A Systematic Approach for Identifying System Requirements from the Organization's Business Model

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Abstract. *Although it is recognized that the business model contains relevant information for obtaining system requirements, we still lack a systematic approach for discovering requirements from an existing organization's business model. This paper proposes a method which starts from a business model, guides the software development team toward understanding business needs and identifying system requirements addressing those needs. Three case studies were conducted where the method applicability could be verified.*

1. Introduction

One of the great challenges of requirements elicitation is ensuring that system requirements are aligned with organization's business needs. Requirements that represent just a single user's perspective, which are partially analyzed and do not consider the environment where the system will be used, may lead to systems which will not address its users' and organization's expectations [Reubenstein and Waters, 1991].

Aligning system requirements with the organization's business needs involves the understanding of the organization's context [Eriksson and Penker, 2000]. In order to understand and represent how organizations work, the Business Process Management (BPM) area has defined a set of concepts, models and techniques with the purpose of drawing up any organization's business model [Marshall, 2000][PROFORMA, 1998].

Although it is recognized that the business model contains relevant information for obtaining system requirements, we still lack a systematic approach for discovering requirements from an existing organization's business model. The aim of this paper it to propose a method guiding the software development team, collaboratively with organization's employees, through the work of understanding the business model, identifying the business needs and defining the system requirements. Our hypothesis is that the business model provides this reference that can be discussed and used as an instrument to collaboratively identify system requirements.

The paper is structured as follows: section 2 presents related work, section 3 shows a business meta-model, considered in this paper; section 4 proposes the method to elicit requirements from a business model, listing its objectives; section 5 and 6 detail the method, presenting its phases and steps with the help of a case study; finally, section 7 describes the conclusions of this research.

2. Related Work

We can find research work considering business modeling as a useful starting point for

system requirements elicitation [Eriksson and Penker, 2000][PROFORMA, 2000][Silveira, Cruz and Schmitz, 2002][Christel and Kang, 1992]. The common agreement among them is that business modeling leads to a learning task that helps system requirements understanding. These approaches propose that the business modeling task is part of the system development process, which means one of the first activities of system development should be the modeling of the business portion to be supported by the system. This is called scenario based approaches, in which the scenario is built by the help of business modeling [Rolland et al., 1998].

The Tropos Framework proposes a software development methodology based on concepts offered by i* used to model early requirements [Mylopoulos and Castro, 2000]. Although the i* concepts embraces some business concepts – such as actors and goals – the Tropos Framework is not intended to build a business model. Enterprise modeling will be used to capture the purpose of the system, by describing the behavior of the organization in which that system will operate. A model will result from this task, from which the Tropos Framework will guide software development team toward the understanding of the problem and design of the system.

Differently from the approaches mentioned above, our method considers that the organization should benefit from having a systematic approach for modeling and managing its business. As organizations learn how business process management can be helpful and continuously maintain a business process model, this model can be used as a high level infrastructure for system development and maintaining the organizational information architecture. In that situations, a different methodology will be necessary for extracting requirements from this model.

3. Business meta-model

There are many approaches for business modeling, and each of them has defined different notations and languages for modeling an organization's business. Despite the approach used to build the business model, system developers should be aware of what to look for in a business model in order to identify relevant system requirements. That means knowing which concepts in the business model leads to system requirements. Based on some approaches for business modelling [Eriksson and Penker, 2000][PROFORMA, 1998][RATIONAL, 2000], the method proposes an initial set of business models (Table 1) from which system analysts should start the requirements identification.

Table 1. Business Models

Organizational Model	stands for the organizational units, its roles and the relationships between them. For example, an IT department may be considered an organizational unit, and a programmer, a role. Besides that, an organizational model represents which roles belongs to each unit, depicting an organizational hierarchy.
Localization Model	represents the way the organization is distributed and the association of each organizational unit and its geographical localization.
Goal Model	shows the business goals and the hierarchical relationships between them. Represents how a goal is divided into subgoals which can be achieved by business processes.
Process Model	this model represent all business processes and their hierarchical structure. It also represents the activities that comprise each business process
Activity Model	represents the relationships between business processes activities and those responsible for each of them. Also shows which business objects – which can comprise any information storage – are handled in each activity and which events trigger or are triggered by the execution of each activity.

When the method refers to a goal model, for example, what we actually refer to is the concept of business goals, the relationships between the goals and the processes to address each goal. There is not the need of existence of a real Goal Model in the organizational model; it is sufficient that those concepts (goals, subgoals and its relationships) exist in the model and are somehow represented. That was the way we found to develop a method that considers an existing organizational business model, regardless of the approach in which it was developed.

4. Method Overview

In short, the method objectives can be summarized as:

- **It considers the organization's context to identify the real problem to be solved –** by analyzing the business model, the development team can search for information about the organization domain area, its work processes, its business goals, its problems etc, all information which can help the development team to understand the organization, its business and the business problem it will address.

- **It establishes a discipline for identifying requirements –** it proposes a sequence of steps for searching and organizing requirements information extracted from the business model. Those steps are organized from identifying the real business problem to be solved to the necessary requirements for the automation solution.

- **It suggests interactions among the involved actors –** it is expected that the business model help the identification of the actors involved with the future system. Additionally, it is expected to involve all these actors into the requirements discussion, using the business model as an instrument for discussion.

- **It avoids premature models –** the method aims at avoiding premature system models during system development, since its target is to identify the main and high level system requirements. Thus, it guarantees that system details will only be discussed later and focuses on the business needs and support.

- **It helps the understanding of the business model** – the method guides the searching of information in business model starting from the business meta-model presented above. By understanding the concepts of this meta-model, software engineers can find each concept in organization business models, even if every business model is represented in a different notation or language.

The method is divided in two main phases: **identifying the problem** and **building of the solution (**Figure 1). The basic aim at the first phase is to discover the actual organization's needs in business processes. Those needs should be addressed by the system to guarantee that the right problem is being solved. In the solution view, the identified needs are analyzed to assess how they can be addressed.

5. Understanding the Problem

One of the case studies conducted in this research will be presented to better illustrate the method, as an example of the sections which will follow. The RML laboratory has developed it business model, months before this case study was conducted, applying the Proforma's approach [PROFORMA, 2000]. This business model will be partially presented in this section as a way of illustrating how a development team can analyze it, identify the main business concepts and elicit some basic software requirements.

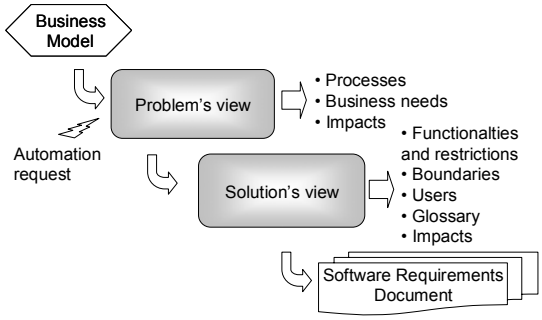

Figure 1. Method for requirement elicitation from the business model

The RML is a laboratory which acts in the area of radiation measurement and protection of personnel exposed to radiations. The organization's clients are other enterprises whose employees work under exposure to different kinds of radiations and who need to be constantly monitored. The monitoring process consists of bioanalysis in vivo, which directly analyzes the person's body to measure the levels of radiation that the person has been exposed. The process of bioanalysis in vivo is supported by a set of systems, developed by the RML IT Department. Those are systems used to perform mathematical and physical calculations with the radiation values measured. A request was made to develop an integrated system to support entirely the monitoring process.

Step 1: Identify the context of the request: The aim of this step is to establish the boundaries of the business area involved with the existing request. In order to identify the business processes involved with the request, it is necessary to search, in the RML's **process model** (Figure 2), the processes that should be supported by the new system. The descriptions of the processes contained in each group of processes should be analyzed to determine whether the process belongs or not to the scope of the request.

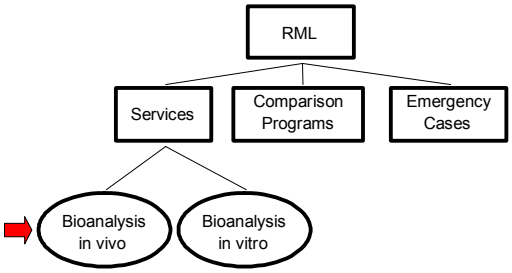

Figure 2. RML's Process Model

Once the business processes involved with the request are identified, it is also important to identify what activities, under these processes, will be considered in the system. The **activity model** of the "Bioanalysis in vivo" process is shown in Figure 3.

The process begins when a group of workers – employees from other enterprises, frequently exposed to radiations – arrives at the laboratory. An employee of the RML searches for each worker's files in a system - Patient Catalogue. If this is the first time that a worker comes to the laboratory, the employee should enter the worker's information into the system. As the system does not have a simple interface, the employee gives the worker a form which should be filled in with name and age. The content of this form will be entered into the system after the group of workers has left the laboratory. Next, another form should be filled with body measurements such as height and weight and entered into another system, called Measurement Catalogue. The worker is positioned at the device which will read the levels of radiation present on the

worker's body. The employee must input this information into a third system, responsible for the calculations of the final level of radiation. A final report is generated.

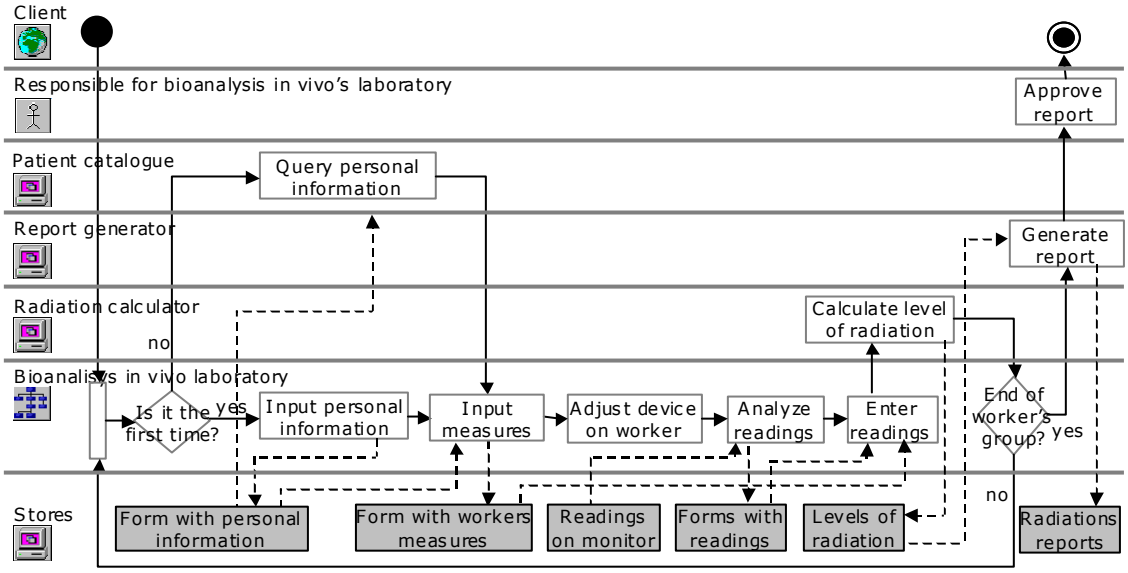

Figure 3. Activity model

By the analysis of the **activity model**, it was possible to understand the process activities and identify which of them are relevant to the request. The only activities that were not considered – "Adjust device on worker" and "Approve report" – are manual activities and are out of the request scope. The activity model guided the discussions, being useful not only as information basis but also as an instrument for discussion and knowledge build. While the group discusses which activities should be considered, new information about its daily execution, only known by the organization employees, arises and is made known also by the software engineer group.

Step 2: Identify business needs: By analyzing the **organizational model**[1] it was possible to notice that the bioanalysis in vivo laboratory comprises one responsible person and a number of technicians. These are the actors who should participate in the meetings to discuss and define the system functionalities.

To discover the business needs it is necessary to find the difficulties in the process and look for their reasons. These reasons are the business needs which must be addressed so that the problems encountered are solved. It is important to note the relationship among each difficulty, its related business need, and the activity containing the difficulty (Table 2). Through this table, we can see that a business need is being considered by the system because there was a certain difficulty in a specific activity of the process.

Table 2. Difficulties found in the activities, related to corresponding business needs

Activities	Difficulties	Business needs
Input personal information	Write personal information in a form and afterwards enter the same information in the patient catalogue system	System interface and performance should be efficient and let the technician enter needed information directly into the system
Input measures	Write the measures in a form and then enter again the measures into the measurement catalogue system	

[1] Not shown here due to space limitations. See Table 1 for model description.

	To associate the personal information of a worker to his/her measurement, in the two different systems, it is necessary to copy manually the workers ID in the patient catalogue into the measurement catalogue	Functionalities of each existing system should be supported by the new system
Analyze readings	Readings are shown in a monitor; the technician must copy those readings into a form and the enter the readings into the calculator system	
Enter readings	Sometimes readings must be entered more than once into the calculator system. Depending on the kind of radiation exposure that the worker has been exposed to, different calculations are needed, and the readings must be entered many times in the calculator system	
Generate report	The levels of radiation calculated by the calculator system must be entered manually into the report system	
	The group of workers must be handled sequentially so that the report is generated correctly, grouping the employees from the same enterprise	Create an enterprise catalogue and relate each worker to an enterprise

Step 3: Identify impacts of business needs: The aim of this step is to have an overview of the impact the identified business needs cause to the organization. These impacts will help define the priorities of business needs and also help to decide which of them will be addressed. The consequences of each business need were identified with the help of the **activity model**. Each business need was assessed to discover its impacts to the activities and to the whole process. Next, with the help of the **goal model**[2], the organizational goals and people affected by the impacts of business needs were identified (Table 3).

Table 3. Business needs impacts on the processes

Business needs	Consequences	Goals	People	Priority
System's interface and performance should be efficient and let the technician enter necessary information directly into the system	- Delay in activities - Redundant work - Need for more employees - Chances of making mistakes	- Be approved by clients - Have competitive costs	- Technicians - Client	High
Functionalities of each existing system should be absorbed by the new system				
Create an enterprise catalogue and relate each worker to an enterprise				

6. The Solution View

Step 4: Identify system functionality and restrictions: It is necessary to analyze the set of activities to be supported by the system to find out the system main functionalities and restrictions. Table 4 shows the main functionalities identified from the listed activities.

Table 4. System main functionalities

Activities	Functionalities
Input personal information	Manage personal information
Query personal information	
Input measurements	Manage measurements
Analyze readings	Manage readings
Enter readings	
Calculate level of radiation	Calculate level of radiation
	Manage radiation information
Generate report	Generate report

Next, it is interesting to analyze the process business needs to identify other

[2] See Section 2 for description.

functionalities which solve the problems found in the process. At this moment, non-functional requirements could also arise. **Erro! Auto-referência de indicador não válida.** shows the result, relating each functionality and restriction found to the business need that originated it. This relationship is important as it documents the reason for the existence of the requirements.

Table 5. System aspects identified from business needs

Activities	Business needs	Functionalities and restrictions
Input personal information	System interface and performance should be efficient and let the technician enter needed information directly in the system	Fast processing
		Simple interface
Generate report	Create an enterprise catalogue and relate each worker to an enterprise	Manage information about RML clients

Step 5: Identify system boundaries: In this step, the objective is to evaluate roles, other systems, storages and external actors which may have to exchange information with the system. It is important to analyze the **activity model** to find out if there are any activities that the new system should support, which are actually supported by other systems. This is not the case, in the case study, once all other systems will be no longer used in the process. Lastly, it is important to analyze the process storages – any places where information can be stored (databases, catalogues, documents, …). Developers should identify which storages will be necessary to the new system. The set of storages identified has to be defined and detailed. However, at this point, this can be done in a simplified manner, as a glossary (Table 6).

Table 6. Simplified glossary

Storages	Description	Information that should exist in database
Patient catalogue	Information about RML's patients	ID, name, address, telephone, enterprise, input date
Measurement catalogue	Information about the patients' measurements	Patient ID, appointment date, measurements, readings, radiation level
Enterprise catalogue	Information about the clients enterprises	Name, address, date

Step 6: Identify the impacts of the new system: It is important to assess the way the new system interferes in the organization's business so that those impacts are known and updated in the business model. This can be done, with the help of the **activity model**, by interactions with future users based on the main aspects defined for the system. The discussions on the process as it is modeled in the business model, and the vision of the functionalities of the new system lead to a set of changes which will occur to the process when the system begins to be used. In the case study, these changes were the activities "Input personal information", "Query personal information", "Input measures" and "Generate report" to be supported by the new system.

Step 7: Generate software requirements document: Finally, software engineers should register in the software requirement document all relevant information about the system. This research has also defined a template for that document, which includes the results of all previous steps.

7. Conclusion

This research work comprised the performing of three case studies, each of them considering real organizations whose business model had been previously developed. The method had been successfully applied in each of them, even when each business

model was developed in a different approach.

Through the case studies, it was possible to conclude that the method can be followed and lead to a real system requirements list. It was somehow easy to find the necessary information required by the method by following its suggestions. We could also conclude that the more detailed the business model is, richer can be the activity of identifying requirements.

This work suggests that the business model can be a reference for guiding the requirements group (including users, system analysts, sponsors etc) in focusing the requirements gathering. A collaborative approach and automated support for conducting the discussion dynamics based on the method is one of our objectives for future work.

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