRs (four concrete actions and four flexible actions). The first action: "**Receives** authorization for traveling" is a concrete action because it results in a concrete free pass while the second one: "**Hopes** to have a good trip on the road" is considered flexible because it describes a quality.

Figure 2 shows one example portraying the classifying actions. Usually, on the screen, we use the field RATIONALE to describe the flexible actions justification.

[1] In our context states are interpreted as "desired states".

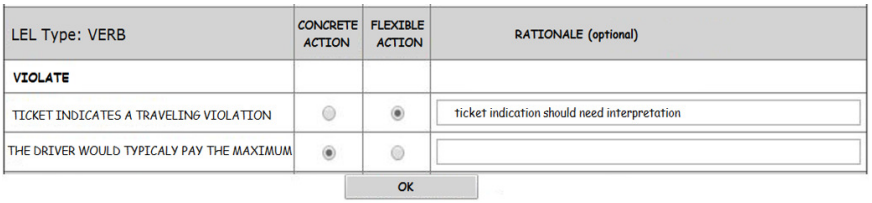

Figure 2 – Screen of AGFL Tool for receiving BRs from C&L Tool

For defining goal elements (exemplified in Figure 3), the RE must select for each BR that denotes a concrete action one LEL symbol element (subject or object) and fill in one verb in a passive voice. Furthermore, if the current actor (see "AUTHORIZED DRIVER") depends on another actor ("operator") to achieve the goal, RE must indicate this by adding "+" a new line, defining a second actor's goal. We call this case a reflexive goal when one actor has a goal but depends on another actor for the goal achievement.

Figure 3 – The screen of the task "Define Goal Elements".

Figure 3 also shows that the RE selected ROAD as the first element, filled liberated (the verb) as the second element and picked operator as the second actor. This means that AUTHORIZED DRIVER depends on the operator for a goal "ROAD BE liberated". This means that operator also has the reflexive goal "ROAD BE liberated".

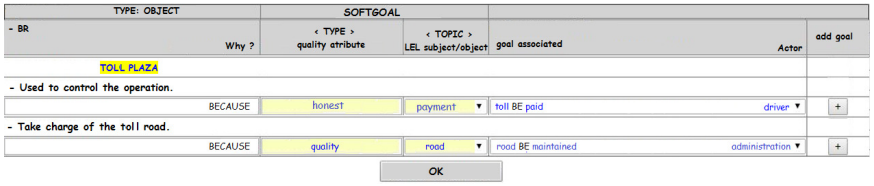

Figure 4 – The screen of the task "Define Softgoal Elements".

Figure 4 shows the OBJECT TOLL PLAZA containing two flexible actions. (a) the RE filled honest (the TYPE) as first element and selected payment (the TOPIC) as the second element. The RE also associated "honest [payment]" with "toll BE paid" by driver. (b) the RE filled quality (the TYPE) as the first element and selected road (the TOPIC) as the second element and also RE associated "quality [road]" with "road BE maintained" by administration.

The activity ***"C - Refine Goals"***, requires that the RE organizes goals and softgoals as a list sorted in chronological order. The RE should recognize when one goal comes before another one. Long-time goals should be placed at the end of the list. The

method proposes two activities to refine the actor's goals: merge goals (concrete and softgoals) by actor and set them in chronological order. Chronological order means long term goals first (the most abstract before and the less abstract after). This order is important on modeling according to the ERi*c method [7]

DEPENDER					DEPENDEE
Softgoal	**Goal**				
ADMINISTRATION					
Quality [road]	road	BE	administrated		
	permission	BE	granted	by	GOVERNMENT
Quality [road]	permission	BE	renewed	by	GOVERNMENT
Quality [road]	toll	BE	approved	by	GOVERNMENT
Fare [toll]	toll	BE	calculated		
Quality [road] = Fast [road], Safe [road], Reliable [road]	road	BE	maintained	by	OPERATOR
Quality [road]	road	BE	maintained		
	toll	BE	computed	by	OPERATOR
Honest [payment]	toll	BE	paid	by	DRIVER
	toll	BE	charged		
AUTHORIZED DRIVER					
Quality [road]	road	BE	liberated	by	OPERATOR
Quality [road]	road	BE	maintained	by	ADMINISTRATION
DRIVER					
Quality [road]	road	BE	maintained	by	ADMINISTRATION
Honest [payment]	toll	BE	paid		
Fast [toll road]	exit	BE	achieved		
	ticket	BE	received		
GOVERNMENT					
	permission	BE	granted		
Quality [road]	road	BE	maintained	by	ADMINISTRATION
	permission	BE	renewed		
Fare [toll]	toll	BE	calculated	by	ADMINISTRATION
OPERATOR					
Quality [road]	road	BE	maintained		
	toll	BE	computed		
Honest [payment]	toll	BE	paid	by	DRIVER
	ticket	BE	received	by	DRIVER
Honest [payment]	vehicle	BE	liberated		
	toll	BE	authorized		
	vehicle	BE	identified		

Figure 5 – The Report of Refined Goals.

For example, explaining Figure 5, ADMINISTRATION goals chain in chronological order is: toll BE charged is important for toll BE paid which is required for toll BE computed, and toll BE computed is necessary for road BE maintained, and so on.

Figure 5 shows the final list of AGFL of Toll Road System goals. The final report shows two new elements: "DEPENDER" and "DEPENDEE". DEPENDER is the first actor, the LEL subject of the actions, and DEPENDEE is the second actor who appears in the elicitation process as an actor from whom the subject ("DEPENDER") depends on to achieve one goal. This idea of "DEPENDER" and "DEPENDEE" is the same used by iStar Framework models.

3. Conclusions

The aim of this work is to propose a strategy to help the RE in the intentionality dimension of the elicitation process.

The AGFL presented in this work is an extension of the first step of the ERi*c Method [7]. The ERi*c Method uses the following composition for the handling the

requirements process: elicitation, modeling and analysis. Elicitation means understanding the contextual knowledge and discovering the software requirements. Modeling means describing requirements. Analysis means verifying and validating the produced models. Consequently, next steps of the system development project are specifying requirements and building models.

For modeling goals and softgoals before the application of iStar Models, the ERi*c Method uses a diagram language similar to state charts that are a simpler view of iStar SR model, to represent chains of goals and softgoals (states) relationships. These diagrams are called "Intentionality Panels" [7], and they should be drawn separated from each other, to control the iStar scalability problem. The idea of separation is based on SDsituations - Strategic Dependency Situations [7] concept. An SDsituation can be characterized as part of the business unit. In order to do that, the RE identifies goals and softgoals arrangements that are connected in a less complicated way, using the criterion defined in the process [7]. We described a process to tackle the intentional dimension of the requirements elicitation activity by supporting the RE during the mission of perceiving the intentionality (goals and softgoals) of an organizational context of the software, preparing a list of candidate goals and softgoals using a systematic process supported by a software tool called AGFL.

The AGFL Tool was developed using PHP, Javascript and MySQL, it has almost 2000 lines of code and required a 9 man-months effort. AGFL Tool will be available on the i* wiki. Future work is aimed at integrating the AGFL and IP Diagram tools. Our contribution relies on proposing a set of heuristics supported by a tool to help the discovery of goal and softgoals.

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