Building Intentional Models Using the ERi*c Method

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Abstract. *Requirements elicitation is the backbone of modeling. People around the world do not give very much attention to early requirements elicitation and more precisely to actors' goals elicitation before eliciting and modeling requirements. This fault will incur in several losses either during the development, or worse, later. Goals {flexible (softgoals) and concrete} are the foundation of GORE and consequently of i*. The ERi*c Method goal elicitation maturity was consolidated by its use in several academic projects and can support not only to the entire requirements process, but also to re-engineer, to change the model of a system, in order to include the use of new technology. This paper shows the strength of the ERi*c Method using as an example a published i* SR model. It also focuses on how the ERi*c Method can split an SR model of an Information System into several comprehensible models, applying the concept of SDsituations (Strategic Dependency situations).*

Keywords: *goals, early requirements, elicitation, modeling, GORE, Goal Oriented Requirements Engineering, ERi*c, goal modeling.*

1. Introduction

The Eri*c method was proposed by Oliveira [3] and has been evolving as it has been used by students and practitioners over the years. We have published parts of the ERi*c method [2] [4] [5] and in this paper we focus on the cornerstone of ERi*c: that is the elicitation strategy and the modularization strategy in their latest versions. We have used a previous published model as an example, as a way, to help communicating our ideas.

2. Objectives of the research

Since the publication of Oliveira's thesis, we have concentrated on improving ERi*c to support the construction of intentional models, as basis for our software transparency effort [6]. The method has been taught at two universities and it has been applied to several case studies as Zipcar (a car-sharing system), embedded systems, and also in a financial system for a very large telecom company.

In the next section we explain in a concise way the latest version of the process used in the ERi*c Method to identify goals. The aim is to show how to build comprehensible i* models departing of an SR model from another author.

2.1 Actors' goals elicitation

Using only one source of information is not the best practice, (see Figure 1) but, in our case, given the constraints and our purpose, the SR model published in [1] is sufficient[1]. Our purpose is to exemplify how ERi*c can re-engineer one previous SR diagram in order to mitigate the complexity by controlling the scalability.
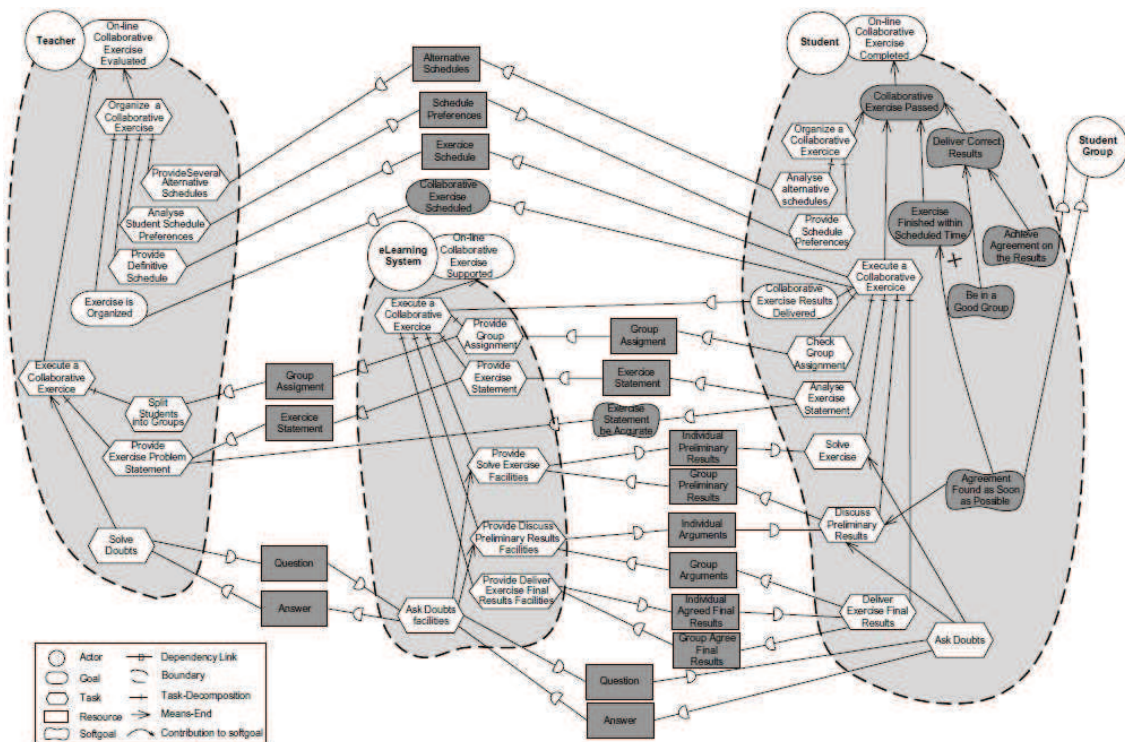

