Computer Science and Information Systems 11(2):461–480 DOI: 10.2298/CSIS130117031C

Collaborative Method to Maintain Business Process Models Updated

Nuno Castela[1], Paulo Dias[2], Marielba Zacarias[3], and José M. Tribolet[4]

[1] Center for Organizational Design and Engineering, INESC INOVAÇÃO, Rua Alves Redol, nº 9, 1000-029 Lisbon, Portugal
Polytechnic Institute of Castelo Branco, Technology School, Av. Empresário, 6000-767 Castelo Branco, Portugal
ncastela@ipcb.pt
[2] Polytechnic Institute of Castelo Branco, Av. Pedro Álvares Cabral n.º 12 6000-084 Castelo Branco, Portugal
paulo.dias@ipcb.pt
[3] Center for Organizational Design and Engineering, INESC INOVAÇÃO, Rua Alves Redol, nº 9, 1000-029 Lisbon, Portugal
Research Center for Spatial and Organizational Dynamics, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal
mzacaria@ualg.pt
[4] Center for Organizational Design and Engineering, INESC INOVAÇÃO, Rua Alves Redol, nº 9, 1000-029 Lisbon, Portugal
Dep. of Information Systems and Computer Science, IST, University of Lisbon, Campus Alameda, Av. Rovisco Pais, 1, 1049-001 Lisbon, Portugal
jose.tribolet@inesc.pt

Abstract. Business process models are often forgotten after their creation and its representation is not usually updated. This appears to be negative as processes evolve over time. This paper discusses the issue of business process models maintenance through the definition of a collaborative method that creates interaction contexts enabling business actors to discuss about business processes, sharing business knowledge. The collaboration method extends the discussion about existing process representations to all stakeholders promoting their update. This collaborative method contributes to improve business process models, allowing updates based in change proposals and discussions, using a groupware tool that was developed. Four case studies were developed in real organizational environment. We came to the conclusion that the defined method and the developed tool can help organizations to maintain a business process model updated based on the inputs and consequent discussions taken by the organizational actors who participate in the processes.

Keywords: collaborative business process updating method, groupware modeling tool, shared business process models.

1. Introduction

This work defines an organizational support method to explicitly describe the steps and participants involved in the dynamic updating of business processes models, in which organizational actors monitor the activities they perform in order to propose updates to the models. These updates are made to models, using annotations, in order to establish a conversation between the involved actors. The proposed updates are reviewed and evaluated by the actors involved in the business process context (each one with his own role) and may lead to the creation of new versions of business process models (updated models).

Considering that enterprise models represent several aspects, views or perspectives of organizations, and that the business processes view is one of the most important of enterprise models because it shows the activities flow as well as its informational inputs and outputs, we believe that the business process model could be used permanently as a support for a variety of operational and management tasks if it could provide an accurate representation of the current business processes. This support could be accomplished because business process models could take advantage of its ability to capture, represent and distribute organizational knowledge. However, business process models have been used primarily to support sporadic organizational tasks, rather than serve as a repository of organizational knowledge to withstand the daily organizational tasks [1].

The model as an updated repository may facilitate the collection and sharing of organizational knowledge making it in an essential tool for implementing learning organizations and materializing organizational self awareness. In order to do this, we developed a method to continuously update the as-is process model and to ensure its connection with the "organizational reality" shared by its members in business process contexts.

This work led to questions related with the conversation/negotiation among organizational actors and between the actors and the “organizational representation”, in order to maintain the as-is model updated. It was empirically observed that the as-is model is not usually updated in organizations despite being an important organizational asset, causing a permanent misalignment between the processes represented and implemented in real life. This observation was later supported by bibliographic revision carried in the course of this work.

Based on the theoretical framework and preliminary empirical evidence, this work seeks to answer the following questions: (1) is the annotation an appropriate mechanism to establish a conversation between the actors and the as-is business process model? If so, its extensions (reviews and evaluations) are appropriated to promote the negotiation between the organizational actors involved in the operational processes where changes are required? (2) Can the organizational actors, using a collaborative process and an appropriate supporting tool, become the modelers of their own organization in a collaborative way?

This work is related with the area of information systems and was guided by the design research methodology [2]. Figure 1 shows the steps of the methodology as well as the expected results in each step for this work.

The first step was designed to recognize problem; the outputs for this step were the work proposal and research questions.

Additionally, it was made an attempt to elaborate the project, which was closely linked with the outcome of the previous stage; the outputs in this work for this step are (1) the key ideas of the method to collaboratively and dynamically update the as-is business process model (that we named PROASIS) and (2) the requirements definition of the tool for monitoring and annotation of processes and activities (that we named MAPA).

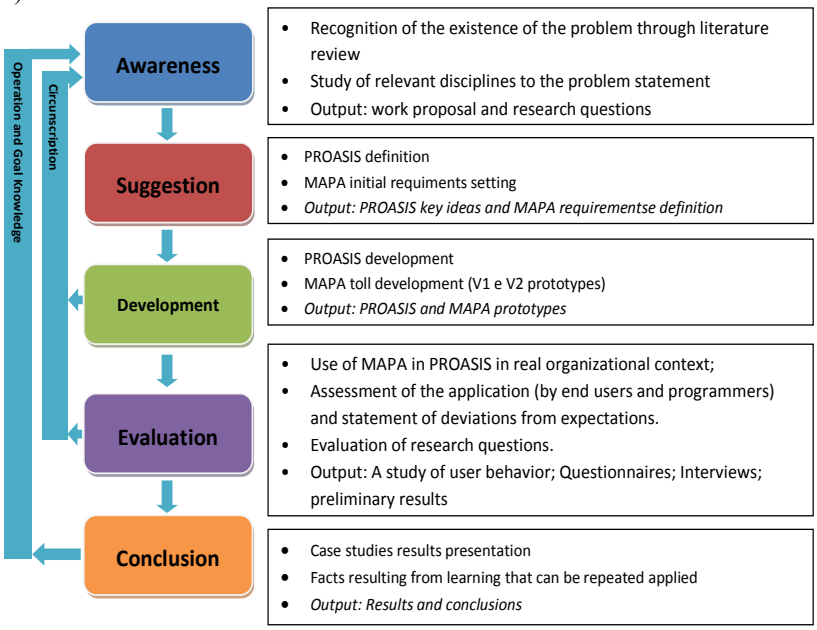

Fig. 1. Design Research Methodology

In addition, we made an attempt to implement the project; the outputs for this step are PROASIS and MAPA.

Once built, these artifacts were evaluated on the evaluation step, through case studies; the outputs for this step are the answers to the interviews, the tool information analysis and some empirical observations.

Finally, in the conclusion step, the overall results and conclusions are presented.

The rest of the paper is structured as follows. Next two sections present the background information and related work to help in the awareness of the problem. Suggestion and development sections define PROASIS and MAPA. The evaluation section presents the case studies carried out in real organizational environment. The results section presents and analyzes the results of case studies. Finally, the conclusion section presents the overall conclusions of this work and points some suggestions for future work..

2. Background

The social, organizational and management sciences have a long tradition in organization modeling [3]. The main purpose of organizational models is to provide analysis forms that enable organizations to produce management theories and principles, and to provide descriptions of the nature, structure and dynamics of organizations.

Morgan [4] defined a set of images or metaphors that simplify the reading and analysis of organizations in order to enhance the dynamics of organizational change. Each image is a part of reality and gives prominence to certain aspects of organizations. The most used metaphors allow organizations to be seen as machines (mechanistic image), organisms, and more recently, as flows and transformation.

The flows and transformation metaphor is based on the principles of complexity. Complexity theory suggests the existence of processes underlying the observable reality, which can explain its state at any instant of time [5]. This metaphor motivates the search for dynamic creation and maintenance of organizations and their environments as concrete social forms.

The complexity is part of our environment, and many scientific fields have dealt with the study of complex systems. There is no single theory of complexity [6], but several theories arising from various natural sciences studying complex systems, such as biology, chemistry, computer simulation and artificial intelligence, evolution, mathematics, physics, economics and social sciences.

Complex Adaptive Systems (CAS) are special cases of complex systems. They are complex because they are diverse and consist of various elements linked by highly nonlinear relationships, and are adaptive because they have the ability to change and eventually learn from experience. The study of systems like CAS leads to the discovery of recurrent patterns of interaction between specific entities. The defining characteristic of CAS is emergence: the notion that at any level of analysis, the order is a property that emerges from the interactions of entities of lower levels. A complex adaptive system consists of a large number of agents, distinguished from each other, whose behavior uses the same set of rules. These rules require that agents must adapt themselves to the behavior of other agents with whom they interact (the principle of co-evolution).

The principles are generic, in that they are common to all complex natural systems. However, the nature of the entities (genes, molecules, numbers, computational agents or systems of human activity) has to be considered, and the application of the principles in each context must to be relevant and appropriate. For example, systems of human activities differ from all other systems because the complex evolutionary human actors can make intentional decisions. Many of the attributes and concepts of complexity theory are well known and belong to the domains of other theoretical frameworks [6]. This theory also describes the distinctive features of complex evolutionary systems, distinguishing them from the complicated systems, like machines. In particular, the concepts of connectivity, interdependence, emergence and feedback are acted on by complexity theory, which adds others, as the co-evolution, space of possibilities exploration, self-organization, multi-dimension, far-from-equilibrium, historicity and time, are used to provide a coherent description.

Kauffman mentions the importance of self-organization in the evolutionary process [7] cit. in [6]. Self organization means that no agent dictates the collective behavior of the system because the system self-organizes itself. "In an organizational context, self-organization can be described as the spontaneous junction of individuals in a group to accomplish a task, for which the group decides what to do, how and when they do, and nobody outside the group manages these activities". The emergent properties are the qualities, structures or patterns that appear at macro level as a result of interactions at micro level. The relationship between micro-events and macro-structure is interactive. This relationship is a co-evolutionary process in which individual entities and macro-structures are created, influencing each other through their interaction in an interactive process. Emergence is the process that creates new order together with self-organization.

A promising approach to the problem of emergence dynamics is provided by models of self-organization [8]. Self-organization can be defined as an organizational spontaneous process (i.e., not driven by an external system), allowing the development of an organized structure. The spontaneous creation of an "organized whole" from various disordered parts, as witnessed in the self-organizing systems in physics, chemistry, biology and sociology, is one of the important parts of emergency dynamics. However, another essential characteristic of emergence as understood in systems theory is its hierarchical and multi-level nature: an emergent whole to a certain level is only one component of an emerging system at the level immediately above. Realistic complex systems (organisms, societies, companies) are characterized by a multi-level structure.

The emergence of a human system tends to create structures, ideas, relationships and irreversible organizational forms, which become part of the history of individuals and organizations that affect the future evolution of these entities [6]. The generation of knowledge and innovative ideas when a team works together can be described as an emergent property in that it arises from the interaction of individuals and not just as a sum of existing ideas, but may well be something new and possibly unexpected. When ideas are articulated become part of the history of each individual and part of the shared history of the team. This process is not reversible, and these ideas and new knowledge can be built to generate new ideas and knowledge.

The theory of communicative action of Habermas [9], acknowledges the existence of rules that support and constrain the interactions between individuals, and that these rules are imposed both internally by interacting individuals and externally by social, political and economic structures of systems. Habermas also explains the set of requirements for a successful communication, and sets the validity claims as requirements to be applied in restoring communication when the communication action is interrupted. The concept of power structures, the validity claims and correctness emphasize the nature of interactions between individuals.

The underlying objective of language, according to Habermas, is to get to a common understanding among the individuals involved [10]. This implies that there is coordination of actions in the form of interaction to allow an orderly revelation, so the speech fulfills this function, since the meanings of the expressions are based on reasons. Habermas refers to this vision as "the basis of the validity of meaning". The

speech is considered the basic unit of linguistic communication, in which each act is composed of one illocutionary or rhetorical force and a propositional content.

3. Related Work

Enterprise model allows communicating, documenting and understanding the organizations activity. Enterprise model have to accommodate different points of view: the individual, the organizational, and the views of various groups of actors grouped in organizational contexts, but at the same time the consistency of the whole model has be guaranteed, allowing to represent the organizational self awareness [11]. The primitive, the syntax and semantics of the business model should allow simple and immediate verification, from each of the organizational actors, from the reality of their continuing action, once the basis of representation must be developed in concrete activities, because this is the only truly verifiable and comprehensive basis which organizational stakeholders can use [12].

According to Adamides [13], modeling has always been in the core of processes management activities and methodologies, because process models have been used in improvement, re-engineering, certification and IT implementation initiatives. Therefore there has been considerable discussion about the characteristics and suitability of the different modeling formalisms. However, has been given little attention to the modeling process itself as a socio-cognitive process.

Rittgen [14] refers that modeling is a kind of conversational negotiation. The four above steps of organizational semiotics ladder were considered in his experience: syntactic, semantic, pragmatic, and social. Most activities at pragmatic level are associated with negotiation. An analysis of workflows at pragmatic level revealed a structure that goes beyond the simple identification of generic activities, so the negotiation process follows a certain pattern, consisting of an initial and rejection state, in a state where acceptance is favored, a state where rejection is favored, a sub-recursive state to negotiate a counter-proposal and a state of acceptance. Each of the states allows a certain set of activities that drives the pragmatic negotiations to different states [14].

According to Borghoff and Schlichter [15], the widespread use of personal computers and associated networks meant that these resources began to be used to work collaboratively, so the designations computer supported cooperative work (CSCW) and groupware were introduced. The groupware designation refers to the solutions and tools designed to support collaborative work in practice, where the role of individual members of groups is an important aspect in the development goupwere tools, because the roles help to structure the interactions between team members and to define the functionalities and access rights of the group. The roles define the social function of individuals in relation to group process, to group organization and relatively to other group members. The roles define rights and obligations in relation to group process. Groupware systems send notifications when something changes. This feature eases the self-awareness of the individual and the group itself and, moreover,

the actions that occur in competition. The notifications inform all users involved in a group of changes made to a shared environment.

Collaborative modeling can enhance productivity and quality of modeling by helping to construct agreement and a sense of model ownership among stakeholders. In order to reach consensus and agreement, modelers need to commit themselves to work as a team and abide by their collective knowledge, conventions and decisions. Their communication strategy sets the goals and rules (explicitly or implicitly) for a conversational dialog in which the modelers propose and argue about (negotiate) the different positions raised. This communication may result in (dis)agreement with, and acceptance/rejection of, the ideas proposed [16].

Despite process models are considered to have great potential for the sharing of knowledge in organizations its potential usage is generally neglected in organizations, mainly because are used by few people such as analysts, developers and managerial staff, who use BPM systems to manage business processes [17]. As a result, process participants or new employees, who need to know about organizational processes or want to give feedback on business processes, are unaware of models as sources for information on business processes. Some reasons that lead to this situation, derive from several factors, such: in the repositories accessible for all stakeholders organizations, such as knowledge management systems, models are usually neglected; the majority of staff in organizations does not accept the use of models, as they often perceive models as technical artifacts used by modelers and analysts; models are closely bound to the modelers, who are in control of changes to them, thus making other staff bystanders in process documentation and change, consequently, getting feedback for business process models is costly and has to be done by modelers personally asking people for their feedback.

These issues can be overcome with the use of groupware solutions, namely with the use of groupware systems for collective sense-making, which implements collaborative modeling with a component of negotiation that facilitates the structuring of arguments and decisions regarding modeling choices [14].

In addition to the collaborative and negotiation features, these tools have to take into account the main characteristics and features that are usually found in the tools for business processes modeling, which can be defined as an automated system that provides capabilities to build business process models [18].

Gonzalez [18] identifies a set of features necessary to collaborative tools for modeling business processes and analyzes a set of commercial tools to check whether these features identified are implemented or not. The requirements of collaborative tools for modeling business processes can be classified according to the spatial-temporal matrix of groupware [19], because the interaction can happen at the same time (synchronous) or at different times (asynchronous) and the participants in interaction can be in the same location or different locations. After reviewing the available tools, three categories of business process modeling collaborative tools were identified [18]: Web tools with modeling support, client/server local tools, and export/import documents tools.

Gonzalez [18] analyzed 35 tools from the market for evaluating the collaborative features considered most important, which include: Web Publishing: the tool contains a module for Web publishing or for exporting to HTML, allowing the model

presentation without having to edit them; Model Viewer: the tool contains a module that allows the model displaying without editing possibility; Information Reports: The tool generates reports, including graphics or information about models; Version Control: this feature allows the comparison of different versions of the same model; User Profiles: the user control allows participants to do just the actions that allowed by their profile; comments and notes: these artifacts allow participants to include information about models asynchronously; Ability to disaggregate and aggregate: this feature allows the splitting of the model into parts, so that participants only work on their part accordingly; Other collaborative features not included in the analysis: notification to alert the participants that changes were made to the model during the asynchronous work and chat for discussion among participants. This study revealed that, in general, most of the tools analyzed provide collaborative features, but many of the features are not present unless, in some cases, all modules have to be purchased, or in other cases, some modules have to be purchased from other vendors.

4. Suggestion and Development

The background section consolidates the motivation behind this work: the need to develop a method and a supporting tool to update the business processes of organizations in a distributed and collaborative way. These method and tool could enable the emergence of new representations of business processes more closely aligned with the operational reality of organizations, based on a negotiation process involving discussion to lead to agreements.

The section of related work provided the guidelines for designing the collaborative updating method and for defining the supporting tool requirements.

To solve the problem of obsolescence of as-is business process models, we decided to build a collaborative method that provides the distribution of processes to stakeholders, allowing the individual proposal for changes, thus this also provides the basis for a participatory discussion extended to all stakeholders, which leads to a continuously update of business processes reducing the gap between the representation and the execution of business processes.

Figure 2 shows the generic activities in PROASIS and shows the negotiation pattern involved in its review and evaluation steps. The characteristics of PROASIS are:

(a) It is executed by people that exists in the operational dimension and share a common representation of business processes.

(b) The mechanisms that they can use in this process to declare misalignments are the annotations. The annotations are used to build updating proposals to the model in order to align it with the reality perceived by each organizational actor. These proposals aim to make the corrective maintenance of the business process model and can have two goals: to correct the model or to increase its detail.

(c) After making an annotation on a modeling element, a negotiation with the actors who eventually share the same context of action may exist. This negotiation/discussion will be made by all stakeholders of the annotated element in order to clarify the original purpose of the annotation. All actors involved in this review should declare the

agreement or disagreement with the annotation made to the model element, justifying it.

(d) After the review of the annotation, the annotation should be evaluated by the actors enabled to do so, having some degree of responsibility on the executed activities or on the organizational actors involved. If the evaluation of the annotation (and any reviews made to it) results in an approval, the changes requested in the annotation could be incorporated in the new version of the process model by the modeler.

(e) These reviews and evaluations made to annotations can improve organizational self awareness since all actors involved in the update context of a particular model or modeling element could collaboratively participate in the update process, trough the analysis and discussion of the model or modeling element.

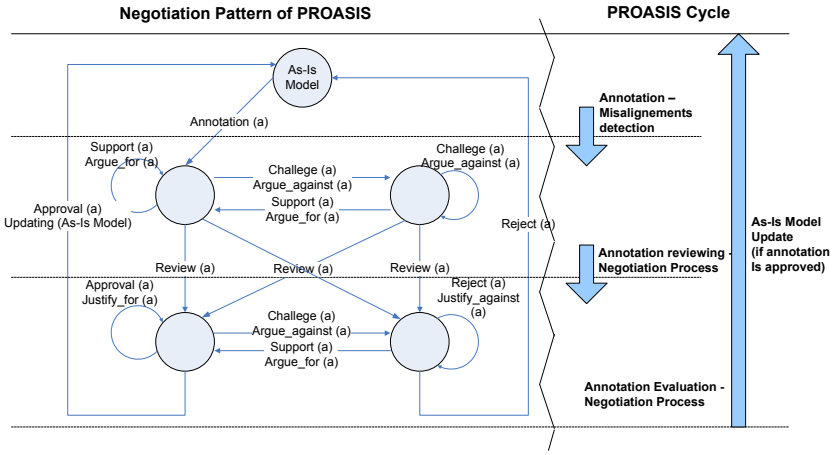

Fig. 2. Activities and negotiation pattern of PROASIS [1]

The set of modeling elements that can be annotated and the organizational actor roles that can be considered as standard annotators in PROASIS, are represented in figure 3.

The organizational roles presented can take on different roles on PROASIS depending on the particular modeling element annotated. Notice that an annotation is always created by individual initiative in a particular context, involving diverse actors in the later stages of reviewing and evaluation. This means that the updating context (PROASIS) captures the actors involved in the action context (operational level), consisting in a subset of actors of the operational model - people who participate in the reviewing and evaluation of the annotations.

To define a dynamic update process whose use is as comprehensive as possible it was necessary to consider the various levels of granularity that a business processes model can provide. These levels of detail derive from the contexts of the operational model (Process, Activity and Organizational Unit), and are considered to support the as-is business process model updating.

One of the goals in defining PROASIS was to approach as much as possible its collaborative updating process to the problem domain of business processes modeling. To achieve this, some options were taken: the annotation remain attached to the

annotated modeling elements; review and evaluations remain attached to the annotation made; two categories of annotations were defined (correction, detail augmentation and adaptation); two types of annotations were defined (textual or graphical, allowing actors to annotate the model through a draft model diagram containing the proposed corrections, thus restricting the universe of discourse because this diagram must comply with the notational language used for process modeling); two types of reviews: agreement or disagreement, both complemented with text; two types of evaluations: approval or disapproval, both complemented with text; creation and maintenance of model versioning linked to the annotations that lead to updates.

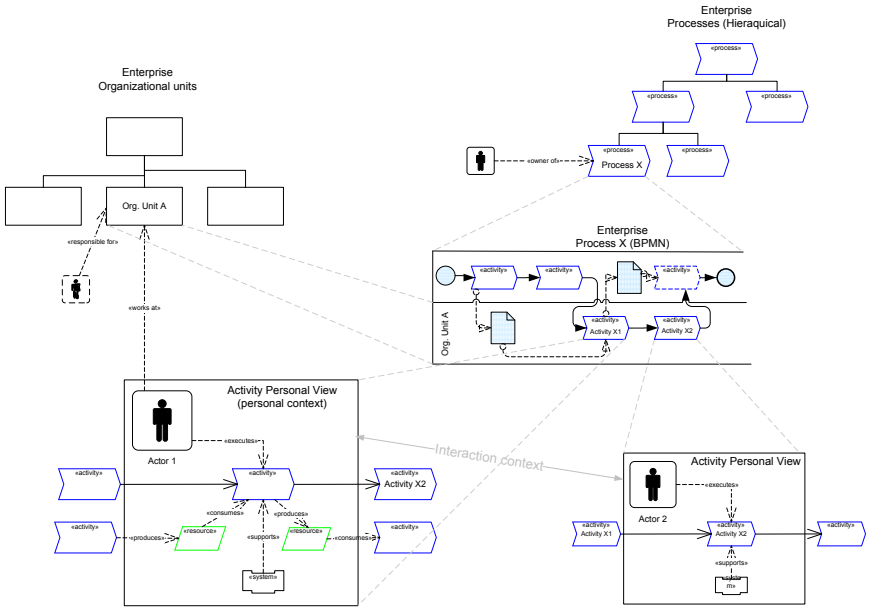

Fig. 3. Business process model [1]

To support PROASIS, the web-based groupware prototype tool MAPA was developed and two versions were created (first we created the v1version, which later has evolved into v2 version).

MAPA v1 works at the activity level of detail. The main view of the version 1 of the tool used when operating at the activity level of detail (figure 4), provide to the activities executors, a view to APV (Activity Personal View) diagrams that aggregates information from the activities and its executing context (the documents used and produced, information systems used to support the activity, previous and subsequent activities, annotations, etc.).

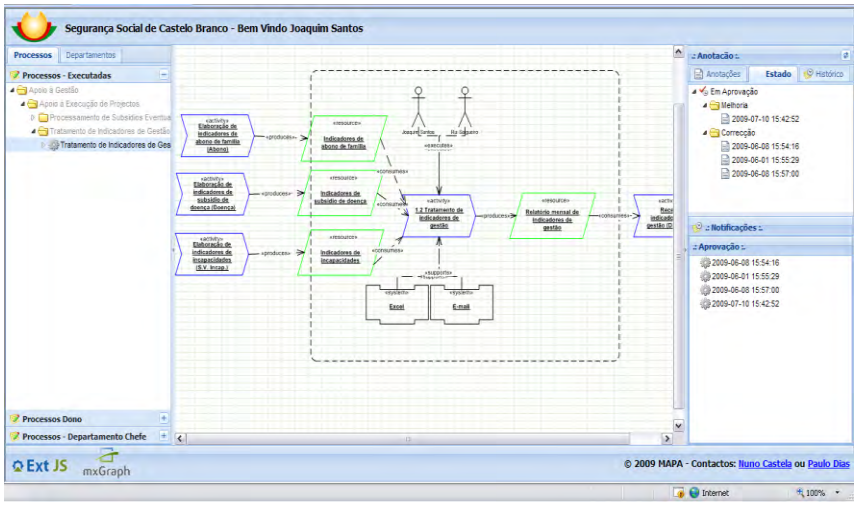

Fig. 4. MAPA v1 screenshot

Notice that although MAPA V2 tool allow modeling with BPMN 2.0 specification, the diagrams shown in the figure 5 and in the following figures were modeled by organizational actors involved in the processes without the care to fully meet this notation.

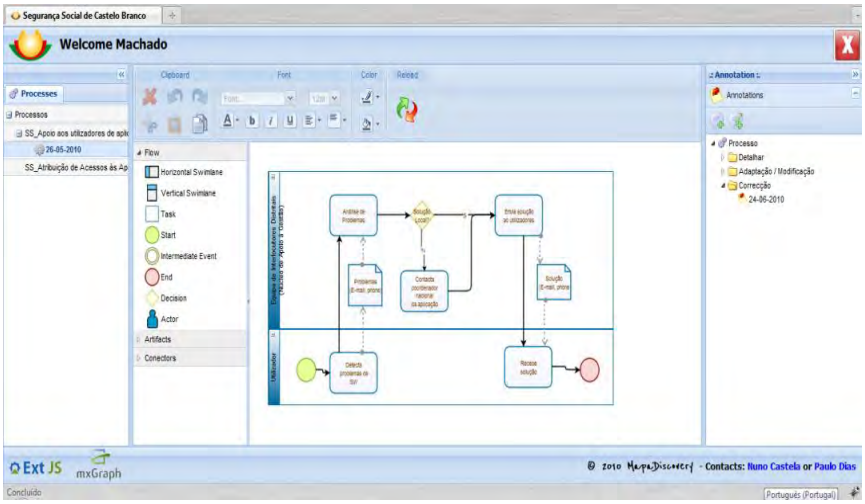

Fig. 5. MAPA v2 screenshot

This version was designed to operate at the process level of detail. Although the MAPA v2 tool does not fully implement the activity detail level, it allows annotating activities and other modeling elements that exists in the process model (in BPMN), either individually or grouped.

Some of the main functionalities implemented in MAPA tool are [20]:

(1) Annotation editing functions: actors need support to make immediate annotations in the context where experiences occur. Therefore, an annotation creation, modification and deleting system was created to be used by organizational users; mapping annotations to modeling elements: is essential to know to what modeling elements corresponds each annotation;

(2) Different levels of granularity: it should be possible to annotate any modeling element (process, activity, role, resource, relation) in the process model as well as any attribute of each object;

(3) Selective distribution of diagrams and modeling elements: users only access information that concerns to them, depending on the role played (executor, process owner and organizational unit responsible);

(4) Access rights: to protect the annotations authors, different levels of access rights should be addressed. Only the author of an annotation must be able to delete or modify it;

(5) Ability to save the entire history of models and their annotations, and the corresponding reviews and evaluations;

(6) Notifications: all actors related to process are notified by e-mail when annotations, reviews, evaluations or updates are made.

(7) Diagramming capabilities: to allow annotator actors to make graphical annotations with proposed changes to models and to allow modeler actors to directly change the diagrams if the proposals for changing the model are approved.

5. Evaluation

Four case studies were set up to evaluate the present work (figure 6).

Fig. 6. Sequence of implementation of case studies

The first case study was conducted at Social Security District Center (SSDC), with MAPA v1 (phase 1) where processes and activities were modeled from scratch with top down and bottom up modeling approaches at the activity level of detail.

The second case study was conducted at Huf Portuguesa, an automotive parts manufacturing company. In this case study the main idea was to model business processes starting from an existing outdated model. MAPA tool helped in the translation of the existing model to build a BPMN end to end business process model. When this model is ended, we can apply PROASIS to maintain processes updated.

The third case study was developed at Technology School of Castelo Branco. It intend to apply PROASIS with version 2 of MAPA tool to the Business Processes of

Academic Services modeled from scratch, using a top down modeling approach at the process level of detail. In this case study we modeled two business processes, involving six users.

The social security case study (phase 2), used MAPA v2 in two of the processes already modeled in phase 1 and in 17 new business processes. The modeling approach used was the same that were used in phase 1, but the level of detail used was the process level of detail. We finish modeling 2 processes from District interlocutors Team, 12 processes from Financial Management Team and 5 processes from Administration and Assets Team.

To illustrate the dynamics of interaction provided by the tool, we show some examples of annotations, and subsequent reviews and approvals made in the context of a business process of social security. Figure 7 show the initial diagram of "Procurement and Materials Management" business process, modeled in MAPA tool. This process shows the interaction between the Social Security District Center, the procurement and patrimony team (equipa de aprovivionamento e património, in Portuguese), the financial management team (equipa de gestão financeira, in Portuguese), the social security central services (serviços centrais, in Portuguese) and the suppliers (fornecedor, in Portuguese) necessary to manage the acquisition of services and equipments for the Social Security District Center.

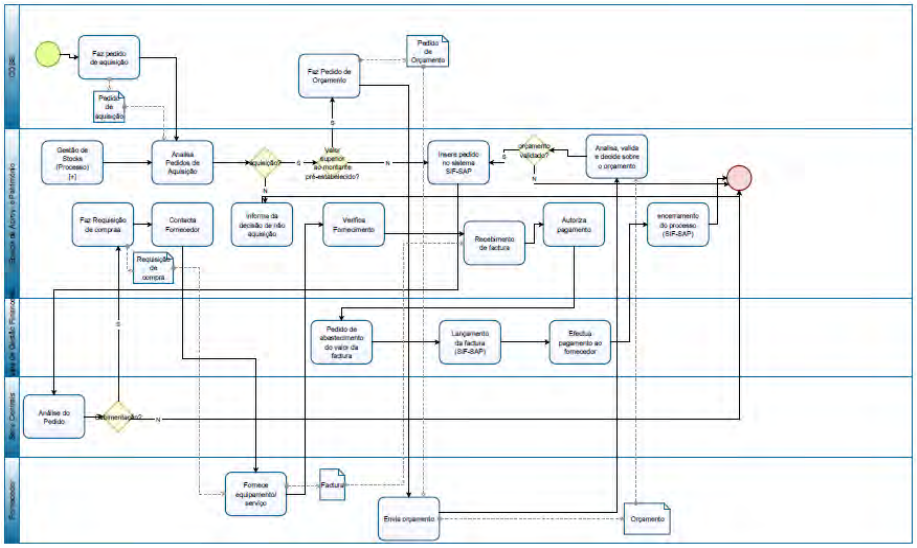

Fig. 7. First version of "Procurement and Materials Management" business process

Figure 8 show the (textual) annotation made by Octávio Gil "After payment authorization by the management, the procurement team and heritage takes to gather copies of invoices to process and send the original to the team financial to ask for account supply", and the corresponding reviews made by 2 colleagues that participate in the same business process that agreeded with the annotation made. In the same figure we can also see the evaluation (approval) made to the annotation by the responsible of the team Sara Soares.

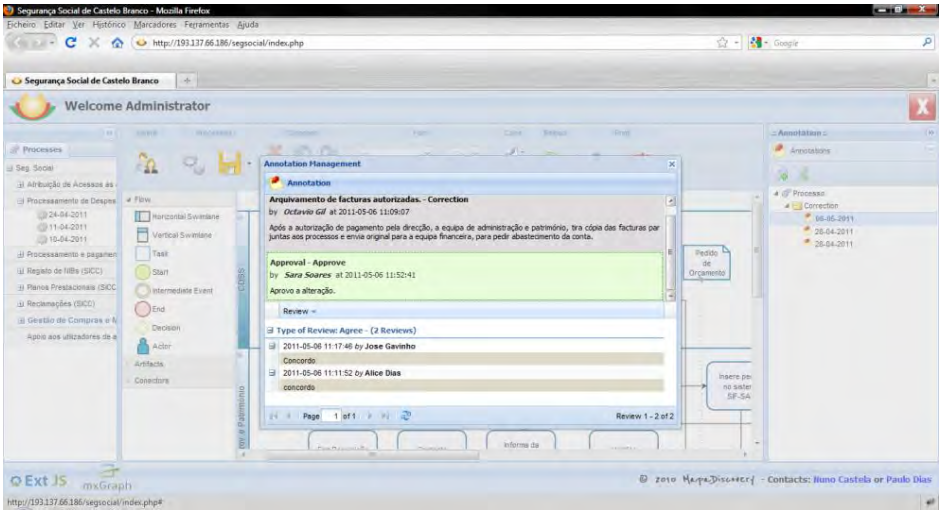

Fig. 8. Textual annotation, reviews and evaluation made to the business process

Figure 9 shows a graphical annotation made in the scope of the same version of the "Procurement and Materials Management" business process by Alice Dias. We can also see the reviews and the evaluation made to this annotation (the team responsible approved the annotation with some comments to improve the process representation) that in addition to the textual description of figure 9, contains a graphic description shown in figure 10.

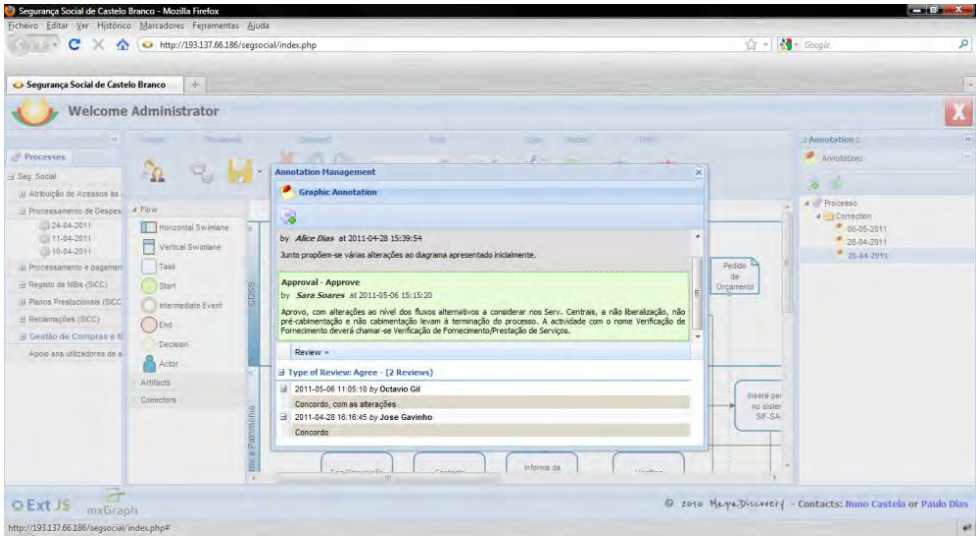

Fig. 9. Graphical annotations with reviews and evaluation

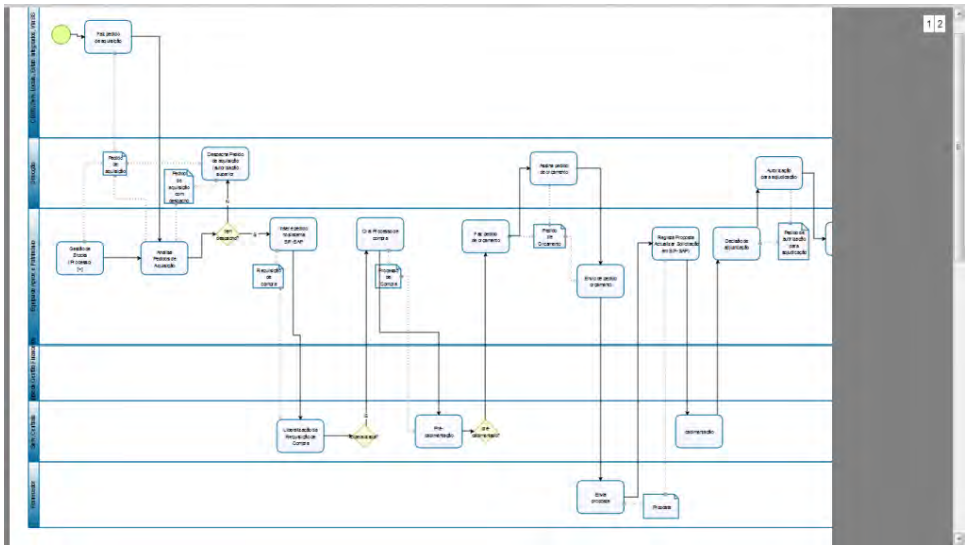

Fig. 10. Graphical change proposals of the annotation made

Figure 11 shows the new version of the "Procurement and Materials Management" business process, modeled in MAPA tool by the team responsible taking in account all the annotations and reviews approved.

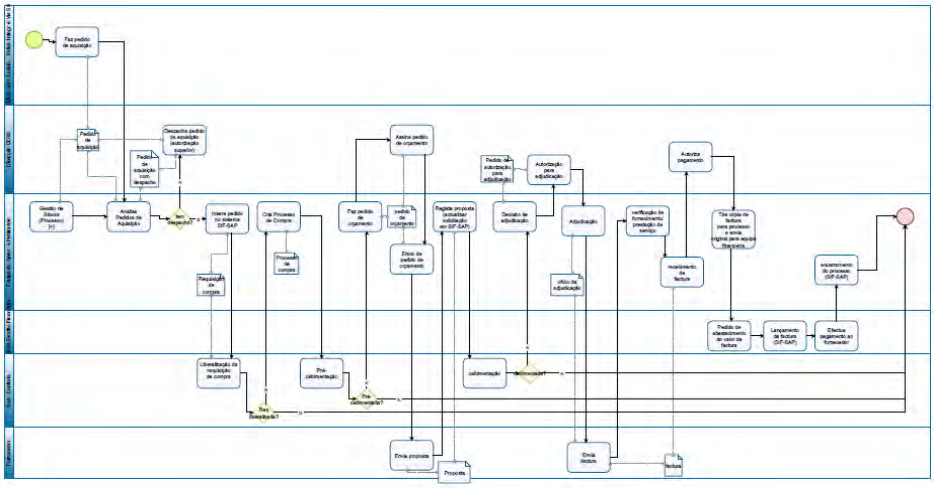

Fig. 11. New version of Procurement and Materials Management" business process

Table 1 shows the summary of the results obtained globally in the two case studies developed where MAPA v2 was used to maintain the as-is business process model updated: Social Security and Technology School of Castelo Branco.

This table discards the results of Social Security phase 1 case study because this case used MAPA v1 and Huf Portuguesa because in this latter case study MAPA v2 was still

only used to translate the former business process model to a new business process model modeled with BPMN.

Table 1. Summary of Case Studies Results

PROASIS Cycle (2)	Summary of results (CDSSCB - phase 2 + ESTCB)	
Modeling	Number of Processes	21
Annotation	Number of annotated processes	16
	Number of annotations made	36
	Percentage of annotated processes	76,2%
	Number of textual annotations	22
	Percentage of textual annotations	61,1%
	Graphical annotations	14
	Percentage of graphical annotations	38,9%
Review	Number of reviews	45
	Percentage of reviewed annotations	69,4%
	Reviews of type “I agree”	44
	Reviews of type “I do not agree”	1
Evaluation	Number of evaluations	29
	Percentage of evaluated annotations	80,6%
	Avaliações of type “approval”	30
Modeling	New process versions (by cycle)	16+2
	Percentage of updated processes (1st cycle)	76,2

From the 36 annotations made, 52.8% were of type “correction”, 22.2% of type “adaptation” and 25.0% were of type “detail”. These results are directly connected with the validation of first business process modeling versions that MAPA allowed.

Also relevant is the relatively high percentage of graphical annotations: 38.4%.

Interviews with organizational actors involved in the case studies were conducted in order to systematize the qualitative results.

From the responses to the interviews conducted to validate the results, 93% of organizational actors have made textual annotations and 40% used graphical annotations, we can see that all actors considered important to discuss the process updating and the widespread use of the MAPA tool to all processes of the organization where they work. 94% of organizational actors considered important the discussion possibility that the reviews allow. The organizational actors also expressed their opinion about the benefits that regular use of the MAPA tool could bring to organizations (figure 12).

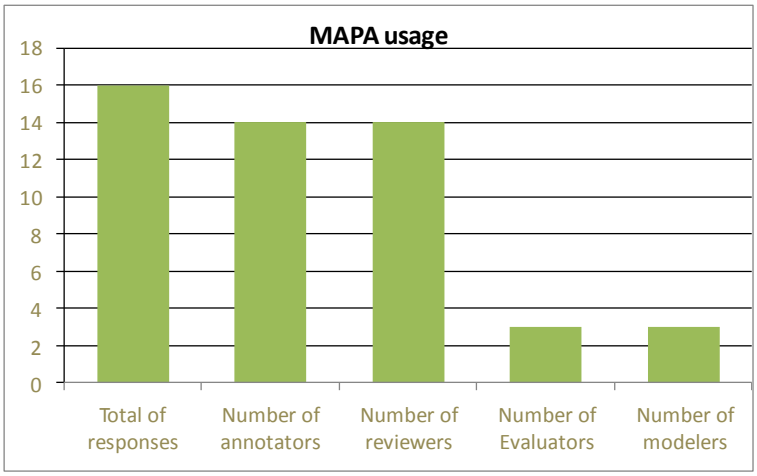

Fig. 12. Number of Answers from users interviews

Some empirical observations were extracted from each case study: in Social Security Phase 1 there was a great ease in the recognition of the process models within the MAPA tool mainly because the executers and leaders were involved in the initial modeling process; in Huf Portuguesa, the operation of the MAPA tool was initially tried with business processes modeled within the Department of Information Systems, but that has revealed to prove fruitless due to the non recognition of processes by their executors and leaders, but we found that MAPA tool can be used as a modeling tool; in Social Security Phase 2, organizational actors showed a greater easiness in interacting with the tool and a great acceptance in using graphical annotations at the expense of textual annotations because they were involved in the initial modeling stages, and we found that the assignment of the modeler role to the process owner provided a considerable improvement in updating processes.

6. Conclusions and Future Work

The results of case studies have demonstrated that the executors of activities, through their participation in PROASIS, established a basis for understanding the business process models and found a channel to express their own vision of the models. From the interviews conducted we found that 88% of the organizational actors involved have proposed updates to the models through annotations, and said they found it a proper way to formalize their proposals. So we can consider that the annotation an appropriate mechanism to express model updates and that the reviews and evaluations are appropriate to promote the negotiation necessary to make the annotations effective.

The annotators have demonstrated availability to make graphical annotations and the modelers have demonstrated availability to create new versions of model (25% of the organizational actors involved in the case studies made updates to the models and 25% of organizational actors who proposed updates to the models have made it

through graphical annotations). These actors see the possibility to actively model collaboratively the organization as important. MAPA has an important role in gathering the information needed to update the model, opening of communication channels that encourages the collection and sharing of knowledge about organizational activities, allowing actors to play the role of active modelers in a collaborative and distributed way, making them organizational modelers.

PROASIS is important in the growth of self awareness, providing explicit representations to the organizational actors that are left with a better sense of what they do and the surrounding context. PROASIS also increase group awareness around processes and activities, creating the history of annotations (and its negotiation/discussion) that culminate with the proper evolution of the modeled processes, aligning them with their implementation in practice.

Some of the concluding remarks that we can make about this work could lead to future work in this area. For instance, PROASIS could have an important role in helping the redesign of business processes in the BPM lifecycle, which is usually based on initial modeling techniques including interviews and meetings, and is triggered by management needs. Instead, PROASIS can run continuously in the background, being triggered asynchronously by the actors, and can significantly reduce the effort in redesigning and updating the as-is process model.

We also recognize the action level of detail as important to try to understand the mental mechanisms used by organizational actors to act in the context of PROASIS, so it is important to consider for future development, personal areas in which organizational actors can declare their actions as they see it in the context of their work.

Apart from the case studies presented, PROASIS and MAPA are being used autonomously in other organizations for the collaborative construction and updating of business processes; MAPA tool is being used at Viriato Theatre Company of Viseu, where nine business processes were modeled, some with multiple versions due to PROASIS; It is also being used at the University of Algarve, where a total of 44 business processes have been modeled, which are being annotated and reviewed by a group.

References

1. Castela, N., Zacarias, M., Tribolet, J.: Proasis, As-is business process model maintenance. In. Frank Harmsen, Knut Grahlmann, Erik Proper (Eds.) Lecture Notes in Business Information Processing (LNBIP), Proceedings of the 3rd Conference on Practice-driven Research on Enterprise Transformation, Luxembourg, Springer, Berlin Heidelberg, Vol. 89, 53-82. (2011)
2. Vaishnavi, V. and Kuechler, W.: Design Science Research in Information Systems, Association for Information Systems (2004) [online]. Available: http://desrist.org/desrist (current October 2011)
3. Zacarias, M, Magalhães, R., Caetano, A., Pinto, H.S., and Tribolet J.: Towards organizational self-awareness: An initial architecture and ontology. In P. Rittgen (Ed) