

A Method for Eliciting Goals for Business Process Models based on Non-Functional Requirements Catalogues

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ABSTRACT

While traditional approaches in business process modeling tend to focus on “how” the business processes are performed (adopting a behavioral description in which business processes are described in terms of procedural aspects), in goal-oriented business process modeling, the proposals strive to extend traditional business process methodologies by providing a dimension of intentionality to business processes. One of the key difficulties in enabling one to model goal-oriented processes concerns the identification or elicitation of goals. This paper reports on a case study conducted in a Brazilian hospital, in which we obtained several goal models represented in i*/Tropos, each of which corresponding to a business process also modeled in the scope of the study. We found NFR catalogues helpful in goal elicitation, uncovering goals that did not come up during previous interviews prior to these catalogues’ use.

Keywords: business processes models, goal models, goal elicitation, non-functional requirements, Tropos, ARIS.

1 INTRODUCTION

The increasing competitiveness drives organizations to promote change in an attempt to improve the quality of the services and products they offer. In recent years, many of the efforts related to managing change in organizations have been conducted in the scope of Business Process Reengineering (Hammer, 1990; Hammer & Champy, 1993). This is based on the assumption that change in business processes should generate radical improvements in critical performance measures (such as cost, quality, service and speed) (Hammer & Champy, 1993). Moreover, it is believed that implementing radical changes in business processes is the way to achieve dramatic and satisfactory results (Hammer, 1990; Hammer & Champy, 1993).

Business Process Modeling is the activity which provides a deep understanding about the organizational processes, so as to grasp how to promote the aforementioned improvements (Hammer, 1990; Hammer & Champy, 1993). However, predicting how a given enterprise environment should respond to changes by simply adopting a business-process centered view is unfeasible since there is a large number of issues to be considered, such as infrastructure, power

and politics, organizational culture, etc. (Yu, 1995). Given this multitude of issues, understanding an organizational setting often requires a number of perspectives (Yu, 1995).

While traditional approaches in business process modeling tend to focus on “how” the business processes are performed (adopting a behavioral description in which business processes are described in terms of procedural aspects), in goal-oriented business process modeling (Yamamoto et al., 2006; Neiger & Churilov, 2004), the proposals strive to extend traditional business process methodologies by providing a dimension of intentionality for the business processes (Kavakli & Loucopoulos, 2003). The Zachman framework (Zachman, 1987) also highlights the importance of “motivation” as a driver for enterprise management and system development. Therefore, in the context of business process modeling, goal modeling is extended not only to capture concerns and motivations of the stakeholders in the achievement of business processes, but to incorporate issues related with the strategy of the enterprise as a whole.

Recently, goal-oriented approaches have been largely addressed in the literature of Requirements Engineering (RE), focusing on how these approaches support requirements analysis and modeling for system development (Kavakli & Loucopoulos, 2003). In this context, *goals* are defined as objectives that should be achieved by the system and its environment (Lamsweerde, 2001). When goals are decomposed and the responsibility to achieve a goal is allocated to the system (as opposed to its environment) a goal becomes a *requirement* on the system (Lamsweerde, Darimont, & Letier, 1998). If the object under consideration is not a software system but a business process embedded in its organizational environment, goals for business processes may be regarded as objectives to be achieved by the execution of a business process in its environment. Following this analogy, as goals guide the design of the target system in goal-oriented RE, goals guide the creation of business processes in goal-oriented business process engineering. In this scenario, goal elicitation is a key activity as it will help us understand if the activities carried out truly relate to the organization’s strategy.

Most of research initiatives related to goals focuses on goal modeling and analysis, while the area of goal elicitation has remained largely neglected. As a result, goal elicitation remains a challenging activity with problems with respect to methodological guidance (some problems are for example identified in (Halleux, Mathieu, & Andersson, 2008) and (Singh & Woo, 2008)). We have experienced this firsthand while conducting a case study in a Rheumatology Department of a hospital in Brazil. The problems we encountered in goal elicitation motivated us to study this subject in further depth. As a result, we propose in this article a systematic way to identify goals in a given organization, thus contributing to the area of goal elicitation. In this case, goals are elicited as part of the so-called AS-IS model, i.e. a stage in which both goals and business processes are aimed at identifying the organization as it is today (in other words, prior to potential business process change). In particular, we investigate here the use of Non-Functional Requirement (NFR) catalogues (Chung et al., 2000; Cysneiros, 2009) in order to tackle the difficulty in identifying business goals. We have observed that a number of non-functional requirements defined in the scope of the NFR framework can be abstracted and extrapolated to identify (soft)goals which have strategic relevance for business process models and that had not been previously identified with other techniques.

This paper is structured as follows: section 2 situates the reader in relation to the approaches for goal elicitation in the context of RE. Section 3 introduces the proposed method of goal elicitation for business process models and section 4 illustrates the application of this method. Section 5 discusses some limitations and benefits of the proposed approach. Finally, section 6 concludes this work, presenting our agenda for future work.

2 GOAL ELICITATION IN THE CONTEXT OF REQUIREMENTS ENGINEERING

Goal-oriented techniques arose in the RE field due to the difficulties presented by traditional systems analysis approaches when dealing with increasingly complex software systems (Lapouchnian, 2005). This issue led practitioners and researchers to move their focus to methods and techniques for developing systems which are better aligned with the organizational strategy, introducing some notion of intentionality in these methods and techniques. This section is split in two sub-sections, the first one dealing with several techniques related to goal elicitation, some of which we applied in the context of our work (e.g. refinement and abstraction techniques). We then dedicated a special section for the NFR Framework, which had a greater impact in our research.

2.1 Overview of Existing Approaches

Although the goal elicitation is an active concern in the RE field, many problems related with goal discovery and refinement are still to be solved in literature. For instance, problems related to goal elicitation have been firstly addressed by the RE literature, but essentially the same problems arise within the business process modeling area. Examples include:

- (i) Goals are difficult to formulate (often these formulations become vague and highly abstract) (Halleux, Mathieu, & Andersson, 2008);
- (ii) The existing approaches for goal elicitation lacks detailed systematic structures (Singh & Woo, 2008), besides being high level and abstract in nature (e.g. asking how, why and how else questions),
- (iii) The involved parties are unable to explicitly state their views (Dardenne, Lamsweerde, & Fickas, 1993);
- (iv) Even when the stakeholders are capable of stating their views, the elicited goals can be conflicting (even when goals are drawn from the same individual) (Alexander, 2002);
- (v) Analysts have limited knowledge about the environment (Dardenne, Lamsweerde, & Fickas, 1993);
- (vi) Stakeholders do not know how to set tactical and operational goals that accurately reflect the strategic goals (Singh & Woo, 2008);
- (vii) Although stakeholders know about their individual obligations, they are seldom aware of how their role contributes to the realization of business-wide objectives (Kavakli, 2004);
- (viii) Stakeholders do not know how to define goal attributes (for example specificity, difficulty, acceptance, and commitment) (Singh & Woo, 2008);
- (ix) Often, there is a confusion about the fundamental distinction between what to achieve (the goal) and the manner to achieve it (the strategy). This makes it more difficult to discover alternative ways of achieving a goal (Nurcan et al., 2005).

Given this difficulty in eliciting goals, we surveyed the state-of-art in the area of RE for goal discovery. Among the sources which could potentially provide goals for analysts, the literature in *goal-oriented requirements engineering* cites (i) stakeholders who can explicitly state them; (ii) preliminary material about the organization (iii) preliminary analysis of the current system (in this case, a preliminary analysis of the current organizational setting) with the identification of

problems and deficiencies which lead to TO-BE goals (Lamsweerde, 2001; Lapouchnian, 2005); and (iv) policies, strategies, products, processes, models of the organization (Basili, Caldiera, & Rombach, 1994) and mission statements (Koubarakis & Plexousakis, 2000).

Once a preliminary set of goals has been identified (using the aforementioned sources), *refinement and abstraction techniques* can be applied to identify other goals (Lamsweerde, 2001). With the *refinement technique*, one can find out sub-goals of the parent goal by asking “HOW questions” about the goals already identified (Lamsweerde, 2001). With the *abstraction technique*, more abstract goals can be identified by asking “WHY questions” about the goals previously modeled (Lamsweerde, 2001; Koubarakis & Plexousakis, 2000). In other words, on the one hand, the refinement strategy consists in selecting some of the abstract goals of the organization, which are then further refined to make explicit sub-goals whose satisfaction would entail the satisfaction of these abstract goals. This top-down goal analysis is useful in the cases where the analyst elicits the goal of the organizational managers, who tend to express high-level goals. On the other hand, the abstraction strategy prescribes the detection of the actors that participate in the organization, along with the elicitation of their goals and operations. This bottom-up goal analysis is useful in the case where the analyst elicits the goal of the organizational actors who tend to express low-level goals.

More sophisticated techniques for goal identification and abstraction include *scenarios*. The large amount of works on this topic can be explained by the complementary characteristics of scenarios and goals. While the former are concrete, narrative, procedural, and leave intended properties implicit, the latter are abstract, declarative, and make intended properties explicit (Lamsweerde, 2001). Furthermore, scenarios are useful means for communicating with stakeholders, offering a natural way to illustrate how their needs may be satisfied or hindered in a given situation (Kavakli, 2004).

Among some specific works in the area, the *GBRAM* (The Goal-Based Requirements Analysis Method) (Antón, 1997) extensively address the problem of identifying goals for system development. It is a methodology for initial identification and abstraction of goals from various sources of information, assuming that no goals have been previously elicited. The method contemplates two complementary activities: goal analysis and goal refinement.

Goal analysis comprehends the exploration of information sources for goal identification followed by organization and classification of goals. This activity is further divided into three types of sub-activities, namely: *explore activities* (which refers to the exploration of the available information, such as interviews, policies, requirements, transcripts, workflow diagrams, corporate goals and mission statements); *identify activities* that are about identifying and extracting goals, identifying stakeholders, identifying agents and their responsibilities from the information provided by the previous explore activities; and *organize activities* that classify and organize goals according to goal dependency relations.

Goal refinement concerns the evolution of goals from the moment they are first identified to the moment they are translated into operational requirements for the system specification. Goal refinement activities can be summarized as follows: *refine activities*, which involve the pruning of the goal set; *elaborate activities*, which refer to the process of analyzing the goal set by considering possible goal obstacles and constructing scenarios to uncover hidden goals and requirements; and *operationalize activities*, which represent the translation of goals into operational requirements. The output of the GBRAM is always a software requirements document (SRD) with the functional and nonfunctional requirements, thus extending beyond goal elicitation.

2.2 The Non-Functional Requirements (NFR) Framework

In our experience, we faced several of the problems described in the previous subsection (specifically (i), (ii), (iii), (v) and (vii)). The use of Non-Functional Requirements (NFR) catalogues helped us overcome some of these problems, allowing us to elicit goals in a more efficient way. The NFR Framework is one of the most prominent solutions proposed to address the problem of identifying non-functional requirements in RE (Cysneiros, 2007; Chung et al., 2000). The insight that led us to employ the NFR framework was based on the observation that while catalogues address quality attributes in a system development activity, similar quality attributes could help us to raise details related to the *quality aspects* of the organization and its business processes.

The NFR framework proposes a series of catalogues, which serve different purposes, such as providing guidelines for: a) the representation and operationalization of NFRs; and b) the prioritization and decomposition during the design process.

The Softgoal Interdependency Graphs (SIGs) represent particular kinds of NFRs, along with their decomposition structures and possible design alternatives to embody the requirement in the future system. Furthermore, SIGs also represent the interdependencies between the NFRs and their operationalizations. An application of SIGs within a real example is presented in (Chung et al., 2000), having *security* as an important NFR for developing a credit card system. Figure 1 illustrates this example, showing that to incorporate security in a given account, three subtypes of NFRs are necessary: *integrity*, *confidentiality* and *availability*. In turn, to incorporate integrity on credit card accounts, two additional NFRs are needed: *completeness* and *accuracy*.

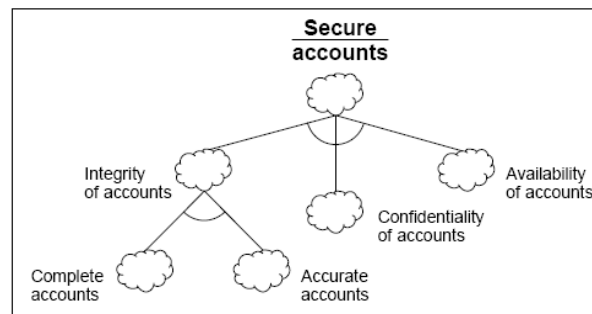


Figure 1. Decomposition of a security softgoal, adapted from (Chung et al., 2000)

The process of decomposing some NFR may be guided (and thus facilitated) by adopting these catalogues since they are helpful in reasoning about what qualities the system to-be is expected to meet.

NFRs play an important role in the research reported by Doerr et al. (2005) which is closely related to our work. The authors propose a systematic approach to elicit NFRs, describing three case studies where this approach has been applied. The main difference regarding our work is the fact that they deal with system requirements, while we apply the catalogues to help us elicit process requirements instead of system requirements. Further, Adams & Doerr (2007) have acknowledged the importance of applying NFRs also to elicit goals related to business processes, and propose a metamodel to show the relations between goals and business processes. However, they do not propose a systematic approach to elicit goals, mentioning this as future work. We address this gap here: section 3 describe our elicitation approach and section 4 illustrate its application.