Figure 1 - The SR model that was used as source of information [1]

We will show that that our choice was adequate to demonstrate how simple the ERi*c process is. Steps: (i) identify the list of relevant symbols which are words or peculiar sentences mostly used; (ii) classify symbols as: subject, object, verb, and state; (iii) describe symbols through notions and behavioral responses definitions [2]. In Table 1, applying the 3 steps above; we selected actors' (teacher and student) tasks as behavioral responses and objects in order to give us more behavioral responses.

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[1] It will be clear that common sense knowledge is used as to fill the gaps of information provided by the chosen information source.

Table 1 –Actors´ tasks and resources from the SR model [1]

TEACHER (SUBJECT)	STUDENT (SUBJECT)	RESOURCES ➔ (OBJECT)
Organize a collaborative exercise	Organize collaborative exercise	alternative schedules
Provide alternative schedules	Analyse alternative schedules	schedule preferences
Analyse students schedule preferences	Provide schedule preferences	exercise schedule
Provide a definitive schedule	Execute collaborative exercise	group assignment
Split students into groups	Check group assignment	exercise statement
Execute a collaborative exercise	Analyse exercise statement	question
Provide exercise problem statement	Solve exercise	answer
Solve doubts	Discuss preliminary results	Individual preliminary results
Provide group assignment	Deliver exercise final results	group preliminary results
Provide exercise statement	Ask doubts	individual arguments
Provide solve exercise facilities		group arguments
Provide discuss preliminary results facilities		individual agreed final results
Provide exercise final results facilities		group agree final results
Ask doubts facilities		

"Behavioral Responses" (BRs) declare actions. Two kinds of actions can be observed: concrete and flexible. A concrete action brings one concrete result, and a flexible action brings a quality attribute [2], [3]. The key point of the template in Table 2 is to identify the motivation, the intentionality (why?) under the BR. "Why does teacher **define** schedule?" – is an example. The verbs to **organize**, to **offer**, and to **analyse** are flexible actions examples as well as "**solves** doubts" and **discusses**.

Table 2 – Teacher's Goals from behavioral responses with concrete actions

SYMBOL (type: subject)		<concrete goal>				actor
-- behavioral response WHY ?	<subject / object LEL>		BE	<verb>	by	<subject LEL>
TEACHER						
➔ Organizes a collaborative exercise.		flexible action				
➔ Offers several alternative schedules .		flexible action				
➔ Analises students schedule preferences.		flexible action				
➔ Defines the definitive schedule.						
BECAUSE **teacher** wants		schedule	BE	created	by	**student**
➔ Executes a collaborative exercise.						
BECAUSE **teacher** wants		exercise	BE	learned	by	**student**
BECAUSE **student** wants		exercise	BE	evaluated	by	**teacher**
➔ Splits students into groups.						
BECAUSE **teacher** wants		group	BE	organized	by	**student**
BECAUSE **student** wants		group	BE	created	by	**teacher**
➔ Solves student doubts.		flexible action				
➔ Provides group assignment.						
BECAUSE **teacher** wants		exercise	BE	proposed		
➔ Provide exercise statement.						
BECAUSE **teacher** wants		exercise	BE	understood	by	**group**
BECAUSE **group** wants		exercise	BE	evaluated	by	**teacher**
➔ Provide solve exercise facilities.						
BECAUSE **teacher** wants		exercise	BE	understood	by	**student**
BECAUSE **student** wants		exercise	BE	done	by	**group**
BECAUSE **student** wants		exercise	BE	evaluated	by	**teacher**
➔ Discusses preliminary results facilities.		flexible action				
➔ Delivers exercise final results facilities.						
BECAUSE **teacher** wants		results	BE	published		
➔ Asks doubts facilities.						
BECAUSE **teacher** wants		exercise	BE	understood	by	**student**
BECAUSE **student** wants		exercise	BE	done		

