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Improvements in the Process of Requisite Elicitation for Public Management Software: A Case Study Using Work Instructions.

Anderson de Souza Góes, José Pereira da Silva e Rodolfo Miranda de Barros

***Abstract*—Requirements elicitation is not an easy task. Different expectations between users and analysts, redundancy of information and lack of standardization can make this task difficult and conflicting. When it comes to software for the public sector this task becomes somewhat more complicated because of the constant changes in federal laws and regulations. This paper presents a case study of applying work instructions to remedy these kind of problems, as well as others found in the company where the study was carried out. We achieved very promising results, namely better utilization of human resources and reduction of job demand.**

***Index Terms*— requirements elicitation, software engineering, public management software.**

I. Introduction

Requirement elicitation is one of the most important steps for the success of software development. At the current market, in which rules and/or technologies change constantly, this specification is even more important [1,2]. A well specified requirement can be easily understood and hence, correctly developed. Nevertheless, in case it does not achieve a significant quality that allows for the correct development, we may face delays in this latter phase, causing lack of quality in the processes and even the failure of a project execution [3].

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Anderson de Souza Góes, Author, is a regular masters student at the Computer Science Department at the State University of Londrina, Brazil. Telephone: +55 43 3371-4678 Fax:+55 43 3371-4294. (e-mail: andersonsouzagoes@gmail.com).

José Pereira da Silva, author, Requirements Specification Specialist at a Software Development Company specialized in the Public Sector at Londrina, Paraná (e-mail:jps0804@gmail.com)

Rodolfo Miranda de Barros, Advisor, is a Graduate Professor at the Computer Science Department at the State University of Londrina. Telephone: +55 43 3371-4678 Fax:+55 43 3371-4294. (e-mail: rodolfo@uel.br).

In order to work in this kind of market, software companies need to use modern techniques for the elicitation of business rules inherent to this field and from them create the software that are adequate to those requisites. Hence, we can see that the pertinent mechanism to manage this flow of information may be defined by the requirement elicitation process [4, 2].

Given this context, this work brings about not only a methodology to improve the specification of requisites for software development (which would be a hard task by itself), but also develops this scenario focusing on software development for the public sector, making this challenge even more interesting, given the many difficulties associated to adapting to and following the constant changes in the Brazilian public sector [5].

Software development for the public sector is a segment where the rules come from several different departments and to manage this possible conflict during development is the responsibility of the requirement elicitations phase, in order to avoid redundancy. Given that the same requirement may be needed in many different regions around the country with different specifications. Hence, it is necessary for the participating professionals to be very skilled so that this factor becomes evident and decisions are made in order to avoid this problem and comply with the requisites.

This case study was performed in a private company at Londrina-PR which has been in the software development business for the public sector around Brazil for more than 20 years. A company that intends to work in this field, creating software that answers these needs must first become specialized, which is a complicated and difficult task. Hence, these companies face the challenge of speeding the process, without losing focus in the quality and in the observance of the existing legislation.

In order to speed up this process in those companies, an essential property is needed: information management, whether this information comes from internal or external sources. It is essential for the knowledge to be recorded in an organized fashion and duly cataloged, so that the best results are achieved [6]. Nevertheless, above all, one must seek the quality of that information, which is the largest challenge faced, given that the specialists in this field do not always present their requirements in a clear and ideal way.

In order to face this challenge, this work intends to present a process model that can help the entire software development for the public sector area. We will do that through the creation of work instruction, attributing new roles, creating norms for the work flow and changing the behavior of the whole team. The public sector is a very specific area because of its specific and complex business rules. Hence, there is a diversity of contexts for the gathering of technical information for its systems. This, combined with the huge amount of information, makes this problem even more complex and a huge challenge during its development.

This article is organized as follows. Section II presents the research methodology we used and related works. Section III contains a theoretical review on the state of the art of the following topics: requirement elicitation, public sector software and work instructions. Section IV describes the current state of the software company as the prior model, specifying its whole structure and workflow in a general way. Section V describes the model we developed and applied during this case study. Section VI presents the results of the application of our model and finally, section VII concludes with general thoughts on the model application and future work.

I. Related works and research methodology

Several studies were performed in the requirement elicitation field, so that it is able to expand requisite engineering. These studies reinforce the importance and the complexity of this area in projects, showing that it is necessary to use engineering techniques in development projects and to emphasize the real necessity of this very important task. In this section we will present some of the research that is related to the research methodology used in the development of this paper.

A. Related Work

In order to reinforce the theoretical review that Will be described in section III, we have also performed a literature search for work related to the theme developed in this paper.

In this literature research we found no work that dealt specifically with the idea of using work instructions to improve requisite elicitation. Nevertheless, we found several similar researches that intend to improve the requirement elicitation in one way or the other and those papers will be discussed in this section.