3 A GOAL ELICITATION METHOD TO DEPEEN THE UNDERSTANDING OF BUSINESS PROCESS MODELS

This section describes our method for goal elicitation inspired by the needs of our case study. Further, the current state of the art in goal literature described in section 2.1 has also influenced our work. Basically, the method comprises two consecutive phases, depicted in Figure 2: (1) *Preliminary Goal Elicitation* to collect an initial version of goal models (see section 3.1) and (2) *Goal Elicitation with Catalogues* to supplement and refine the previously derived goal models by means of NFR (see section 3.2).

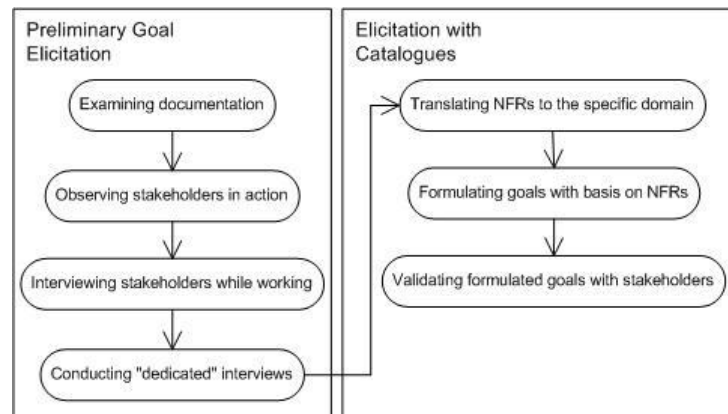


Figure 2. Goal Elicitation Method

3.1 Preliminary Goal Elicitation

This preliminary goal elicitation and modeling effort was divided in four stages according to the source of information and technique used to interact with the process stakeholders. In the first and second stages, we captured both hardgoals and softgoals.

In a *first stage*, the available documentation about the organizational processes was assessed. This revealed some organizational characteristics such as: organizational structure and human resources, routines, business processes (with a brief textual explanation in natural language about these processes) and physical space. From the organization structure, we could infer internal actors and the business process they carry out. This documentation also provided goals previously achieved by the department (along with their impacts) and goals which were yet to be achieved by the department, giving us some insight about the nature of the business processes under consideration and about some relevant goals (stated in natural language). Further, a first interview was undertaken with a physician (who does not belong to the organization), who served as an expert to help us understand general concepts about the medical domain. Additionally, concepts related with rheumatology (diseases, medicines and other technical terms) were briefly surveyed in online information sources.

In a *second stage*, we obtained a preliminary goal model along with a preliminary business process model. The approach used here consisted in observing the process performers during business process execution, i.e., we observed the daily routine of the organization and captured goals for each stakeholder involved in the business process. While this approach allowed us to understand how actors interact and how actor dependency relationships are

established in practice, the actors' focus on getting the work done prevents one from revealing most of the intention and motivation behind their practices.

A *third stage* focused on eliciting requirements by interviewing the organizational actors while observing them in action. No specific questions have been used in this phase; we solely focused on understanding the actors' practices and their rationale. This helped to reveal the goals of specific activities as well as goals related to a process as a whole. Thus, the model generated in previous stages could be incremented through refinement/abstraction techniques (refer to section 2.1). This enabled us to capture the rationale (more general goals) behind more specific goals. It is a fact that the interviews during the process execution provided a more strategic dimension, in the sense that they have captured details related with the organization's strategy in a lower level of abstraction. However, in spite of that, the goal models obtained were strongly related to the business process models, not capturing knowledge about the enterprise setting as a whole. In other words, stakeholders have a great difficulty in formulating goals, tending to state that their goals are to perform their personal activities! This deficiency in goal formulation was addressed in a fourth stage.

In this *fourth stage*, we concentrated in "dedicated interviews" not only with the business process actors but also with the department manager (by "dedicated interviews" we mean that the interviewees devoted all attention to the elicitation process as opposed to being fully involved in activity execution). The elicitation interviews in this stage focused on raising internal problems of the organization, as well as problems associated with the relationship between the department and external organizations, highlighting all kinds of conflicting interests. The problems and deficiencies that the stakeholders believed to exist in the organization provided not just additional goals to enrich the models, but also some obstacles for goal realization, reasons for non-achievement of goals and possible solutions for these obstacles.

3.2 Goal Elicitation with Catalogues

Although we found it hard to deepen the goal analysis in the preliminary phase, during the four stages we have reported in the previous sub-section, we had the opportunity to understand the organization's context, its problems, deficiencies and so forth. By observing the execution of the business process, interviewing the stakeholders and observing the organizational setting, we could keep direct contact with implicit factors that underlie the organizational context. These previous stages were thus crucial to provide insights about new concerns that could be added. An important function of these insights regarded the fact that they guided us to suggest which NFR types could be extracted from NFR catalogues (Chung et al., 2000; Cysneiros, 2009; Rilston & Castro, 2002; O'Sullivan, Edmond & Ter Hofstede, 2002) and subsequently adapted to the organizational context.

The fact is that having applied the aforementioned goal elicitation techniques, we observed that a large number of goals seemed to have remained unidentified. The basis for this observation was that a number of business processes seemed to be unrelated to strategic goals after the preliminary phase, which could indicate that (i) a large number of processes had no strategic relevance or that (ii) the goals were incomplete or defined at an inadequate level of abstraction. The former situation (i) would indicate a serious issue for the organization and in fact, reveal a blatant disconnection between operational practices and strategic directions. Given the common difficulties in goal elicitation as reported in the literature, and the apparent success of the organization in conducting its business, we have opted to formulate a hypothesis based on (ii), which has motivated us to perform a second goal elicitation effort.

In this second effort, we employed the *NFR framework* (Chung et al., 2000; Cysneiros, 2009; Lamsweerde, 2000). We observed that a number of non-functional requirements defined in the scope of the NFR framework can be abstracted and extrapolated to identify (soft)goals which have strategic relevance for business process models and that had not been previously identified. The insight that led us to employ the NFR framework was based on the observation that while catalogues address quality attributes in a system development activity, similar quality attributes could help us to raise details related to the *quality aspects* of the organization and its business processes. Fortunately, this insight has been confirmed after the application of the catalogues in the goal elicitation activity.

In accordance with the NFR types catalogues, we formulated additional goals for the business process, initially without participation of the stakeholders. The translation from *NFR types* in the catalogues to *goals* was highly related to the knowledge acquired in previous stages, i.e., to adequately refine the NFRs we had to consider the meaning of the NFRs' refinement in the context of the domain under consideration. After incorporating these additional goals into the model, we applied the same techniques of abstraction/refinement previously applied for identifying additional goals. For the sake of brevity, we concentrate here on some relevant portions of the resulting goal models.

4 APPLICATION OF THE METHOD OF GOAL ELICITATION FOR BUSINESS PROCESS MODELS

In this section, we elaborate on the application of the method proposed in this article to the case study. Subsection 4.1 describes the case study. Then, subsection 4.2 discusses the results of a preliminary phase of goal elicitation; and, finally, subsection 4.3 explains how we employed NFR catalogues to refine the goals elicited in the preliminary phase.

4.1 Case Study: Goal Elicitation in the Rheumatology Department of a University Hospital

The case study was conducted in the Rheumatology Department of Cassiano de Moraes University Hospital (HUCAM Hospital) which is part of the Federal University of Espírito Santo in Vitória, Brazil. This case study had the main purpose of supporting us on the creation of a systematic method to align goals and business processes.

In the context of the hospital, the department has the following functions: (i) providing educational training to form specialists in rheumatology; (ii) providing outpatient medical care and (iii) developing research to investigate the incidence of rheumatologic conditions in population. This department is composed of six specialists in rheumatology, two nurses and two physiotherapists, among other professionals to help hosting patients. Rheumatology residents and interns temporarily join the department for educational purposes, also assisting in the daily routine. The department performs fifteen business processes, such as outpatient care, drugs infusion, among others and performs an average rate of five thousand and seven hundred outpatient medical care instances per year.

The Project team was composed by: (i) enterprise modelers: one analyst (junior researcher), two consultants (senior researchers); and (ii) hospital clients: one doctor, one resident, one member of administrative staff, and a few patients. As a result, we developed a total of eight sets of Tropos (Bresciani et al., 2004) models (eight Tropos actor models, each one relating to a Tropos goal model). Each set of Tropos models corresponds to a business process, also modeled in the

scope of this study. Besides, a ninth Tropos models has been elaborated to capture organizational issues which are relevant for many business processes. It is relevant to say that many draft models had been elaborated in several cycles (involving elicitation, analysis and modeling) before these resulting models were finalized.

The results we achieved so far only cover the first phase of the project (i.e. AS-IS). All goals and process models have been fully validated by the head doctor (seen as the person responsible for this project, the one who has a broader view of the organization) and partially validated by the other hospital members. The TO-BE part of this project is ongoing work and should be the subject of future publications.

4.2 Results of the Preliminary Goal Elicitation Method

Figure 3 exhibits a Tropos diagram depicting the goals of a physician who conducts the diagnosis business process.

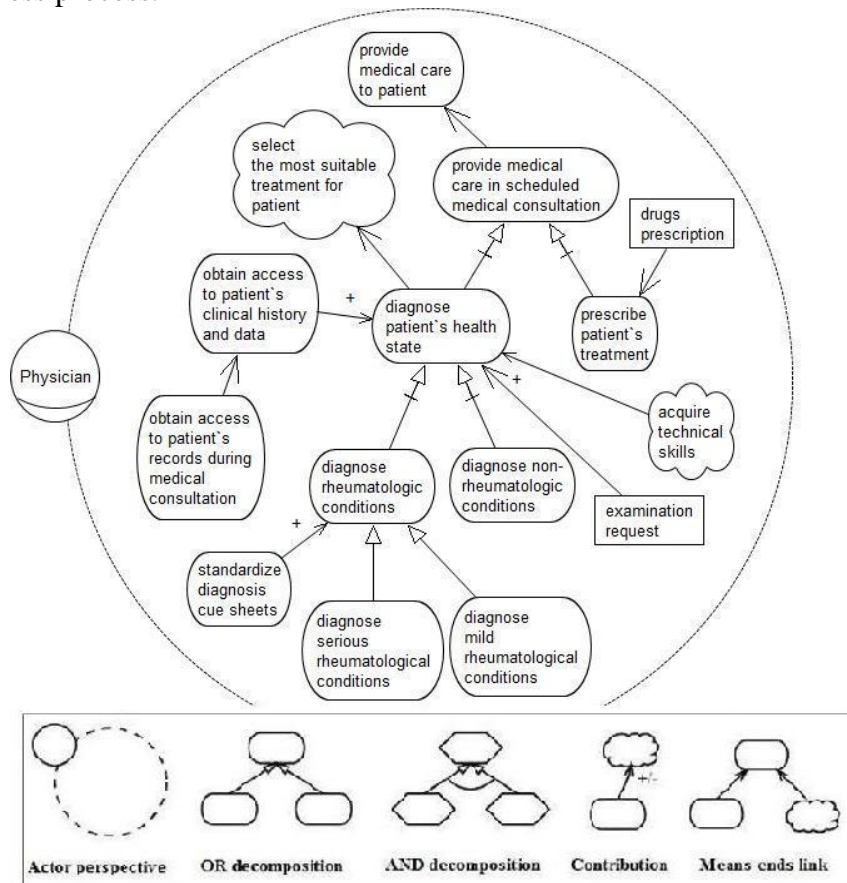


Figure 3. Goal model resulted from the preliminary goal elicitation activities

Summarizing the constructs and techniques applied in Figure 3, we have that in Tropos diagrams, actors are represented as circles, goals as oval shapes and softgoals as cloud shapes. Moreover, (soft)goals can be related with three kinds of relationships: means-end link, contribution link and AND/OR decomposition¹ link.

¹ The AND/OR decomposition can be made by using the “HOW questions” previously mentioned (section 2.1).

The physician provides medical care to a patient (Provide medical care to patient goal) through a medical consultation (Provide medical care in scheduled medical consultation goal). During consultation, the physician diagnoses the patient's health state (Diagnose health state goal) and prescribes the treatment (Prescribe patient's treatment goal which uses, in turn, a Drugs prescription).

The main goal of the physician is to Diagnose patient's health state. During the process of diagnosis, the physician can find either rheumatologic or non-rheumatologic conditions (Diagnose rheumatologic conditions goal and Diagnose non-rheumatologic conditions goal). After diagnosing the patient's health state, the physician is able to select the most suitable treatment for the disease (Select the most suitable treatment for patient softgoal). For this reason, Diagnose patient's health state is a mean for Select the most suitable treatment for patient.

The physician must have accurate knowledge so as to discover the presence/absence of diseases (Acquire technical skills softgoal). He/she must also access the patient's data for being able to determine how the patient health condition is evolving along the time (Obtain access to patient's clinical history and data goal). One of the means for accessing the patient's data and thus to know its clinical history is to obtaining access to patient's records (Obtain access to patient's records during medical consultation goal).

A last remark about the model refers to a goal prioritization. Although Diagnose patient's health state is the main Physician's goal, there is no prioritization of this goal (or any other of this model) by the stakeholders in a strict sense. Indeed, as we have noticed along the interviews, since the physician constantly pursue the diagnosis of the patient's state, this entails that the other goals are articulated around this goal in an attempt of contributing to its satisfaction.

4.3 Results of the Goal Elicitation with Catalogues

Before discussing the outcomes related with the use of the catalogues with the stakeholders, we have translated the NFR types to (soft)goals in the context of the domain under consideration. This translation is necessary since the NFR types suggested by the catalogues are highly generic (even in the context of systems development) and an adaptation is required to express the meaning of each NFR type in terms of the context of the domain.

In catalogues, softgoals are classified according to a NFR *type*, which indicates the particular NFR, such as security or performance, addressed by the softgoal. The softgoals also have a *subject matter* or *topic* which represents the object to which the NFR type refers. Then, in one step of the NFR framework (step 2.4 of the NFR framework (Chung et al., 2000)), to specify some softgoal, the analyst must specify the NFR type and its "topic". For example, in the "good performance for account" softgoal, the NFR type is "performance" and the topic is "account".

Similarly, in our case, the translation step follows the same rationale. For instance, if we consider the NFR type "confidentiality", we must also regard what represents "confidentiality" in the health-care domain (in particular, in the health-care domain of our organization). To properly specify what represents "confidentiality" in this domain, then we must specify the topic which this NFR type refers to. In our case, we have identified the need of confidentiality for the patient's information. Once specified the NFR type and the topic, we have the Maintain healthcare information private softgoal.

After we have applied the translation step for all the chosen NFR types of our case study, the NFR types originated the following goals:

- (i) Accessibility (Rilston & Castro, 2002). Obtain access to medical care;
- (ii) Confidentiality (Rilston & Castro, 2002). Maintain healthcare information private;
- (iii) Completeness (Rilston & Castro, 2002). Obtain complete information about patient's treatment;
- (iv) Accuracy (Rilston & Castro, 2002). Obtain accurate information about patient's treatment;
- (v) Traceability (process and data) (Rilston & Castro, 2002; Cysneiros, 2009). Obtain traceability for information in patient's treatment refined into Obtain traceability in investigation of patient's condition, Obtain traceability in relation to treatment administered to patient and Obtain traceability in relation to physicians who prescribed patient's treatment.
- (vi) Integrability (Rilston & Castro, 2002). Coordinate patient care with other healthcare providers refined into Coordinate patient care with specialists in areas related to rheumatology, Coordinate patient care with municipal and state health services (to obtain what is called "integrated treatment" exploring the benefits of information integration) and Coordinate patient care with other hospital departments.
- (vii) Trust and confidence to the provider (assurance)(O'Sullivan, Edmond, & Ter Hofstede, 2002). Trust physician (not shown in the Figures 4 and 5 since this goal belongs to the patient's perspective)
- (viii) Empathy (level of caring and personalized attention provided to the requestor) (O'Sullivan, Edmond, & Ter Hofstede, 2002). Show empathy to patient

The use of NFR catalogues is a technique generally applied in the elicitation of non-functional requirements (thus, represented as softgoals in i*/Tropos). However, in our case, focusing on the NFR types led us to elicit goals which could be objectively evaluated, i.e. hardgoals instead of softgoals². For instance, the requirement of Accessibility has led to the identification of the hardgoal Obtain access to medical care (in other words, this represents the patient's intention to obtain a vacancy in the healthcare service). Besides, the translation seems to be highly domain-dependent. For example, traceability refers to the capacity of tracing patient's data along the treatment. As we have noticed, another particularity concerned with the translation is that different NFR types are mapped to the same goal in the organization. Distributivity (capacity of reaching all decision-makers (Rilston & Castro, 2002)) and integrability (capacity of adequately and efficiently integrating operational information (Rilston & Castro, 2002)) mean the same in this context (in the sense that both mean the information must be integrated so as to reach all decision-makers caring about that information). Privacy and confidentiality are also mapped to the same goal.

With respect to the goals added, we were able to identify goals which had remained implicit in the preliminary study (Figure 4). Most of these goals were either associated with quality aspects of the previously modeled goals (Obtain complete information about patient's treatment softgoal and Obtain accurate information about patient's treatment softgoal) or with quality aspects for the service as a whole (Obtain access to medical care and Coordinate patient care with other healthcare providers softgoal and the softgoals

² Softgoals are those that have no objective satisfaction criteria and that are "subject to interpretation" (Yu, 1995), "imprecise, subjective, context-specific and ideal" (Jureta, Faulkner, & Schobbens, 2006).

originated from its refinements). The fact that most of the elicited goals address quality attributes of the organizational setting can be accounted by the issue that the NFR catalogues are also concerned about quality attributes (in the system development activity). Observe that, in this case, the usage of catalogues can be compared with some kind of abstraction strategy which complements the existent technique of abstraction (which uses the WHY-questions). This abstraction strategy had allowed us to concentrate on the identification of quality metrics for assessing how the operational goals are achieved along the time so that they support the achievement of the strategic goals of the organization.

We also have noticed that some of the elicited (soft)goals address exceptional situations, for example, the softgoal **Coordinate patient care with specialists in areas related to rheumatology** is relevant only in the case the rheumatologist needs to clarify further details about the diagnosis with other specialists (for example, a dermatologist or ophthalmologist) in the hospital.

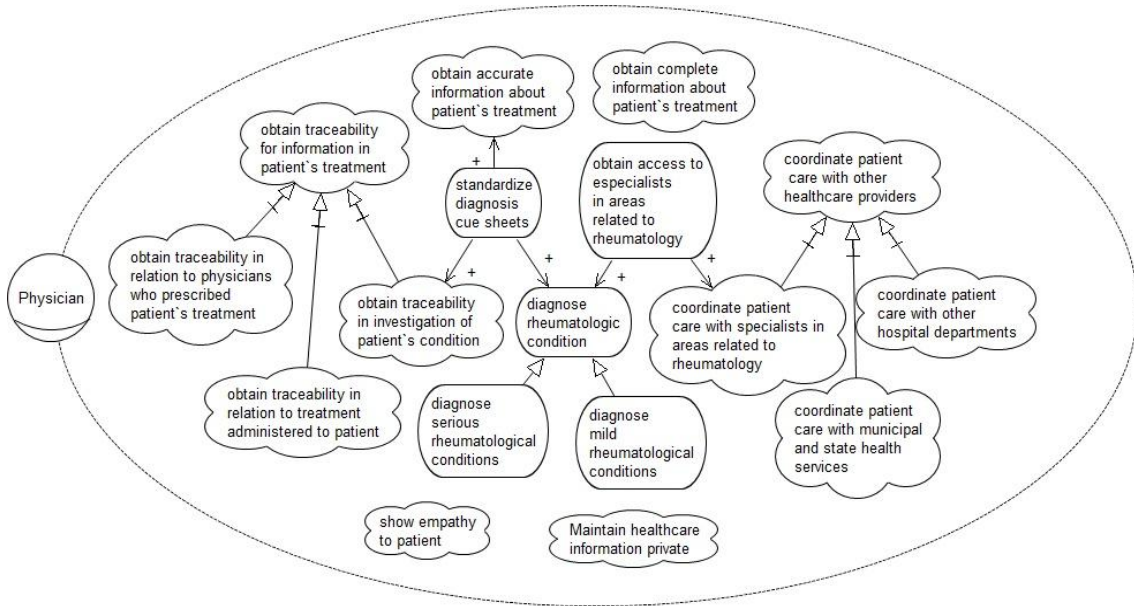


Figure 4. Portion of the goal model obtained in goal elicitation activities with catalogues (1)