Following the process we show (Table 3) concrete goals elicitation. Flexible goals, which are elicited form flexible actions, are manipulated by the template showed by Table 5, after the elicitation of concrete goals from objects (Table 4).

Table 3 – Student's Goals from behavioral responses with concrete actions

STUDENT					
→ Participates in a collaborative exercise.	flexible action				
→ Analyses alternative schedules.	flexible action				
→ Chooses schedule preferences.					
BECAUSE **student** wants	preferences	BE	considered	by	teacher
BECAUSE **teacher** wants	schedule	BE	defined		
→ Executes collaborative exercise.					
BECAUSE **student** wants	exercise	BE	evaluated	by	teacher
BECAUSE **teacher** wants	exercise	BE	evaluated		
→ Checks group assignment.	flexible action				
→ Analyses exercise statement.	flexible action				
→ Solves exercise.					
BECAUSE **student** wants	exercise	BE	evaluated	by	teacher
BECAUSE **teacher** wants	results	BE	published		
→ Discusses preliminary results.	flexible action				
→ Delivers exercise final results.					
BECAUSE **student** wants	exercise	BE	evaluated	by	teacher
BECAUSE **teacher** wants	results	BE	published		
→ Asks exercise doubts.					
BECAUSE **student** wants	exercise	BE	understood		

Table 4 –Concrete goals from objects behavioral responses

SYMBOL (type: object)		<concrete goal>				actor
→ behavioral response	WHY ?	<subject/object LEL>	BE	<verb>	by	<subject LEL>
ALTERNATIVE SCHEDULES						
→ They are communicated by teacher	BECAUSE	preferences	BE	considered	by	student
SCHEDULE PREFERENCES						
→ Student choose the best schedule.		flexible action				student
EXERCISE SCHEDULE						
→ Is elaborated by teacher.	BECAUSE	schedule	BE	obeyed	by	student
→ Must be obeyed by students.	BECAUSE	exercise	BE	evaluated	by	teacher
GROUP ASSIGNMENT						
→ Student group receive the assignment.	BECAUSE	exercise	BE	done	by	student
→ Is defined by teacher.	BECAUSE	group	BE	created	by	teacher
EXERCISE STATEMENT						
→ Appears in the assignment.	BECAUSE	exercise	BE	done	by	student
→ Is made by teacher.	BECAUSE	exercise	BE	done	by	student
QUESTION						
→ Student asks doubt in the exercise.		flexible action				
ANSWER						
→ Teacher answers doubt in the exercise.		flexible action				student
INDIVIDUAL PRELIMINARY RESULTS						
→ Student solves exercise.	BECAUSE	exercise	BE	done	by	student
→ Should be distributed for the group.	BECAUSE	results	BE	published		teacher
GROUP PRELIMINARY RESULTS						
→ Should receive the agreement of the group.		flexible action				
INDIVIDUAL ARGUMENTS						
→ Student discusses preliminary results.		flexible action				
→ Can be distributed for the group.	BECAUSE	solution	BE	discussed	by	student
GROUP ARGUMENTS						
→ Student discusses preliminary results.		flexible action				
→ Can be distributed for the group.	BECAUSE	solution	BE	discussed	by	group
INDIVIDUAL AGREED FINAL RESULTS						
→ Student agree with results.		flexible action				
→ Final results should receive an agreement.		flexible action				
GROUP AGREE FINAL RESULTS						
→ Final results is sent to teacher.	BECAUSE	exercise	BE	evaluated	by	teacher
→ Final results should obey schedule.		flexible action				