We performed this search in several scientific bases, including *IEEE Xplore, ACM Library, Science Direct and Scopus.*

The work presented in [2] uses the function and the knowledge of the stakeholders to define and execute an improvement identification process during the requirement elicitation phase. Using the experience of the stakeholders to determine a method that can leverage the improvements in this phase, this work was able to obtain significant improvement in his processes.

Raspotnig and Opdahl [3] present an interesting work on the comparison of the literature on the widely used techniques in the requirement elicitation phase with the goal of identifying the best of them. Since our proposal is to improve the require elicitation process for public sector software development, both studies [2] and [3] converge to a common result, that the opinion of analysts and managers responsible for the requirement elicitation phase contribute significantly for the application of techniques and methodologies which intend to improve this practice.

De Gea et al [4] defend using tools to help the requirement elicitation phase but did not limit itself to this idea, for they also realized that the application of methodologies can also improve this practice.

Two different studies [8,9] use the intelligence embedded in the company social processes through the mapping of the usability of the techniques use to elicit requirements. This relates this work to the one present above [4] and to the methodology used in that paper.

Sajid [10] defends using four techniques to elicit requirements, calling them the conversation, observation, analytic and synthetic methods. Each of these methods represents a way to help the requirement elicitation process.

The conversation method includes the idea of performing an analysis of the main areas where improvement is required and the analytic method includes the idea of putting into practice the ideas found with the conversation method. This paper also states that the practice of these methods allows to establishing a high quality requirement elicitation process, which was effectively demonstrated in our work, especially in the application and execution of the two methods described in order to develop work instructions.

The last paper mentioned in this section is the work of Klenz et al [11], which builds a framework and a tool to help the requirement elicitation process. According to this work, this model helps and directs in a general way the best ways and methods to elicit the requirements.

All the papers mentioned in this section have the common goal of proposing methods and ways to generally improve the requirement elicitation process. This goal is compatible with the main goal of our paper, which can be characterized by the usage of work instructions.

B. *Research Methodology*

The research methodology used in this work serves as the basis for the creation of the case study [7]. We intended to improve software development for the public sector but found no specific model for this type of approach. Hence, we adopted a research methodology specified and developed by GAIA, the software factory of the Computer Science Department at the University of Londrina. More details about it can be found at http://www.gaia.uel.br/gaia_PDS/PDS.htm.

The methodology developed and applied at GAIA supplies the general foundation for any scientific application that concerns software development and the application of its model in a case study. This methodology is presented in Figure 1.

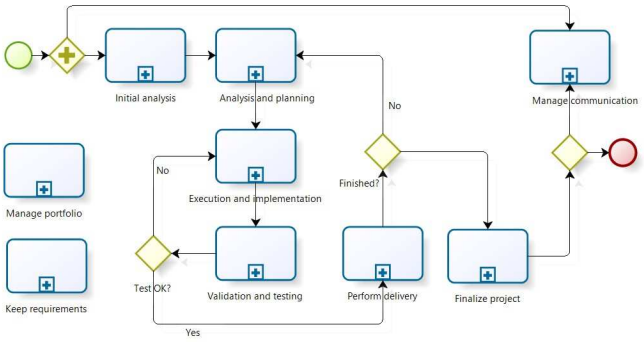


Fig. 1. Research and Development Methodology used for the Software GAIA.

According to Figure 1, we have 9 application levels. The process starts with the macro-activity Initial Analysis, when the project scope is defined in meetings with the customers. Next, we find the activity Analysis and Planning, referring to the building of a general plan for the project development and information recording through the project plan.

The next step is Execution and Planning, where the project development and execution begins. Soon afterwards, we have the Validation and Tests step, which define whether the project follows to Delivery or must return to Execution and Implementation in order to solve inconsistencies and/or problems found during tests.

In case the work was perfectly done, the next step is Finalize the Project. Together with the tasks above, there are three tasks which work in parallel whose main responsibility is to assure coherence and correct project development through its life cycle. These tasks are Manage Portfolio, Requisite Maintenance and Communication Management. Since the main focus of our research is requisite elicitation, the task Requisite Maintenance will be expanded in Figure 2.

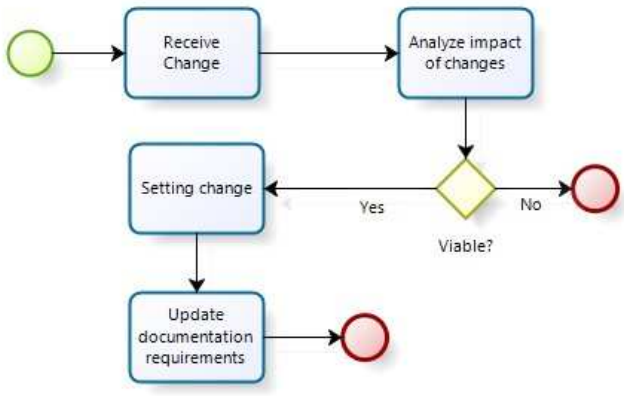


Fig. 2. Requirement Management with the GAIA Methodology.