After applying the catalogues, we could notice that some of the goals spontaneously mentioned are actually goals for implementing mechanisms for the attainment of more abstract goals. This had remained implicit when applying the abstraction technique, but was finally revealed through the use of the catalogues. For instance, in Figure 4, we suggested three types of traceability: Obtain traceability in relation to treatment administered to patient softgoal (obtain information about the drugs prescribed along the treatment), Obtain traceability in relation to physicians who prescribed patient's treatment softgoal (obtain information about the physicians who had already prescribed treatment to the patient) and Obtain traceability in investigation of patient's condition softgoal (obtain information about the conditions which had already been investigated previously by the physician). Actually, this last goal was the motivation for the standardization of diagnosis cue sheets (previously modeled). The standardization of diagnosis cue sheets was one of many means towards achieving traceability in the investigation of diseases.

Finally, all goals suggested through the use of catalogues were validated by the stakeholders in a validation interview. They acknowledged the need of these goals and were also

able to spontaneously mention other goals (for example the refinements of the Provide medical care to patient goal, shown in Figures 5). The goal Provide medical care to patient can be achieved in three forms: by achieving a consultation appointment (in this consultation, the physician examines the patient and prescribes the treatment); by providing attendance for assessment of high cost drug (the physician examines the patient and in the case of the need of a high cost drug, he/she issues a certificate) and by an informal meeting (the goals which denote these situations are, respectively: Provide medical care in scheduled medical consultation goal, Provide attendance for assessment of high cost drug goal and Provide informal meeting goal). In these informal meetings, the physician can examine a patient who reports the presence of symptoms, or the physician just issues some document required by the patient (a medical certificate, a medical report or a prescription of drugs). The goals which denote these situations are, respectively: Provide attendance for assessment of symptoms goal, Provide attendance for elaboration of medical certificate goal, Provide attendance for elaboration of medical report goal and Provide attendance for elaboration of prescription of drugs goal. Furthermore, we were able to refine the Obtain access to medical care goal in terms of two other goals, namely, Obtain access to medical care (to internal patients) goal and Obtain access to medical care (to external patients) goal (not shown in the Figures 4 and 5 since this goal is a dependency relation from the patient to the receptionist).

It is essential to emphasize here that all kinds of goal relations, such as goal refinement/abstraction, conflicts, and so forth have not been identified by the stakeholders (in the elicitation with catalogues). Hence, these goal relations are expressed in the models after the approval of the stakeholders of our suggestions. With respect to the goal conflicts, we have also suggested resolutions for them. Again, models reflect stakeholders' decisions after assessing the potential trade-offs of our suggestions.

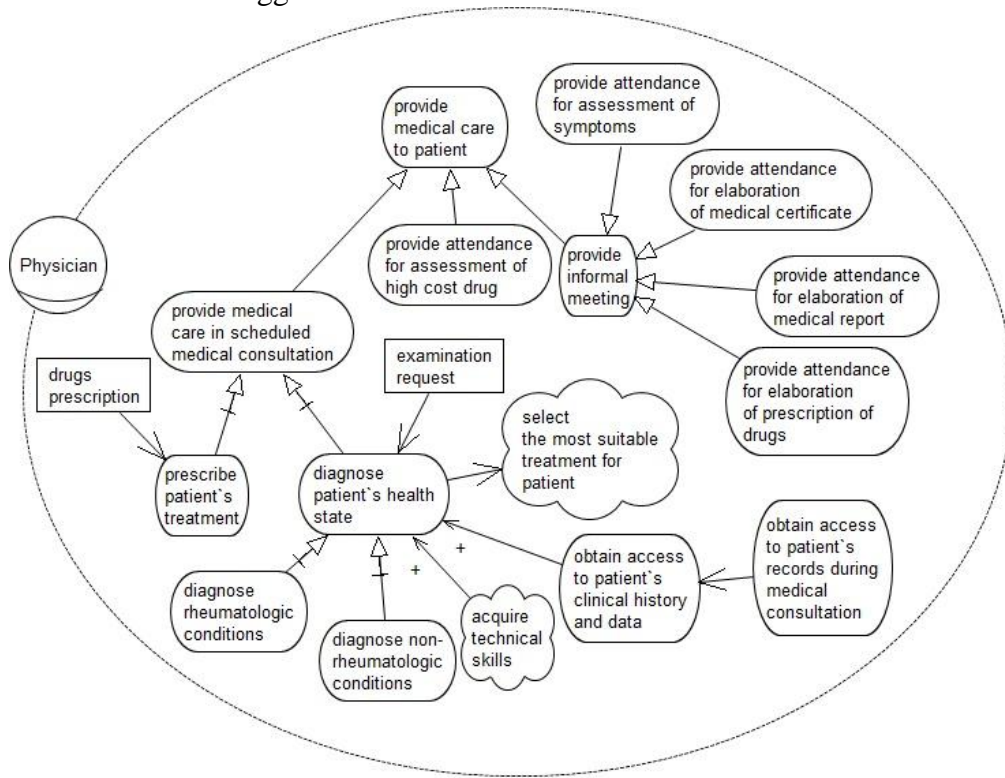


Figure 5. Portion of goal model obtained in goal elicitation activities with catalogues (2)

5 DISCUSSION

5.1 Benefits of the Proposed Approach

In relation to our method, we have found the preliminary goal elicitation activities useful in addressing our need to understand the organizational setting. This has enabled not only to capture details about the enterprise and its business processes, but also to provide proper understanding about the domain under consideration. However, we have found the preliminary stages to be deficient in the identification of *strategic concerns* related to the organization's goals since the focus was concentrated on operational activities. This difficulty was partly addressed through stakeholder interviews. Although these interviews addressed many organizational issues, much knowledge still remained implicit. With respect to that, the catalogues provided by the NFR framework have shown to be useful as a complementary tool to elicit goals.

Before discussing the nature of the additional goals identified with the support of catalogues, we must highlight some particularities about translating NFR types to goals. We have observed that the translation is highly domain-dependent, i.e., one must take into account how a NFR must be mapped to some goal in the organization domain such that this goal makes sense regarding the organizational context, as we have illustrated in section 5.2. Further, one must define whether a NFR type should be represented as a soft or hard goal. As observed in (Daneva et al., 2007), analysts tend to treat NFRs as softgoals, however, as demonstrated in the case study, some NFRs could be objectively specified in the context of the domain.

In relation to the goals uncovered with the help of catalogues, we believe that goals have enabled us to reason about the organization from a more strategic point of view. This can be confirmed by the fact that some additional goals referred to quality attributes; either for specifying qualitatively a hardgoal or for specifying quality metrics for the business process as a whole. We have observed in this case study, that stakeholders have difficulties in explicitly stating quality attributes for business processes (the same difficulty is often reported to elicit requirements in system development (Cysneiros, 2007)). In that respect, the catalogues here employed provided guidelines for identifying these attributes in a systematic way.

We also observed that, in certain cases, stakeholders formulate goals which are highly dependent on the current *operationalization* of the organization's objectives, i.e., much emphasis is given to the goal of applying successfully a particular solution for a problem. Catalogues partially helped to overcome this issue, revealing higher level goals not easily identified by the abstraction technique. Further, some of the goals uncovered through catalogues had initially been deemed an inherent organizational characteristic by stakeholders, and thus had not been spontaneously mentioned.

At first sight, the technique we have employed seems highly dependent on the experience of analysts in conducting the elicitation effort (experience in the sense that analysts must have broad knowledge about the domain). This issue (of acquiring the knowledge about domain) has been addressed in the preliminary stages with the immersion inside the organization. We believe this is the case partly because of the need to translate NFRs into goals which are specific to the organization's domain. Further investigation in NFR type catalogues for business process in a particular business domain may prove to be fruitful to reduce the dependency on analyst experience and improve goal elicitation in general. In this sense, NFR type catalogues can be seen as design patterns in goal modeling. The compilation of these catalogues in a format of design patterns would allow one to reuse the knowledge by making available methodological

connections which are tacit in an experienced modeler's mind and which are not typically available to the novice.

5.2 Limitations of the Proposed Approach

We have faced two main difficulties with respect to the elicitation activities reported here. The first one concerns the knowledge-intensive characteristic of the health care domain. Some incorrect details of business process have been identified since these details are specific to medical business processes. This issue has been mastered in the third and fourth stages with the support of the interviews.

The second difficulty seems to be an inherent challenge for elicitation activities in most realistic settings, and relates to the limited access of the analysts to stakeholders and the bounded resources allocated for elicitation. In our study in particular, we have not been able to access all the stakeholders of the chain who are indeed interested in the elicited goals. For example, the Rheumatology Department is inserted into a very complex structure in which the department itself is solely one of many "leaf nodes". The stakeholders at higher levels, such as the public administrators, the physicians of other public health services have not been covered, limiting the identification of higher-level goals of the whole system. Such higher-level goals were only inferred by an indirect analysis (i.e., by analyzing the goals which we were able to capture and inferring how the higher-level goals from the whole system might be related with lower-level goals).

6. CONCLUSIONS AND FUTURE WORK

This paper has described our efforts in proposing a method for goal elicitation within the context of AS-IS business process modeling. We have presented and exemplified the proposed method by discussing a case study conducted in a Rheumatology Department of a Hospital in Brazil. Next to this, we have discussed the potentials and limitations we identified in our work.

The catalogues provided by the NFR framework have shown to be useful as a complementary tool to elicit goals. More specifically, a number of non-functional requirements defined in the scope of the NFR framework can be abstracted and extrapolated to identify both hard- and soft-goals which have strategic relevance for business process models. As a result, goal models were more complete after employing the technique. The main limitation of the approach seems to be related to the inherent challenge for elicitation activities in most realistic settings, and relates to the limited access of the analysts to stakeholders and the bounded resources allocated for elicitation.

Further research steps will be necessary to associate particular goals with guidelines for business process (re-)design. Additionally, in our future work, we intend to investigate suitable representation and semantics to relate goal models and business process models (especially in the presence of softgoals). Moreover, we aim at investigating the impact this approach of eliciting additional goals through the use of NFR catalogues shall have in business process structures as well as in the systematic redesign of business processes.

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REFERENCES

Adam, S., & Doerr, J. (2007) On the Notion of Determining System Adequacy by Analyzing the Traceability of Quality. In Proceedings of the 8th International Workshop on Business Process Modeling, Development and Support. Trondheim, Norway.

Alexander, I. (2002). Modelling the Interplay of Conflicting Goals with Use and Misuse Cases. *Proceedings of the HCI*02 Workshop on Goal-Oriented Business-Process Modeling (GBPM 2002)*.

Andersson, B., Bergholtz, M., Edirisuriya, A., Ilayperuma, T., Jayaweera, P., Paul, J., et al. (2008). Enterprise Sustainability through the Alignment of Goal Models and Business Models. *Proceedings of 3rd International Workshop on Business/IT-Alignment and Interoperability (BUSITAL'08) CEUR Workshop Proceedings*.

Andersson, B., Bergholtz, M., Edirisuriya, A., Ilayperuma, T., Johannesson, P., & Zdravkovic, J. (2007). Using Strategic Goal Analysis for Enhancing Value-based Business Models. *BUSITAL'07: Second International Workshop on Business/IT Alignment and Interoperability, Workshop at CAiSE'07 The 19th International Conference on Advanced Information Systems Engineering*.

Antón, A. I. (1997). Goal Identification and Refinement in the Specification of Software-Based Information Systems. *Ph.D. Dissertation, Georgia Institute of Technology*. Atlanta GA.

Anton, A., & Potts, C. (1998). The Use of Goals to Surface Requirements for Evolving Systems. *Proceedings on ICSE-98: 20th International Conference on Software Engineering*. Kyoto, Japan.

Asnar, Y., Giorgini, P., Massacci, F., & Zannone, N. (2007). From Trust to Dependability through Risk Analysis. In *Proceedings of the Second International Conference on Availability, Reliability and Security (AReS 2007)*. Vienna.

Basili, V. R., Caldiera, G., & Rombach, H. D. (1994). The Goal Question Metric Approach . in *Encyclopedia of Software Engineering* , 2 , pp. 528-532.

Boardman, A., & Shapiro, D. (2004). A Framework for Comprehensive Strategic Analysis. *Journal of Strategic Management Education*.

Bresciani, P., Giorgini, P., Giunchiglia, F., Mylopoulos, J., & Perini, A. (2004). Tropos: An Agent-Oriented Software Development Methodology. *Journal of Autonomous Agents and Multi-Agent Systems* , pp. 203–236.

Cardoso, E., Guizzardi, R., & Almeida, J. P. (2010). Goal Models and Business Process Models in a Health Environment. *Technical Report* . Department of Computer Science. Federal University of Espírito Santo. Vitória, Brazil (forthcoming).

- Chung, L., Nixon, B., Yu, E., & Mylopoulos, J. (2000). *Non-Functional Requirements in Software Engineering*. Kluwer Academic Publishers.
- Cysneiros, L. (2007). Evaluating the Effectiveness of using Catalogues to Elicit Non-Functional Requirements. *Proceedings of 10th Workshop in Requirements Engineering*, pp. 107-115.
- Cysneiros, L. M. (2009). *Personal page of Luiz Marcio Cysneiros*. Retrieved 02/19/2009, from <http://math.yorku.ca/~cysneiro/nfrs/nfrs.htm>
- Daneva, M., Kassab, M., Ponisio, M. L., Wieringa, R., & Ormandjieva, O. (2007). Exploiting a Goal Decomposition Technique to Prioritize Non-functional Requirements. in *Proceedings of the 10th International Workshop on Requirements Engineering (WER'07)*.
- Dardenne, A., Lamsweerde, A. v., & Fickas, S. (1993). Goal-directed Requirements Acquisition. *Science of Computer Programming*, 20, pp. 3-50.
- Doerr, J., Kerkow, D., Koenig, T., Olsson, T., & Suzuki, T. (2005) Non-Functional Requirements in Industry: Three Case Studies Adopting an Experience based NFR Method, In *Proceedings of the 13th IEEE International Conference on Requirements Engineering*. Paris, France.
- Estrada, H., Martínez, A., & Pastor, O. (2003). Goal-based business modeling oriented towards late requirements generation. In *Proceedings of the 22nd International Conference on Conceptual Modeling*.
- Frankel, D. (2003). *Model Driven Architecture: Applying MDA to Enterprise Computing*. OMG Press.
- Halleux, P., Mathieu, L., & Andersson, B. (2008). A Method to Support the Alignment of Business Models and Goal Models. *Proceedings of 3rd International Workshop on Business/IT-Alignment and Interoperability (BUSITAL'08) CEUR Workshop Proceedings*.
- Hammer, M. (1990). *Reengineering Work: Don't Automate, Obliterate*. Harvard Business Review.
- Hammer, M., & Champy, J. (1993). *Reengineering the Corporation: A Manifesto for Business Revolution*. London, England: Nicholas Brealey Publishing.
- Kavakli, E. (2004). Modeling Organizational Goals: Analysis of Current Methods. *Proceedings of the 2004 ACM Symposium on Applied Computing (ACM SAC '04)*. Nicosia, Cyprus.
- Kavakli, E., & Loucopoulos, P. (2003). Goal Driven Requirements Engineering: Evaluation of Current Methods. In *Proceedings of the 8th CAiSE/IFIP8.1 Workshop on Evaluation of Modeling Methods in Systems Analysis and Design, EMMSAD*.
- Kavakli, E., & Loucopoulos, P. (1999). Goal-driven Business Process Analysis Application in Electricity Deregulation. *Information Systems*, 24, pp. 187-207.
- Koliadis, G., & Ghose, A. (2006). Relating business process models to goal-oriented requirements models in KAOS. *Advances in knowledge acquisition and management (Pacific Knowledge Acquisition Workshop)*.

- Koubarakis, M., & Plexousakis, D. (2000). A formal model for business process modelling and design. *In Proceedings of Conference on Advanced Information System Engineering*, pp. 142–156.
- Kueng, P., & Kawalek, P. (1997). Goal-based business process models: creation and evaluation. *In Business Process Management Journal 3*, pp. 17-38.
- Lamsweerde, A. (2001). Goal-Oriented Requirements Engineering: A Guided Tour. *5th International Symposium on Requirements Engineering, IEEE Computer Society Press*.
- Lamsweerde, A. (2000). Requirements Engineering in the Year 00: A Research. *Proceedings of ICSE 2000: 22nd International Conference on Software Engineering*. ACM Press.
- Lamsweerde, A., Darimont, R., & Letier, E. (1998). Managing Conflicts in Goal-Driven Requirements Engineering. *IEEE Trans. on Software Engineering, Special Issue on Inconsistency Management in Software Development*.
- Lapouchnian, A. (2005). *Goal-Oriented Requirements Engineering: An Overview of the Current Research*. Department of Computer Science, University of Toronto.
- Markovic, I., & Kowalkiewicz, M. (2008). Linking Business Goals to Process Models in Semantic Business Process Modeling. *12th International IEEE Enterprise Distributed Object Computing Conference (EDOC '08)*.
- Mylopoulos, J., Chung, L., Yu, E., & Nixon, B. (1992). Representing and using non-functional requirements: A Process-oriented Approach. *IEEE transactions on Software Engineering*, pp. 483-497.
- Neiger, D., & Churilov, L. (2004). Goal-Oriented Business Process Engineering Revisited: a Unifying Perspective. *in Proceeding of The First International Workshop on ComputerSupported Activity Coordination (CSAC 2004)*.
- Neiger, D., & Churilov, L. (2004). Goal-Oriented Business Process Modeling with EPCs and Value-Focused Thinking. *Business Process Management*, pp. 98-115.
- Nurcan, S., Etien, A., Kaab, R., & Zouka, I. (2005). A strategy driven business process modelling approach. *Journal of Business Process Management*, 11, 6, pp. 628-649.
- O'Sullivan, J., Edmond, D., & Ter Hofstede, A. (2002). What's In a Service? Towards Accurate Description of Non-Functional Service Properties. *Distributed and Parallel Databases*. Kluwer Academic Publishers.
- Pastor, O., & Molina, J. (2007). *Model-Driven Architecture in Practice*. Springer Verlag.
- Rilston, F., & Castro, J. (2002). Enhancing Data Warehouse Quality with the NFR Framework. *Proceedings of the V Workshop on Requirements Engineering*. Universidad Politecnica de Valencia.
- Rolland, C., Souveyet, C., & Camille, B. A. (1998). Guiding Goal Modeling Using Scenarios. *IEEE Trans. on Software. Engineering, Special Issue on Scenario Management*.

Singh, S. N., & Woo, C. (2008). A Methodology for Discovering Goals at Different Organizational Levels. *Proceedings of the Third International Workshop on Business/IT Alignment and Interoperability (BUSITAL'08) held in conjunction with CAiSE'08 Conference*. Montpellier, France.

Soffer, P., & Wand, Y. (2005). On the notion of soft-goals in business process modeling. *BPM Journal*, pp. 663– 679.

Yamamoto, S., Kaiya, H., Cox, K., & Bleistein, S. (2006). Goal Oriented Requirements Engineering: Trends and Issues. *IEICE - Transactions on Information Systems*.

Yu, E. (1995). Modeling Strategic Relationships for Process Reengineering. *PhD Thesis* . Departament of Computer Sciences, University of Toronto.

Zachman, J. (1987). A Framework for Information Systems Architecture. *IBM Systems Journal* , pp. 276-292.