Flexible goals

After identifying concrete goals we should identify flexible goals [3]. When one concrete action is found ➔ the action will define a concrete goal. When one flexible action is found ➔ the action will define a flexible goal. Eric Yu's thesis defined: "A goal is a condition or state of affairs in the world that an actor would like to achieve"

and our basic idea is: "ACTIONS CHANGE STATES AND STATES ARE GOALS" [3].

The aim of the template (Table 5) is to identify the motivation under the flexible action, "Why does the teacher **organize** a collaborative exercise?" – is an example.

The idea is: flexible actions mean that quality attributes are the reason of each action.

Table 5 indicates the best concrete goal, which is associated to the flexible goal, and also the actor who has the goal responsibility.

Table 5 – Flexible goals elicited with concrete goals associated

SYMBOL			FLEXIBLE GOAL			
→ behavioral response flexible action	WHY ?	< type >	< [topic] >	<concrete goal associated>	<actor>
Teacher						
Organizes a collaborative exercise. BECAUSE		quality	[solution]	exercise BE shared	**group**
Offers several alternative schedules. BECAUSE		fare	[schedule]	schedule BE created	**student**
Analises students schedule preferences. BECAUSE		proper	[delivery]	preferences BE considered	**teacher**
Solves student doubts. BECAUSE		accurate	[solution]	exercise BE learned	**teacher**
Discusses preliminary results facilities. BECAUSE		proper	[exercise]	exercise BE done	**teacher**
Teacher answers doubt in the exercise. BECAUSE		accurate	[solution]	exercise BE learned	**teacher**
Student						
Participates in a collaborative exercise. BECAUSE		quality	[solution]	exercise BE done	**student**
Analyses alternative schedules. BECAUSE		fare	[schedule]	exercise BE done	**student**
Checks group assignment. BECAUSE		reliable	[group]	group BE created	**teacher**
Analyses exercise statement. BECAUSE		reliable	[exercise]	exercise BE understood	**student**
Discusses preliminary results. BECAUSE		quality	[solution]	exercise BE done	**student**
Student choose the best schedule. BECAUSE		good	[schedule]	schedule BE obeyed	**student**
Student asks doubt in the exercise. BECAUSE		quality	[solution]	exercise BE done	**student**
Should receive the agreement of the group. BECAUSE		quality	[solution]	exercise BE done	**student**
Student discusses preliminary results. BECAUSE		quality	[solution]	exercise BE done	**student**
Group						
Student discusses preliminary results.. BECAUSE		quality	[solution]	solution BE discussed	**group**
Student agree with results. BECAUSE		quality	[solution]	exercise BE done	**group**
Final results should obey schedule. BECAUSE		reliable	[schedule]	exercise BE evaluated	**group**

2.2 Actors' goals refining

At this point, the ERi*c Method proposes two activities: merge goals (concrete and flexible) by actor and set them in a chronological order. Chronological order means: long term goals first (the most abstract before and the less abstract after). During this activity we should delete duplicated goals; they do not help the process.

2.3 SDsituation identification

Definition: "*An SDsituation is a dependency construct with one situational intentionality (one common goal) which is temporarily shared by some actors* "[3].