Figure 2 shows us the main flow of requisite management which is divided into four main tasks. The first, “Receive Change” refers to the changes which are required by the customer. The second, “Analyze Impact of the Change”, is where the change requirement is evaluated by a team made up of analysts, developers and project managers, which verifies whether the proposal is viable. If the proposal is deemed viable, we begin the next phase of the project, “Define Change”.

Another information presented by Figure 2 is that in this phase of the project is defined the timing and method for the execution of this change and also a measurement of its impact in the whole system, by performing a structural evaluation of its execution. Finally, after these projects are finished the last phase, “Update Requisite Documentation”, begins. In this phase we update the necessary documentation for each change performed in the initial requirement.

These processes will be further described in the development of our model, showing the real need for each application task inside requirement elicitation.

II. Literature Review

In this literature review we analyzed the most recent papers published in the last four years which were published in the higest quality and visibility scientific bases, such as IEEE *Xplore*, ACM *Library*, *Scopus*, *Science Direct*, and others. Our goal was to express the real state of the art of the fundamental and structural parts of this work. , Hence, we were able to build a strong and consolidated foundation about the definitions and terms which will be approached throughout this paper.

A. *Requirement Elicitation*

According to [8, 12] requirement elicitation is the initial phase in the process of software development, in which a market research is systemically performed in order to find, organize and track the characteristics of a system. These reference also state that this phase can be understood as the set

of techniques used to determine, detail, document and validate requisites for a information systems product. Hence, we can define requisite management as the software engineering area which deals with the application of techniques and methods that connect the needs to the solution.

Requisite elicitation is a long process with intense activities for knowledge capture, combination and dissemination [9,13]. During this phase, all those involved in the process exchange information on the context and on the activities which will be supported by the software under development. Different points of view, mind models and divergent expectations between users and analysts make this phase rather difficult and full of conflict. In many cases, the user is not even aware of its real needs.

All those facts stated above turn requisite elicitation into a complex and risky activity, whose result may be incomplete or inconsistent requisites [14]. Shen et al. [15] state that the problems in this phase are responsible for 55% of the hurdles in computer systems and 82% of the effort related to error correction is directly connected to this phase. Hence, we can say that requisites are the foundation for every project, characterizing what customers need to use of modify in a system and how it must perform.

This importance is real not only during software development, but also for any process that includes the development of new software artifacts [9,14]. In order to have requisites that really describe the intended system, it is necessary for them to be duly elicited. Among the activities that are included in achieving this goal we mention business domain, requisite capture and classification, priorities definition, conflict resolution, ambiguity and inconsistency verification and finally, system requisites negotiation.

Many techniques were proposed to help some of those activities [16], always considering that the main parameter for the evaluation of a requisite engineering phase is the level of understanding and precision that the system developers have on the expectations of the stakeholders. If this vision is not precise, the resulting system will not satisfy the needs and expectations of the customers. The satisfaction level is the most important and final indicator of the quality of a computer system, and the one most influenced by the quality of the requisites.

Following this idea, one of the best known methods for system specification is JAD (*Joint Application Development*) [17]. JAD is a genetic term that describes several methods to conduct workshops between customers and developers who work together is all development phase, including requisite elicitation. Its main approach is to use a dynamic group of techniques to facilitate workshop sessions. This technique has been widely used but there is no conclusive study on its efficacy in generating complete and precise requisites.

Another set of methods used are the point of views oriented to technique [18]. This technique considers that each stakeholder to the project can foresee the future system under different perspectives. Hence, the techniques try to capture those different points of view. One example of this method is VORD (*Viewpoint Oriented Requirements Definition*) [19], where different points of view are defined and structured under the supervision of the analyst (and not in a collaborative fashion). This may cause details that were considered very important to be lost during the integration phase.

Besides the ones mentioned, another well known method for requisite elicitation is the use of scenarios, which are used to improve the communication among the parts involved in the system specification [18]. Its usage has been very useful in the identification and communication of requisites. There are many approached base on scenarios for requisite elicitation such as event scenarios and use case. The latter is widely used in the software industry.

B. Software for the Public Sector

Developing software for the public sector requires a lot of attention and concentration. The rules that are inherent to this type of business come from several sources, the main one being national legislation. These rules establish the principles that are applied to the public sector referring mainly to accounting, human resources, taxes, social security, internal controls, council, public health, public education and others [20, 21].

According to [22], these rules are created by the Brazilian legislative organs of all levels (federal, state and municipalities). Verification is the obligation of the Accounting Tribunals, Legislative houses, Public Attorney, Municipal Councils and every citizen.

