Using ISO 9000 to Elicit Business Rules

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PUC-RioInf.MCC50/98

Abstract

Business rules have been largely used in database modeling and more recently in the field of information technology, but rarely in requirements engineering. This article will focus on business rules as prescribed procedures that should be followed to achieve the business's goals. The ISO 9000 documentation includes policies, procedures and instructions to assure the final product's conformance with ISO 9000 requirements. Partly for this reason, it is contended here that ISO 9000 standards and associated documents can be of a great help for business rules elicitation. The authors' main contribution is to propose a conceptual model for not only eliciting business rules, but also integrating them into a software requirements baseline model. This proposal uses ISO 9000 characteristics and integrates them with the idea of natural language-based requirements descriptions.

Key words: ISO 9000, Business Rules, Requirements Elicitation, Requirements Baseline

Resumo

Regras de negócios vêm sendo largamente utilizadas na área de modelagem de bancos de dados e mais recentemente em encontrado eco na área de tecnologia da informação, mas raramente é abordada pela engenharia de requisitos. Este artigo entende regras de negócios como procedimentos que devem ser seguidos para que se atinja as metas do negócio. A documentação gerada para se obter uma certificação ISO 9000 inclui políticas, procedimentos e instruções de trabalho que tem por finalidade assegurar que o produto final estará em conformidade com os requisitos da ISO 9000. Em parte por isso, dizemos que os padrões da ISO 9000 e a documentação associada a estes, podem ser de grande ajuda na elicitação de regras de negócios. A maior contribuição dos autores é propor um modelo conceitual para não apenas elicitar regras de negócios, mas também integrá-las ao modelo "Requirments Baseline". Esta proposta utiliza-se de características da ISO 9000 e as integra com a idéia de descrever requisitos com o uso instrumentos baseados em linguagem natural.

Palavras-Chave : Elicitação de Requisitos, Regras de Negócios, ISO 9000, Requirements Baseline

[1,2] This work was supported by CNPq
[3] This work was supported in part by CNPq grant n. 510845/93-2

1 - Introduction

Business rules, in the computer science literature, are usually referred to as a means to elicit data base needs with respect to events/actions referring to data entity [Kappel 95] [Dias 91] [Daya 88] [Halle 96] [Halle 97]. We take a broader view. For us, business rules are prescribed guides or procedures that should be followed to achieve the business's goals.

The main contribution of this paper is to propose a partly tested model to elicit business rules, an idea that has not as yet been explored, according to our literature review. An essential characteristic of this method is the use of ISO 9000 documentation.

Many techniques have been proposed to describe business organizations. There are techniques to design how the information flows, to describe the sequence of actions an organization follows, the hierarchy, and so on. In some ways, all these descriptions refer to business rules, but they don't cover an important aspect, the set of rules establishing how the business works [GUIDE 96].

According to [CB-25 97], in October 1997, more than 140.000 companies, worldwide, had been certified. It is relevant that ISO 9000 certification is not restricted any more to large companies. Medium and small businesses, from small bakeries to large industrial organizations, are also being certified. Figure 1 illustrates the steady growth in number of ISO 9000 certified companies, in Brazil.

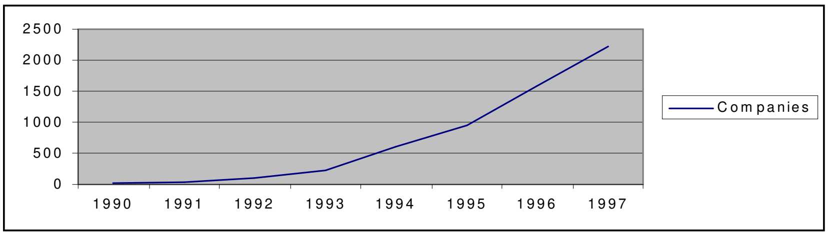

Figure 1 - Number of ISO 9000 certified companies in Brazil

This positive trend regarding ISO certification creates, in our opinion, an opportunity for making use of ISO documentation for business rules elicitation. Indeed, our main hypothesis is that by using the ISO 9000 required documents for business rules elicitation, one can significantly improve software requirements elicitation in organizations.

This hypothesis was inspired by the idea that since the Quality Manual used for ISO certification is the guide defining what will be done and how it will be done, as Corrigan [Corrigan 94] puts it, it could also be an important source for eliciting software requirements.

A bibliographic survey was first carried out to verify whether some evidence for our hypothesis could be found in the literature. Initially, we looked for elements towards an answer to the question on how a method could be developed for business rules elicitation based upon ISO 9000 knowledge. Very few elements were found [GUIDE 96] [Herbst 96] [Rosca 97], however, that considered business rules in a broader way. Indeed, most of the literature on business rules is concerned with their impacts on data modeling. One exception is Fiorini and Macedo-Soares [Fiorini 96] who propose a method to elicit business processes in companies that pursue total quality and to integrate these processes with requirements elicitation.

Further investigations were carried out in the business administration literature. In Matos [Matos 88], we thus learnt that many companies are actually giving training to their employees on what rules are being applied to the business. Harrington [Harrington 96], as well as Macedo-Soares and Chamone [Macedo-Soares 94] implicitly touch upon the question of business rules when discussing the principles and key practices of total quality strategies, notably that of business process management. While not explicitly addressing the question, Corrigan [Corrigan 94], Hayes [Hayes 96], Hilary [Hilary 96], Hockman et al. [Kumberly 94], Macedo-Soares and Lucas [Macedo-Soares 96], and Struebing [Struebing 96] provide pertinent observations for its treatment in their analyses or comparisons of ISO 9000 and Total Quality Management (TQM).

Both the above mentioned literature review and a recent experience in helping a company with ISO 9000 certification by one of the authors were used to develop a tentative model for business rules elicitation based on ISO 9000 documents. It thus became evident that the latter could play a central role in defining what Leite [Leite 93] calls Universe of Discourse (UofD):

> *"Universe of Discourse is the general context where the software should be developed and operated. The UofD includes all the sources of information and all known people related to the software. These people are also known as the actors in this UofD."*

Once the business rules have been identified, they are used to elicit the symbols of the Language Extended Lexicon (LEL) [Leite 93]. The objective of an LEL is to register the vocabulary of a given UofD. It is based upon the following simple idea: understand the problem's language without worrying about understanding the problem [Leite 94]. The main objective of the LEL is to register signs (words or phrases) peculiar to a specific field of application.

LEL is a meta-model designed to help the elicitation of the language used in the macrosystem. This model is based on the idea that a circular description of language terms improves the comprehension of the environment. Each sign is described by natural language sentences for its notions and behavioral responses. In the description of each sign, a high level of circularity is maintained, since each sentence uses signs also described in that LEL. The notions must try to elicit the symbol's meaning and its fundamental relations with other entries. The behavioral response must specify the connotation of the symbol in UofD.

Our definition of business rules is consistent with Leite's one [Leite 98]:

> *"Business rules are statements about the enterprise's way of doing business. They reflect business policies. Organizations have policies in order to satisfy the business objectives, satisfy customers, make good use of resources, and conform to laws or general business conventions. Business rules become requirements, that is, they may be implemented in a software system as a means of a requirement of this software system."*

We present our proposal by first giving a brief introduction to ISO 9000 (Section 2), then explaining the core of our proposal (Section 3). Sections 4 and 5 describe in detail how we are planning to use our proposal, including an example drawn from our initial case study. We conclude by showing how we view our contribution in terms of achieving better quality software systems, by reusing the information contained in ISO 9000 documents.

2 - Introduction to ISO 9000

According to ISO 9000 standards [ISO 94], a product is the result of an activity or process, and can be part, or an association of one or more of the following abstract classes:

1. Hardware - Equipment, components, objects, part of pieces, similar products;
2. Software - Methods, documents, information, procedures, instructions, and projects;
3. Processed Materials - Characteristics of incoming product transformation into continuing process, both physical, chemical and biological;
4. Services - A class of products that are consumed while being produced; in a certain sense they can be considered intangible.

At this point, it is important to make clear what we understand by the following expressions:
✓ **Quality System -** The organizational structure, responsibilities, procedures, processes and resources for implementing quality management;
✓ **Quality Manual -** A document stating the quality policy and describing the quality system;
✓ **Quality Policy -** The overall intentions and direction of an organization concerning quality, as formally expressed by upper management;

✓ **Requirements for Quality -** An expression of the needs or their translation into a set of quantitatively or qualitatively stated requirements for the characteristics of an entity to enable its realization and examination;
✓ **Nonconformity -** The non-fulfillment of intended usage requirements.
From the model for the ISO 9001/9002 standards [ISO 94] it becomes clear that, for ISO 9000 purposes, the supplier is the organization providing a product to a customer. ISO 9000 standards call the company being certified as a supplier; its suppliers are called sub-suppliers.

One of the main objectives of implementing a quality system is to achieve customer satisfaction by ensuring the continued repeatability of a set of product and service characteristics that have been explicitly or implicitly agreed upon by a customer and a supplier [Sakofsky 94]. This requires controlling what is done and, consequently, implies that everyone knows *what* is done and *how* it is done [Corrigan 94].

One can clearly see how important it is to document all processes to assure the customers' requirements are met, by performing controls, when one pursues such an objective. In this connection, it is relevant that one of the ISO 9000 requirements (4.5 - Document Control) states:

> *"... there must be established and maintained procedures to control documents and data that relate to the requirements of the international standard. These documents shall be reviewed and approved for adequacy by authorized personnel before issue. This control shall ensure that: a) the pertinent issues of appropriated documents are available at all locations where operations essential to the effective functioning of the quality system are performed; b) obsolete documents are promptly removed from points of issue or use."*

This requirement implies that every change in the process has to be documented, approved and available at all locations *before it is implemented*.

Another ISO 9000 requirement (4.2 - Quality System) states:

> *"... there must exist a documented quality system to ensure that a product conforms to specified requirements. This shall include: a) preparation of documented quality system procedures and instructions in accordance with the requirements of the ISO 9000 International Standard; b) the effective implementation of the documented quality system and instructions."*

Put differently, 'the company must follow process documentation at every step of production as well as document the production process as it is enacted'.

There is no rigid format for the Quality Manual, but it is usually divided in sections following the ISO standards. This accounts for a manual with at least 4 sections, where section 4 is divided into 21 sub-sections, one for each requirement of the ISO standard. When referring to section 4.3, for example, we will be referring to the section in the Quality Manual that specifies the requirement contract review.

Section 1 should refer to the scope of the quality system, Section 2 to important references on the manual and Section 3 to the necessary definitions for understanding the Quality Manual.

The ISO standard establishes the following two requirements for the Quality Manual:
a) specify the structure of the quality system's documentation;
b) include or refer to procedures that indicate how requirements for the quality system can be met.

The documents required by the ISO 9000 standard are usually built on a three-tier set of documents (see figure 2) [Corrigan 94] and can be described as follows:
1 - Quality Manual (QM) - It is the strategic level document. It defines "What has to be done" to assure that the specified requirements are met.
2 - Quality Control Procedures (QCP) - This document refines directives found in the Quality Manual pointing out "how the quality objectives can be achieved".

3 - Standard Operational Procedures (SOP) - This document registers the documented procedures meeting the applicable requirements of the quality system. Operational procedures can be included or referenced in the Quality Manual.

For practical purposes, when we use the expression "Quality Manual", we are referring to any or all of the three documents.

We will now detail *some* of the most important sections of the Quality Manual and provide some relevant examples of their business rules:

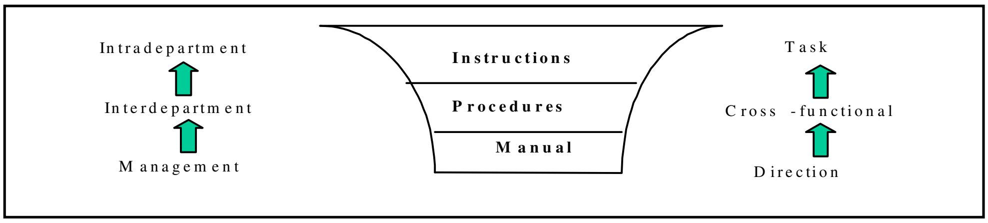

Figure 2 – ISO 9000 Documentation System

Section 1 of the Quality Manual is only a presentation of the Quality Manual and is usually very short. The most important information given here is the distribution list, which establishes who is to receive the copies of the Quality Manual.

Section 3 describes the Business's Profile and contains a global scenario of business goals. It usually indicates the products or services offered by the company as well as its market profile.

Section 4 is subdivided in 21 subsections. Some quality systems include one or two extra requirements, for example, legal requirements. As mentioned before, there is no fixed format for the Quality Manual, but usually the subsections are organized according to the following format: 4.1, 4.2,..., 4.21. Some of them are described bellow.

Section 4.1, Management Responsibility, defines the quality system, the organizational structure, the responsibilities and authorities, as well as the management review. The latter process is meant to appraise the effectiveness of the quality system and should therefore be directly correlated to business health.

Section 4.2 and 4.5 were described earlier in this section.

Section 4.3, Contract Review, presents the procedures to assure that the contract established with the client is correct and that it can be carried out by the company in the specified space of time.

Section 4.4, Design Control, only applies to companies being certified according to ISO 9001 standards. It refers to the necessary procedures to control and verify the design of the project.

Section 4.6, Purchasing, details the purchasing process which must include descriptions of the procedures for verification, storage and maintenance of purchaser supplied products to be used in any step of the product's production process.

Section 4.7, Product Supplied by the Client, refers to the process that specifies how products, supplied by the customer, will be identified, verified and stored.

Section 4.8, Product Identification and Traceability, imposes complete traceability to incoming products, sub-products produced during the process, as well as the final product itself.

Section 4.9, Process Control, is where the company (the supplier) identifies and plans the production.

Section 4.10, Inspection and Testing, defines the process to assure that products are not used or processed until they have been inspected for conformance to specified requirements.

Section 4.14, Corrective Action, refers to the necessity of establishing procedures to deal with non-conformities, and correcting the process so that the identified non-conformities do not reoccur.

It is important to emphasize that the ISO standards we are proposing to use are not related to ISO 9000-3 [ISO 91] which are the guidelines for the application of ISO 9001 for the development, supply and maintenance of software. ISO 9000-3 is not focused on the elicitation process.

Finally, it is important to stress that, although ISO 9000 may be a way of achieving Total Quality (TQ) and part of a TQ strategy, ISO standards and TQM should not be confounded [Hilary 96] [Hayes 96] [Macedo-Soares 94].

3 - Integrating Business Rules into the Requirements Baseline

An important assumption of our research is that requirements are not static in time. They thus necessarily change during the software life cycle [Leite 95]. This means that the requirements found during the requirements definition, continue to evolve as the software is being developed. As such, the software engineer must pay attention to the possible changes and evolution of requirements. The requirements baseline is structured as follows [Leite 98]:

- a lexicon model view;
- a basic model view;
- a scenarios model view;
- a hypertext view;
- a configuration view.

Our proposal is to integrate business rules into the baseline to provide a global description of the governing rules of the macrosystem, and to help in the communication process with the client/customer.

Figure 3 portrays the overall strategy. First, the software engineer must define the Universe of Discourse (UofD) (see "DEFINE UofD" on Figure 3), by carrying out interviews and reading manuals, books, legislation, Quality Manual, etc. [Leite 93].

At this initial step, a first reading of the Quality Manual is important to give the software engineer an understanding of the application domain. A first definition of UofD may be drafted at this point. The engineer can elicit business rules at the boundaries of the UofD.

The second step is to produce a first LEL version based on symbols identified during the first reading of the Quality Manual and on some symbols already identified during interviews and readings carried out at the initial step. This first LEL version may contain merely notions associated with each symbol. In this case, behavioral response must be completed during the third step, which corresponds to "ANALYZE QUALITY MANUAL" in Figure 3.

Software engineers face a problem when defining symbols of the LEL: they may go to the actor of the UofD responsible for the requirement where the symbol was found. Section 4.1 contains a table where it is possible to identify who is responsible for each requirement and may help to identify who is the actor to be consulted.

At this point, it is not necessary to have a complete LEL's definition. What is important is to have a basic definition of the LEL that can help the software engineer to analyze the Quality Manual and help understand the UofD vocabulary.

The "ANALYZE QUALITY MANUAL" process, corresponding to step three, aims at eliciting the business rules by way of the manuals. The software engineer should use the LEL to better understand the UofD vocabulary while reading the Quality Manual or interviewing actors of the UofD. The heuristics, appearing as a mechanism in the SADT of Figure 3, are detailed in Section 4.

The objective of the “CHECK CONSISTENCY” process, corresponding to step four, is to provide the necessary feedback to the two previous processes. At this stage, the software engineer must look for new LEL’s symbols contained in the business rules, their notions and behavioral responses, and integrate them into the LEL. This process also accounts for checking whether there are missing rules, based on LEL’s symbols not referred to in any rule. If there is any symbol not present in the business rules, the software engineer must look for it in the Quality Manual so as to be absolutely sure that there are no business rules related to this symbol.

This process will continue until no new LEL’s symbols are found in step three.

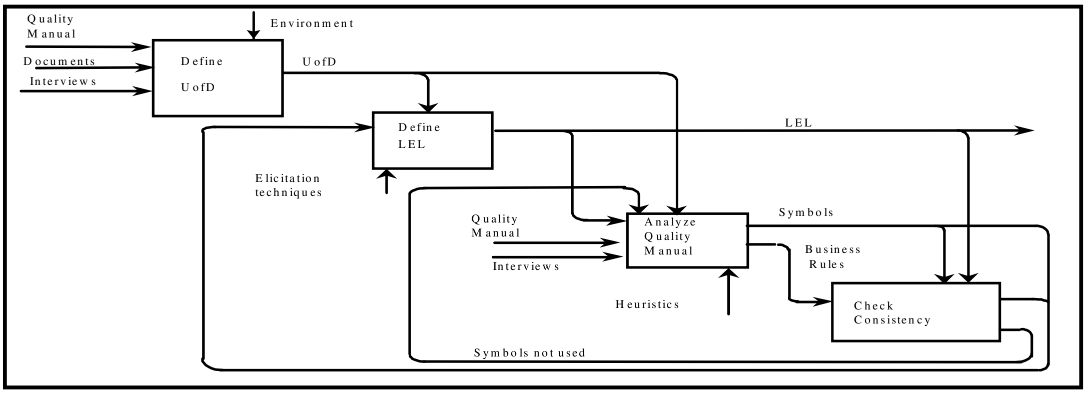

Figure 3 - SADT model for integrating Business Rules in Requirements Baseline

4 - Eliciting Business Rules

When referring to the use of business rules in the software definition process, Herbst [Herbst 96] points out that one of the main tasks of system analysis is to collect all information relevant to the UofD.

Based on Leite’s conceptual model [Leite 98] and on the literature about business rules we propose the conceptual model presented in Figure 4.

Business rules may be written according to the syntax shown below as inspired by Leite’s requirements baseline [Leite 95].

- Number + “-“ + Business rule statement + ${}_1^n${“- Section :” + ISO’s requirement}

Each rule must have its own unique number. The use of numbered rules plus the ISO’s requirement associated to the rule aims to help elicitation and cross-referencing. One business rule has to be related to one or more ISO’s requirements.

The business rule statement must follow specific patterns depending on the type of business rule. These patterns are detailed in the following sections.

4.1 - Non-Functional Rules

Non-functional rules can be viewed as business rules that concern constraints and behaviors.

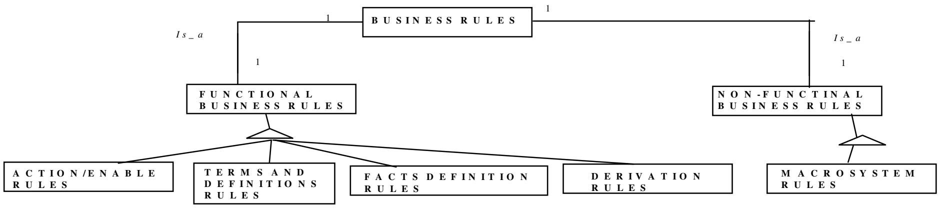

Figure 4 – A conceptual model for business rules

4.1.1 – Macrosystem Rules

Macrosystem rules describe the necessary policies to constrain the behavior of the organization. They must follow this pattern:

- [Property] + Non-Verbal Phrase + Relation + [Property] + Non-Verbal Phrase

Where:

- Property is a phrase denoting a characteristic of a Non-Verbal Phrase and may be a symbol of the LEL.
- Non-Verbal Phrase should be a symbol of the LEL.
- Relation is a verbal phrase and may be a symbol of the LEL.

Common key words found in relations are:

- Must/Must not be ... than (grater/lower/taller/thinner/..)
- Must not exceed
- Can not

Example:

An undergraduate student can not borrow books from the library.

4.2 – Functional Rules

This type of rule expresses general policies regarding the organization's functionality. It can be divided into two groups of patterns. The first comprises terms, facts and derivations; the second includes Action Enablers rules.

4.2.1 - The First Group

The first group must follow the pattern:

- Non-Verbal Phrase + Verbal Phrase + [Non-Verbal Phrase]

Where:

- The first Non-Verbal Phrase should be an entry of the LEL.

Next, we will detail the differences between each type of business rules that belongs to the first group.

Term/Definition: business rule denoting some sort of definition. Common key words found were: Is defined as, can be viewed as, is denoted as, is known as, is someone who, is something that, is a/an.

Example: A customer is someone who purchases products

Derivation: business rule expressesing some kind of mathematical operation. Common key words found were: is calculated, is computed, is equal to.

Example: The total amount of an order is calculated using the formula in Appendix 1.

Fact: business rule asserting an association between two or more terms. Here the second Non-Verbal Phrase has to exist and both have to be entries of the LEL. By default every rule matching this syntax and does not fit in the two types stated above should be a fact.

Example: A customer can request a specific car model.

4.2.2 – The Second Group

The second group is composed of the Action/Enabler rules and must follow one of the following patterns:

- IF + phrase + then/implies + phrase
- When + phrase + then/implies + phrase

- Because + phrase
- Non-Verbal Phrase + Verbal Phrase + Because + Phrase

Where:

- Non-Verbal Phrase must be an entry of the LEL.

Example:

If a preferred customer places three orders within one week, then send the customer a free gift.

4.3 – Conceptual Model for searching ISO 9000's documentation

Finding business rules requires knowing the business. This is why it is important to define the UofD and an initial version of the LEL. The LEL will provide a general scope for the vocabulary, which reflects the Quality Manual vocabulary, and will provide a source for business knowledge.

The best source for ISO 9000 information in an organization is the quality leader. If the organization does not have a quality leader, the software engineer must look for the Management Representative who is responsible for maintaining the quality system.

Reading the Quality Manual will often prompt the software engineer to read the Quality Control Procedures manuals, and sometimes, also, the Operational Procedures manuals.

The more relevant parts of a Quality Manual and the respective rules that can be found inside these are briefly described below. We also present some of the sections of the Quality Manual where one can find business rules, together with some information on what one can expect to find in each section.

Figure 5 shows a conceptual model, inspired by Fiorini's work [Fiorini 96] for searching ISO's 9000 documentation with a view to eliciting business rules. Figure 6 details some parts of the conceptual model.

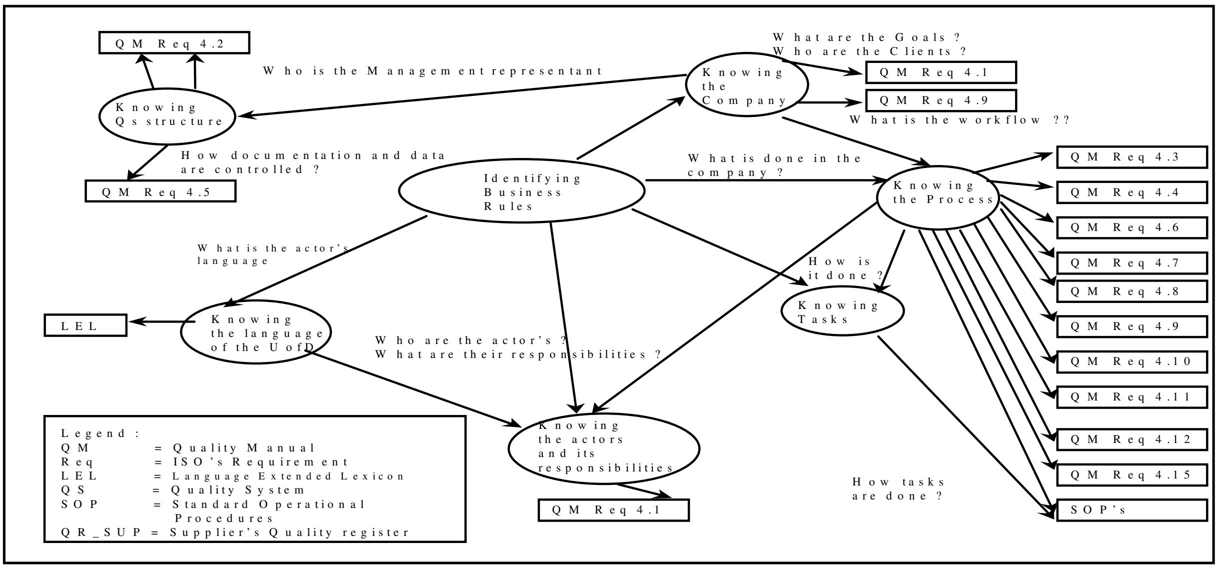

Figure 5 – A general Conceptual Model for Searching ISO's Documentation with a View to eliciting Business Rules

On the following paragraphs we detail the conceptual model by section.

By reading section 4.1, one can identify the different actors of the UofD.

Section 4.2 is where the software engineer can find out how the quality system is structured, its manuals and how to use them.

Section 4.3 will help the software engineer know the limits of the UofD. This section presents the procedures to assure the contract established with the client is correct and can be honored by the company in the defined space of time. Here, it is possible to identify many actors linked to the production process itself, and others who will act as sub-suppliers. Figure 7 illustrates part of this section for a Quality Manual of a clinical laboratory.

Section 4.5 is a good source of information about important documents, processes and actors of UofD.

Section 4.6 may help derive useful business rules related to the process of buying the incoming product.

Section 4.7 can be a good source of information when specifying a system interacting with the client This section can be helpful in eliciting business rules related to both functional and non-functional requirements. Since it accounts for interactions with the clients, it provides a good source of *quality* requirements such as performance, safety, easy of use and reliability.

Section 4.8 should be carefully studied and detailed with the actors responsible for this section, since it plays an important role in ISO 9000, imposing complete traceability to incoming products, sub-products produced during the process and to the final product itself. Therefore, many rules can be identified by way of this section

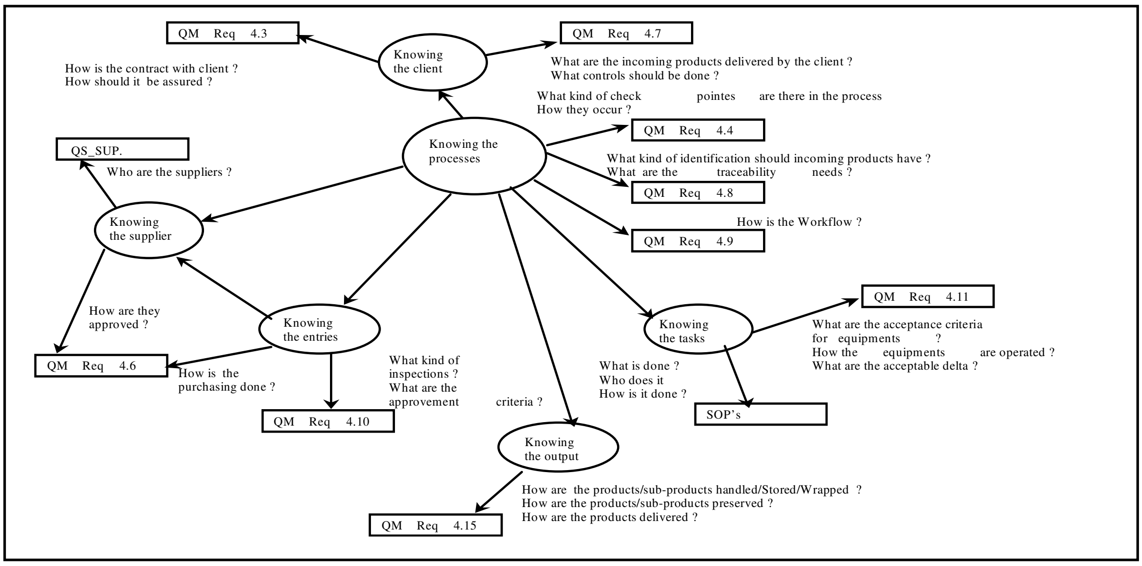

Figure 6 – Detailed conceptual model

In addition to the conceptual model, the following general heuristics were created to help the software engineer in the process of eliciting business rules:

1. Check every point in the Quality Manual that makes any mention to external clients, such as: customers, suppliers, and sub-supplier;
2. Pay attention to any information or incoming product being processed in any form. It will probably be part of a productive process and will be written somewhere in the Quality Manual. Also, there is a good chance it may reflect a business rule;
3. Check for points in the Quality Manual defining behaviors or process quality. They can point out business rules that will express non-functional requirements;
4. Once finished the search for business rules in the Quality Manual, eliminate redundancies and check for possible rules linked by functionality;
5. Check for policies (rules) expressed in the Quality Manual. It is common to find expressions like: "Company's policy for purchase is ...";
6. Check for the Keywords defined in the above mentioned sections 4.1 and 4.2.1;
7. Check for the sentence structure defined in the above mentioned section 4.2.2;
8. Check every occurrence of the patterns in sections 4.1 and 4.2;

9. Repeat the search process until no further rules can be found. Each time the search is carried out, more is learnt about the business, and the capability to elicit rules that were not observed earlier is increased

The following business rules are obtained from Figure 7:

1. **Draw sites** ask the **client** for a **medical order** with **tests** to be performed. – Section 4.3
2. The **Attendant** will enter all the required information in the system. – Section 4.3
3. The system will automatically generate **bar code labels** to the **samples.** – Section 4.3
4. The system will automatically generate a **protocol**. – Section 4.3
5. The **protocol** must have the **requested tests** and **delivering data.** – Section 4.3

And the following business rules were extract from figure 8:

6. Traceability of **Kits, reagents and controls** will be assured by using a spreadsheet containing identification of the product and **date of opening**. – Section 4.8.2
7. Each **recipient** must have a **code bar label** with its unique number. – Section 4.8.2
8. The computational system will generate a **sample number** – Section 4.8.2
9. The computational system must provide ways to check where a **sample** is now. – Section 4.8.2

Words boldfaced in the above business rules represent important symbols of the language belonging to the UofD. These symbols must be represented in the LEL with its respective notions and behavioral response. Every subject and direct object of business rules are good candidates for becoming LEL's symbols.

4.3. – Contract Review

The Draw sites will ask the client for a medical order with the tests to be realized.

The attendant checks if it is possible to deliver the patient's report in the time required by the client.

The attendant will enter all the required information in the system, which will automatically generate bar code labels for the samples and a protocol.

Once attendance is finished, a protocol is given to the client. The protocol must have the requested tests and delivering data.

Figure 7 - Example of a section 4.3 - Critical Analyses of the contract

4.8.2 - Traceability

4.8.2.1- Incoming Products Traceability

Traceability of Kits, reagents and controls will be assured by using a spreadsheet containing identification of the product and date of opening.

Each recipient must have a code bar label with its unique number. The computational system will generate a sample number for each recipient.

Traceability of samples collected from a client will be achieved by code bar reading every time a sample moves from one place to another. The computational system will provide a way to consult the position of specific samples and the places it has been to.

Figure 8 - Example of traceability requirements in a clinical laboratory

Notions and behavioral responses for each symbol must be initially searched for in the Quality Manual and its sub-products. The Quality Manual will at least be useful to point out the actors responsible for that requirement. Every actor of the UofD present in the business rules should be a symbol of the LEL (patient, collection post, distribution sector), as well as words and expressions peculiar to the domain (kits, reagents, delivering data, tests) found by the process described previously.

Figure 9 gives an example of LEL extracted from Figures 5 and 6. During a real LEL specification, all symbols arising in notions and behavioral responses must be also represented as an LEL entry.

5 - Checking LEL and Business Rules Consistency

Once the business rules and the LEL have been identified, their consistency must be verified. Towards that end, we propose the following general heuristics:

- *Every important symbol in a business rule has to be represented in LEL.*
- *Every LEL entry should be present in at least one business rule.*

When this check is carried out for the first time, many symbols present in business rules may not be present as yet in a LEL. This is the time to include them in LEL with their respective notions and behavioral responses

As this process becomes a cycle it is possible that updating a LEL brings new symbols not yet represented in business rules. This may point to some forgotten business rules.

The software engineer must be sure this symbol is not in LEL with another name. If so, he or she should update the LEL with this alias. If not, the software engineer may go back to analyze the Quality Manuals and search for the business rules related to the symbol.

Figure 9 gives one example of this. **Calibration** is a symbol that is part of the behavioral response of **Analyzer,** which is part of the notions of the symbol **tests, which** are found in business rule 2. **Analyzer** is a symbol that is not present in business rules. This could mean that there are business rules about analyzers and calibrations not found in the analyses of the Quality Manuals.

<u>**Analyzer**</u>
Notion:
- Equipment used to perform **tests**.

Behavioral response
-
- Requires **calibration**.

<u>**Bar code label**</u>
Notion:
- Used to elicit a particular **recipient.**
- Contains a unique number.
- This number is called **sample number**.

Behavioral response:
- Automatically generated by the system during **patient** data input
- Fixed the recipient by the **attendant.**
- has to be linked to one and only one **patient**.

<u>**Kits**</u>
Notion:
- Chemicals used in **analyzers** to perform specific **tests**.

Behavioral response
- Each **Kit** has a **serial number.**
- .Operator register **Kit** data and date of opening a **spreadsheet.**

<u>**Tests**</u>
Notions:
- Are performed by **analyzers.**
- A set of **tests** grouped in one **test** is called a **profile.**
- Can be performed by one or more **sectors**.

Behavioral Response
- Have **constraint rules** for admission purposes.
- **Reference values** are printed in **patient** report.

Figure 9 - Example of LEL entries extracted from business rules

On the other hand, symbols such as draw sites, samples, patient, as well as some others, have not as yet been represented in LEL and should be included. Notions and behavioral responses of these symbols may still not be completely clear to the software engineer. In this case, another analysis of the manual must be carried out, and probably, also an interview with the actor responsible for the requirement where the business rule was found.

The process of checking LEL and business rules consistency is an interactive process. Up to now, we only have very general heuristics. These will be refined as we conduct more case studies about the method in question

6 - Conclusion

This work focuses on an important aspect of business rules that is hardly addressed in the literature: how to elicit business rules. What we propose is to take ISO 9000's documentation as a starting point for rules' elicitation [Rosca 97]. Our preliminary investigations led us to believe that doing so could be significant in terms of using business rules as a source for software requirements elicitation. Since software quality can only be achieved if the requirements are met, it is very important to have a precise definition of the requirements before engaging in software production. By its very nature, ISO 9000 documentation provides guidelines for defining requirements with the necessary precision.

Our main process is described in Figure 3. It not only proposes a tentative conceptual model to elicit business rules, but also integrates business rules sentences into the LEL, a fundamental representation scheme for the requirements baseline [Leite 95][Leite 97]. Since the requirements baseline is geared towards natural language sentences, the integration of business rules into the proposed scheme is very simple, using the links established by the common vocabulary, that is the LEL.

We believe that this process can lead to an improvement in software production because ISO 9000 requires a quality system to be complete, well documented and updated. In fact, our proposal aims at reusing quality documentation produced by a quality process. We take as point of departure the already verified documentation in order to gather significant information about the business, which, in turn, will constitute a major source for eliciting the software requirements of the organization in question. However, as is obvious, our strategy should be complemented with other elicitation strategies to better describe the real requirements of a future system.

Future work will include case studies which should contribute to developing better heuristics and their automation. The basic automation support, under construction, is founded on the concept of hypertext since the requirements baseline is based on the links provided by the common vocabulary. It is also important to stress the evolutionary nature of the requirements baseline, which also matches ISO policies for maintaining the quality system. The identification of patterns present in business rules points to the possibility of building a tool to facilitate the process of finding the business rules in the Quality Manual.

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