Figure 2 illustrates the organizational components cycle. SDsituations should be identified by goals in the business part. Each frontier between two SDsituations can be discovered because a time interruption occurs during two SDsituations in the cycle.
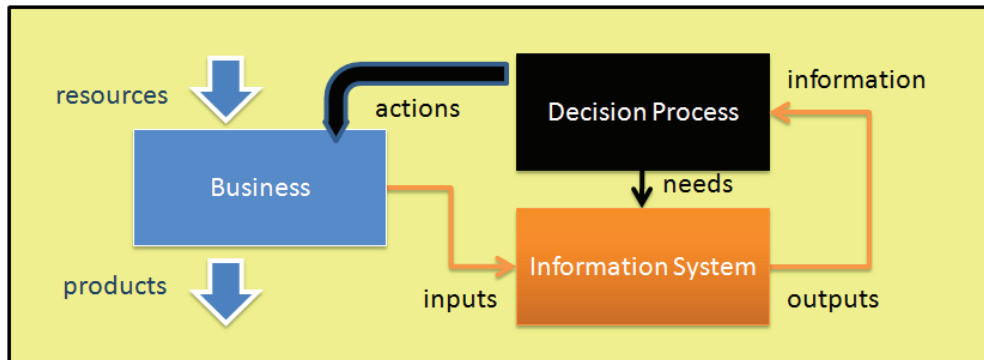
Figure 2 – Organizational Components Relationship Schema

The inputs of the IS are time stamped and the outputs are produced after some time slice. The outputs of the IS are the information about the "world" that the decision process needs to act on the business in order to improve business results. As such, five SDsituations were distinguished (Table 6): (1) Groups Organization, (2) Schedule Definition, (3) Exercise Proposition, (4) Exercise Solution, and (5) Exercise Evaluation.

Table 6 – Goals organized by actors in a chronological order

DEPENDER	(SDsituation)					DEPENDEE
teacher						
accurate [solution]	(5)	exercise	BE	learned	by	**student**
	(5)	results	BE	published		
easy [delivery]	(5)	exercise	BE	evaluated		
	(4)	exercise	BE	done	by	**group**
	(4)	schedule	BE	obeyed	by	**group**
	(3)	exercise	BE	understood	by	**group**
	(3)	exercise	BE	understood	by	**student**
	(3)	exercise	BE	proposed		
fare [schedule]	(2)	schedule	BE	defined		
proper [delivery]	(2)	preferences	BE	considered		
reliable [group]	(1)	group	BE	created		
	(1)	group	BE	organized	by	**student**
student						
	(5)	results	BE	published	by	**teacher**
	(5)	solution	BE	discussed		
	(5)	exercise	BE	evaluated	by	**teacher**
quality [solution]	(4)	exercise	BE	done		
	(4)	schedule	BE	obeyed		
reliable [exercise]	(3)	exercise	BE	understood		
	(2)	schedule	BE	defined	by	**teacher**
	(2)	preferences	BE	considered		
	(1)	group	BE	organized		
group						
	(5)	exercise	BE	evaluated	by	**teacher**
quality [solution]	(5)	solution	BE	discussed		
	(4)	exercise	BE	done		**student**
quality [solution]	(4)	exercise	BE	shared		
	(4)	schedule	BE	obeyed		

2.4 Modeling Actors' Goals

This activity prepares one IP (Intentionality Panel) Diagram, one SD Model, and one SR Model for each SDsituation; but due to space limitation only one SDsituation is showed. Figure 3 shows the IP Diagram and Figure 4 shows the SR Model both from the same SDsituation (4) – Exercise Solution.
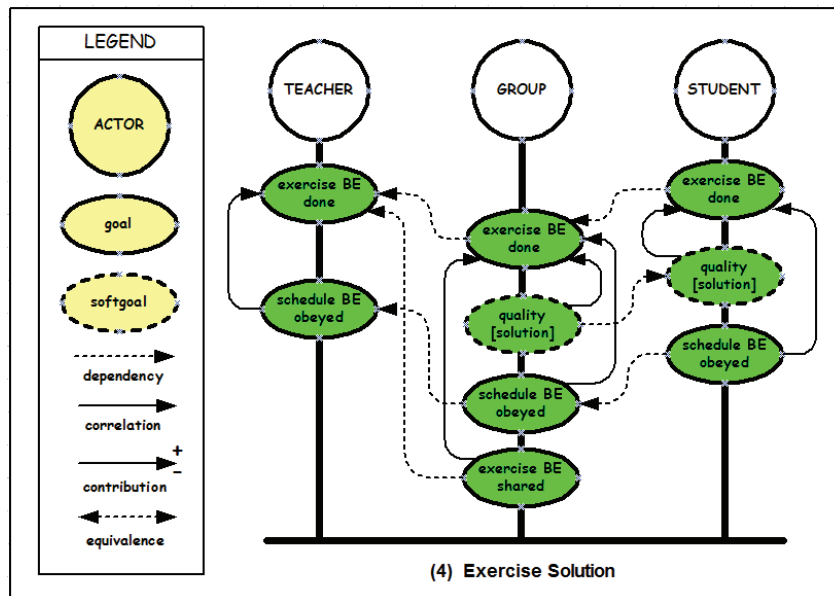

Figure 3 – SDsituation: (4) Exercise Solution – IP Diagram

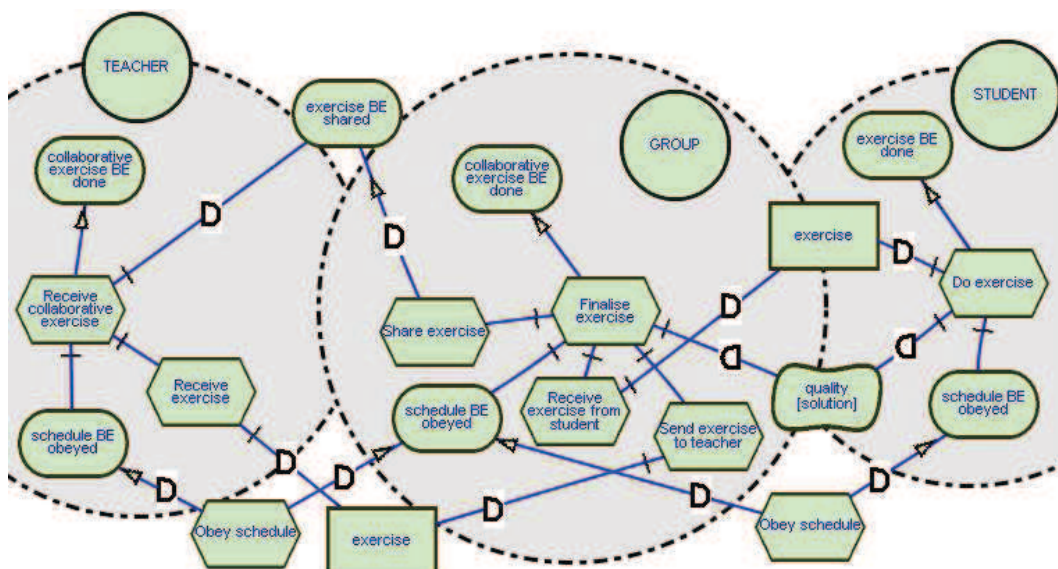One benefit of appling SDsituation concept is to deal with different situations in separated diagrams.

Figure 4 – SDsituation: (4) Exercise Solution –SR model

3. Scientific contributions

The main goal of the ongoing research is to improve the method and to find ways of empowering requirements engineers to use intentional requirements engineering. In this paper we have focused on:

a.) Elicitation, which has been simplified consequently removing one step and one template, see Table 5; bringing more simplicity into the method.

b.) The SDsituations concept received more attention; we described more precisely the idea and therefore better results for student jobs.

c.) Instructions, heuristics, and examples were included in the whole method.

4. Conclusion

Intentional modeling can be the basis for software to be transparent. Expressing the desires of the social actors involved in a given context is a solid start point as to produce software artifacts that will not only perform what the client wants, but which also provides a solid ground for informing stakeholders about the software. We believe that the example discussed above does provide more detail about ERi*c, making it possible not only the publicity of the method, but also providing an opportunity for discussion over its limitations or appropriateness. It is mister to say that we are still trying to provide an environment that would automate some of its tasks.

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