Besides those facts, there is still an important need of the Brazilian public sector to become more normal in order to comply with international standards. Dáros and Pereira [5] stress this fact by pointing out the International Public Sector Accounting Standards that define new accounting standards for the public sector making it define efforts and resources in order for the process of evolution in the public sector becomes

Fig. 3. Organizational Structure of the Company

as fast as possible. Hence, there is a great expectation for results in this market.

In this context, we need a criterion for the correct interpretation of business rules, given that errors in this phase may cause technical and structural problems that become unacceptable in the future, during the development and the deployment of the system. These errors may also incur in very high costs especially those related to rework. Also in this scenario, the constant change of Brazilian legislation is a reality because in the current national legislation world there is a great tendency toward constant change.

Hence, the organization must always be alert to these changes in order to adapt quickly. The main goal must always be to make sure that the software customers are able to comply with legislation that is imposed to them and the huge amount of data that they must deal with. A software factory must worry with the reception and the standardization of those data, applying techniques that demonstrate how each situation is progressing in order to present the answer the final customer is hoping to receive.

Shen et al. [15] state that it is also inherent to this area the need for systems to be fully integrated in order to share information and use similar work routines among the many different areas. This project complies with this idea using the idea that the constant change in norms and regulations in the public sector must be embedded in the requite elicitation through work instructions.

C. *Work Instructions*

Formal process management and quality control programs have been widely adopted by the industry, and a good example of those is Total Quality Management. Work instructions, also called standardized operational procedures are also a common component of those programs. These instructions focus on decreasing the variations that occur when different professionals execute the same task in different ways [23].

Hence, work instructions can be considered as a set of procedures that describe the step by step instructions as how to finish a certain task [23,24]. This set of instructions gives the employee a detailed description of how to deal with a specific task within his job [23]. This type of technique is widely used in the industry and in the service sector, as well as in the development of systems for medical services, nuclear power plants, manufacturing, educational services and many other [23,24].

Manghani [24] states that using work instruction simplifies activities and increases productivity. Based on that, he also lists dome of the key benefits to the business offered by the use of those instructions:

- Descreasing the learning curve/training time for new employees;
- Assures the business continuity (the business does not stop because of an employee, given that another can perform his job);
- Standardizes the process;
- Improves the understanding between different areas;
- Makes it easier to delegate tasks;
- Assures bigger safety to client, due to the existence of standardized procedures;

It is recommended that the instructions are derived from a consensus among the stakeholders, business experts and/or consultants. This document is indicated for common and repetitive use, establishing rules, guidelines and activities characteristics or results, in order to promote transparency, consistency, reproducibility, permutability and ease of communication [24].

Manghani [24] also states that work instructions bring many benefits, if they are duly applied and become a company standard. In case this does not happen, they may be as inefficient and the oral transference of information, causing an increase in training time, high failure ratio and lack of quality, among other consequences.

Given the benefits and the recommendations about work instructions, we came to the conclusion that they are quick to implement and possibly bring promising results. Hence, in order to test the efficacy of this technique within a company, we created a normative work instruction to standardize the activities of requisite elicitation in a simple and efficient way. This area was suffering from several problems that came from different sources and which, according to our vision, could be solved by the adoption of a few standardized procedures.

III. Prior Model and Case Study Application

In order to provide the needed practical subsidies, we performed a case study in a Londrina/PR software development company specialized in the public sector. We noticed first that this software factory had a formal structure which demonstrated clearly the entire life cycle of a software system and had some characteristics and problems in its process, as we will present in the item diagnosis that follows.

A. *Formal Structure*

The company where we applied this Project presents a software life cycle and parallel to that, a department structure where it is possible to realize the roles and the phases of the systems in sectors that are located in physically separated places. These sectors are called External Relationship, Projects, Development, Quality and Distribution, as we can see in Figure 3.

According to this figure, we can see the existence of a specific organization that is responsible for requisite elicitation for software creation, which is called “External Relationship Sector”. This sector was, consequently, selected as the main goal of this study. As we come into contact with the reality of this department, we can see the characteristics that are inherent

to its work routine, which we describe in the following items.

B. Human Resources

The External Relationship Department has five employees. The company sought professionals knowledgeable on the business rules of the public sector and also professionals that had an IT background.

In this department there is a professional with a law and accounting background and another with an IT background, both with several years of experience as requisite analysts for the public sector. The job for a company analyst includes requisite elicitation and project development as a whole, tasks that belong to the External Relationship and the Project departments. The rest of the team includes two professionals with an IT background helping the requisite elicitation process and one with experience in customer support. All the professionals split the functions keeping in mind the goal of fully answering the existing demand.

C. Work Methodology

In this section we will describe the practices formerly adopted by the requisite elicitation team. This process treated all the demands from the customers using a proprietary system in the format of a CRM (Customer Relationship Management) where all requirements from internal and external public are recorded. After that input, the team begins to work each issue individually, a process that was called triage.

In the triage process, when the demand is clearly specified the team elicits its requirements and forwards it to the next department in the factory organizational structure (the project department), following the demand until its conclusion and liberation. If the demand is not acceptable, it is terminated and the system will inform the customer on the event. There is also the alternative that allows the team to get in touch with the customer in order to obtain further information and clear doubts in order to answer to the demand.

This procedure is quite slow, specially due to the fact that there is no formal process that stops demands that have no conditions for analysis. Hence, there was a great work demand for all the members of the team and they spent a lot of time trying to understand what the customers were effectively demanding. Hence, there were lots of resources being wasted, delaying the demands.

Part of this delay was caused by the way the requisite elicitation was performed. In most complex cases a document called “business vision” was created to present textually the needs for that demand and which tried to prevent any difficulties in understanding from the other departments in the company.

The analysts supported the five branches and six representatives of the company, which were distributed in many regions across the country. Usually, this was a job for the requisite analysts, due to the fact that they were the most experienced professionals in the department. This work takes a large portion of the work day from those analysts, hindering the sector’s performance.

Besides, another fact that called our attention was the high flux of demands coming from the external public, causing a stock of solicitations in the CRM whose answer was being wait by the public since the department team could no deal with all the existing demand in due time. This situation stressed the relationship between the department and the rest of the company and specially the final customer. In Table I we can see the numbers of this sector as determined empirically in April/2012.

TABLE I
DATA FROM THE EXTERNAL RELATIONSHIP DEPARTMENT. SOURCE: DATA EXTRACTED FROM THE EXTERNAL RELATIONSHIP DEPARTMENT IN APRIL 2012.

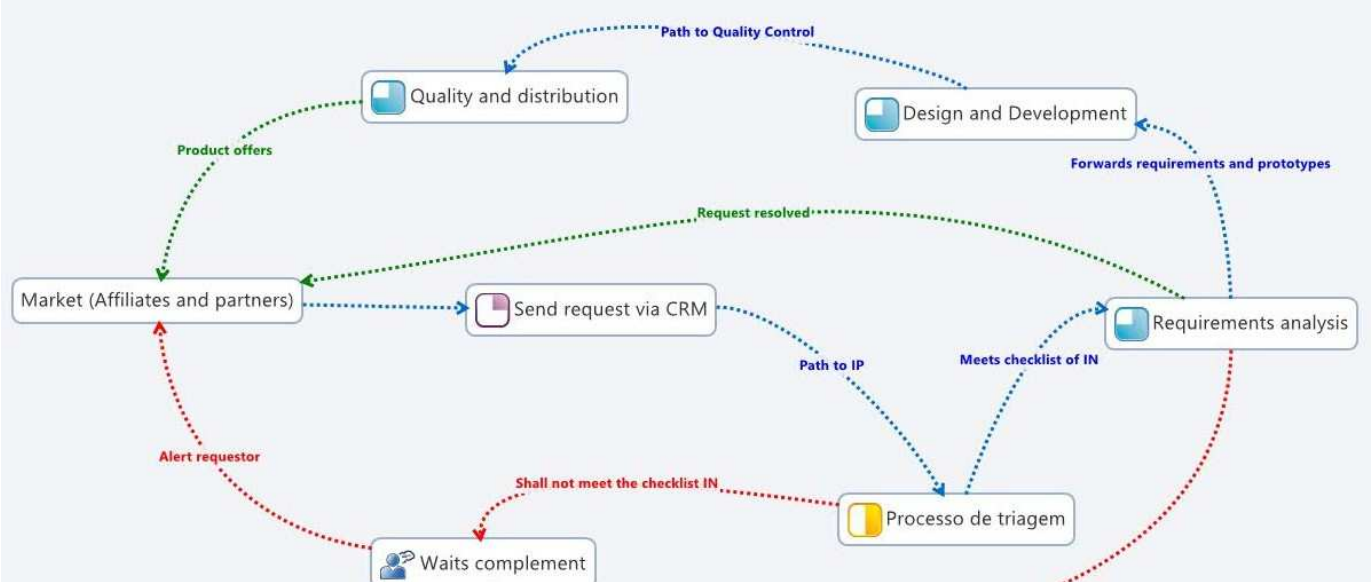
Description	Amount
New requirements per day	30
Requirements analyzed by the team each day.	15
Stock of requirements waiting for analysis.	200
Telephone calls received for information on requirements.	180
Telephone calls made for clearing of doubts on requirements.	86

According to Table I, we can see that even though the company has a quite large number of professionals, the demand is about 100% greater than its production capacity. Given that out of the 30 daily incoming requirements the company manages to analyze only 15, there is a stock of about 200 demands waiting for analysis. This fact is justified in part by the lack of a process able to identify and stop requirements that are repeated or that cannot be analyzed.

D. Internal Communication.

Another problem we found in the company is related to the internal communication problems within the group, specially due to the External Relationship Department need to constantly keep in touch with the other departments and most of all, with the customer base. We realized that there was a relational problem especially in the communiqué sent by the CRM when doubts still remained in a requirement and questions were asked in order to clear them out.

At that moment an e-mail was sent to the customer where it was said that the demand was withdrawn for clarification. It became clear that in spite of the fact that it was being sent form complementation, the customer often did not understand that because usually there was no information to complement the requirement. Given this frequent lack of information for specification, it becomes clear that there is a need for the creation of techniques and/or mechanisms that standardize this relationship and avoid the friction due to this interaction.



IV. Proposed Model and Case Study Application

Given the case we described, it was a consensus that we needed to implement changes to improve the existing process. This improvement was responsibility of the External Relationship department, given its main role in the process. The improvement goals were to arrive at a requisite elicitation process quicker, with more quality and hat produced results closer to the client expectations. If those goals were achieved, the communication between the company and its customer base would be improved.

Figure 4 shows all the existing phases for the execution of a service demand inside the company. It will be explained throughout this section, giving a complete vision of the entire software production cycle for this company, giving special emphasis on the External Relationship Sector. Given that this is where the requisite elicitation team works, it is the only channel for demand input. Figure 4 intends to show the systemic communication between the factory and its customer base, that should generate benefits such as speed and clarity for each demand processed.

In order to correctly answer to the demand described we created a work instruction that seeks to attack the problems found in the sector responsible for requisite elicitation. We approached several problems and their possible solutions, making it possible to measure the results and cause a constant improvement in the process.

The Work Instruction was divided into action groups in order to bring clarity on the requisite elicitation process for the actors. It presents a division in the demand treatment, creating a previous analysis that will verify only the formal aspect of the demand (a checklist). In this phase the content of the demand will not be verified – only the fact whether it contains some important formal requisites that are inherent to each type of request. Only if the demand passes this phase, the content of the demand will be duly analyzed. Hence, if a demand is incomplete or is repeated, it will be cancelled even before entering the solicitation stock.

This normative instrument is organized so that it can attack the detected problems, seeking to treat individually each problem situation that may exist in this phase of the system construction. The instruction intends to be as close as possible to the existing way of working in this department, in order to minimize its impact in the daily routine.

The instruction's goal concerns the documentation for requisite elicitation. Given the author's decision not to mention the company's name and to not identify it, this item will be described only as (5.2.1), which is described as the following:

> Item 5.2.1 with the description "Formal requisites according to demand type", has a subitem 5.2.1.1 whose title is "Demands for software change (errors/improvements)" where it describes the mandatory characteristics of this type of demand, which are: client name, system to be changed, version of the system under use, application to change, declaration of the change type (error or improvement), detailed description of the problem, emphasizing that each demand must deal with a single issue, contain a justification (when it is an improvement) and present examples or procedures to reproduce the situation, indicate a database to identify the real case, include attachments such as images and documents that aver to the change and also authorization from management when the change is going to cause impact in other departments of the customer, such as finances, administration or others.

In this first part of the Work Instruction (5.2.1.1), our goal is only to improve the initial step of every demand of software change, given that this is the biggest type of demand for the company under study. We can see that the procedures described can increase the speed of this phase with a quicker and formal analysis, for the demand that does not possess the minimal requirements will be returned to the customer for correction. It is important to stress that even with the described

norm, these terms were not mandatory. Henceforth, they are mandatory for each demand that arrives for scrutiny.

This change will bring objectivity to the solution and will not demand full technical knowledge from the responsible collaborator, allowing him to provide a feedback to the customer in a reasonable time frame. Hence, the regulating piece in the formal analysis phase worried only about items whose nature was related only to the process and whose absence in the demand would make it harder to materially verify the request.

We can also see that this is a initial filter that will make the approved requests to be of more quality. Besides, it will not give the customer the false impression that the problem is under analysis only because it was register. On the contrary, it will clearly state that the customer needs to specify his needs more clearly. This reaction will make the customer analyze his request more carefully and many issues may become unnecessary or nonexistent.

We also implemented in the request reception system some routines that will improve the quality of the request by giving the user immediate feedback. These routines should alert about situations such as similar or equal texts in different fields (which characterizes the use of cut and paste) and also verify if the user was using a version that was older than the one being marketed or if there are examples for the errors and justification for improvements, as well as warn against the lack of attachments.

We can come to the conclusion that the clear differentiation between formal and material analysis will allow for a smaller number of professionals enrolled in the process even before it can be effectively treated. Therefore, there will be a significative decrease in the costs, for the requests will be forwarded to the more experiences professionals already with the minimum amount of information needed to analyze and specify requisites.

During the study of the process for our case study, we also perceived the existence of indirect requests that come through the same channel (the CRM). Hence, we decided to create a norm for this issue. The item 5.2.1.2 of Work Instruction 002/2012 dealt specifically with this issue (requests related to licensing). They became subject to the same criterion of formal analysis, adjusted for its special characteristics. Hence, they started to be forwarded directly to the sector that is responsible for the distribution of products, stopping to cause an impact in the routine of the requisite analysts.

With the implementation of this norm, we tried to make clearer the roles of the collaborators in the External Relationship department and also created a structure for the communication with the other departments in the company.

The requisite analysts stopped dealing directly with the other sectors and a new pre-support phase was created to define the type of issue, create a protocol number for the request and provide information on an already existing possible solution, in order to try to point the users to other channels to solve the problem, obtain clear information already available at the system and other issues. Hence, we expect to decrease drastically the amount of time spent in dialoguing with the market by establishing a systemic communication.

Besides, it becomes clear at the work instruction that after the formal analysis phase the request will be analyzed by the requisite analysts. They will observe the materiality of the request and will be able to close the request or forward it for further information in case of incoherence, lack of clarity, resolve or nonexistent problem, among other reasons. In this case, the customer will receive an automatic communiqué for him to respond.

When the request is deemed acceptable, the responsible collaborator will elicit all requisites, in order to make it clear the need for change, indicating or suggesting the artifacts to be used and forwarding the issue to the Department of Projects. From that moment on, the best ways to solve the problem will be studied and analyzed and the request will follow its flow until delivery to the customer, when he will be officially communicated about the issue resolution.

In our study on improving the process, we also approached and created norms for issues related to extraordinary situations that reside outside the normal request flow. In this study we already listed issues such as reopening of already closed request and early release of requests to the market, and such issues were dealt with topics 6 and 7 of Work Instruction 002/2012.

This Work Instruction was created as a case study and when dealing with the reopening of a closed request, it first make explicit that there is not request review possibility, given that it was already duly dealt with by the factory and forward to the client for him to use. Nevertheless, there is an exception to the rule, in case there is no satisfactory response to the request then the issue can be reopened for analysis. Nevertheless, for this option to be effective, especially for the problem to be mapped and the history of the issue is correctly kept the norm presents some necessary conditions.

For an issue to be reopened, according to item 6.1.1, there should be a formal communiqué that will be made by a collaborator who is superiorly ranked to the one who made the request. He must establish the grounds to the request, proving that the original request was not correctly dealt with. With this item, it will be possible for the company to realize where resides the mistake in the way the problem was dealt with, allowing for improvement in the whole process.

When the market refuses the solution and gives a proper reason, the request will be reopened by the External Relationship department, being duly flagged as already treated and not solved. Hence, a new analysis of the problem is performed. If the request is considered valid, it will be forwarded to the next sectors, which will perform the correct process to solve it. In this type of situation an internal memo will be sent to the other sectors with the subject containing the terms “termination refused by customers”, information that will make the other departments to see this issue as a priority, given that it is a rework.

Item 07 of Work Instruction 002/2012 presents the regulation for another exceptional situation, the early release of requests to the market. First, the rule stipulates that every release will be done through the version calendar, defined by the department of Quality Control and Distribution. Nevertheless, in exceptional cases there may be an early release of an application.

In these extraordinary cases, when there is an urgency that justifies the early release of an application outside the official version calendar, there must be an official request by the unit responsible for servicing the customer. This request will present in a clear way the arguments for this need and will try to prove that the market cannot wait for the resolution of the problem without causing problems to its activities.

This request will be done to the External Relationship department, which will receive it and immediately analyze it. Next, it will forward to the area responsible for releasing the applications (the Quality Control and Distribution department), which will be responsible for the effective releasing the application. If the request is accepted the application will be forwarded to the External Relationship Department which will release it to the customer. If the request is denied, the customer will receive information concerning the denial.

The regulation changes the communication between the software factory and the customer, specifically concerning requests that are forwarded for further information. Whenever there is a need for complementation of information on a specific request, this request will be returned to the customer, making it clear that the devolution occurs for completion sake. Whenever the information is complemented, the customer is allowed to send it to analysis again..

On the other hand, when the request is technically consistent, it will be evaluated by the requisite analyst which will perform a complete study on the problem, analyzing the possible impacts on other modules, as well as its economic and technical viability. Next, the documents are built containing the specification of requisites and the respective prototypes to guide the application construction, finalizing the initial request made by the client.

V. RESULTS

Soon after the creation and approval of Work Instruction 002/2012, we started the initial deployment where first we showed the document to all process participants (members of the company and its units). In this phase of making the document known we made it clear that the idea was not making the process more bureaucratic but exactly the opposite, the application of these changes would increase the quality of work and the relationship among participants.

It was made clear that the goal was to implement a systemic concept in the relationship between market and company and that requisites would be treated with more professionalism and formality with the utmost goal of keeping a strong control of the business rules and also achieve more results on the issue of final customer satisfaction, besides bringing more quality to the requisite elicitation process.

At first the implantation of the rules caused some difficulties related to adaptation, due to the fact that this was a new reality. There was an impact in the routine of all those involved and all of them had to adapt to change. Nevertheless, as time passed, the routines were implemented and members of the team understood that the changes would be extremely important for the continuous improvement of the process especially when the first results came.

The results were quite evident after the second month of implementing Work Instruction 002/2012. We can see from Table II that there was a major improvement in the results of the External Relationship department, the major responsible for requisite elicitation in the software factory. In that table we can see the numbers from this department according to a research done in June/2012.

Analyzing Table II we can see from the first two lines that even though they were not analyzed by the staff, all requests passed through triage and were forwarded from clarification or directly to the analysts. We can also see that the number of requests analyzed by the team increased 33%. Before the process of classification, the company could analyze up to 15 instructions per day, a number that increased to 20. Lines 3 and 4 of Table II show a gratifying decrease of more than 50% in a single month of the number of requests forwarded each day to the customer for clarification

TABLE II
DATA FROM THE EXTERNAL RELATIONSHIP DEPARTMENT. SOURCE: DATA EXTRACTED FROM THE EXTERNAL RELATIONSHIP DEPARTMENT IN JUNE 2012.

Description	Amount
New requirements per day	30
Requirements that pass through the triage process per day	30
Requirements forwarded for doubt cleating per day in the first month	12
Requirements forwarded for doubt cleating per day in the second month	5
Requirements analyzed per day by the team	20
Stock of requirements waiting for analysis	20
Telephone calls received for information on requirements.	120
Telephone calls made for clearing of doubts on requirements.	22
Requirements with “waiting for response” status	150
Requirements that are answered and sent over again by the customer	60
Requirements that were closed by the customers after being sent out for doubt clearing.	60

We can also see in Table II a decrease of 90% in the number of requests in stock (beforehand, there were 200 of them and now there is an average of 20). Another important fact is the decrease of calls for information on requests, from 180 to 120 (a 34% reduction) and also a decrease in the number of calls for further information on requests, from 86 to 22 (an 80% reduction), which was due to the fact that the requests arrived for analysis more complete.

There are also requests that are cancelled by the customer himself after they were sent back for further clarification. This was due to the fact that many times the customer discovered that the request had already been made by another coworker of his, his version was outdated and the newer one already solved the issue or the request was under development. In other cases the customer gave up the request because he could not catalog it or explain what he really wanted, making evident that he had a problem when filling the request.

Finally, we can realize in Table II that there was a general and significant improvement in the requisite elicitation process in the company under study after Work Instruction 02/2012 was implemented and regulated the process of input and treatment of business rules in the factory. It allowed for much better results than the ones previously achieved, what is evidence of the efficacy of the implemented procedures which will also become subject to continuous improvement.

VI. Conclusion

This study reiterates the importance of requisite elicitation, which is a phase of utmost importance in the software development process. Applying good practices in this phase may cause a huge gain in quality and precision when responding the needs of the final customer, for there will be a bigger correspondence between what the market desires and the applications that are built.

During our work we detected that the company under study had several problems. One of the most important was the vulnerability of the treatment of business rules coming from the external customers. We also noticed that it was in this organization best interest the improvement of this process, for this information is extremely important in this kind of activity (system development for the public sector).

Our main goal was to channel in the best way possible the input of this information in order for all knowledge coming from internal and external customers could pass through a single channel and receive the due treatment in order for this information to become software requisites with the due consistence and legality and avoiding redundancies for several different regions of the countries and for the company to become as close as possible to what the market aspires.

The application of this process was performed in the main company system daily by the collaborators responsible for requisite elicitation, making all users to use them and identify themselves with the system improvement process. Another important aspect refers to the way the questionnaires were applied and how the results were measures, using quality and applicability metrics and outlining possible improvements that can be implemented in this model.

Hence, we could notice that the implemented artifacts caused a relevant improvement in the requisite elicitation process. These improvements could be seen in the second month after the implementation of the norms. We also notice that part of the success achieve was due to the research and implementation that took into consideration the reality of the company, which could also measure the results achieved and become able to achieve a continuous improvement in the requisite elicitation process.

Future works include expand and generalize this work for whatever organization that develops software, either in the public or private sector, as this models matures in the company under study. Hence, we can develop a generalized model for the requisite elicitation phase in all areas and segments, contributing in an efficient and effective way to the software development process.

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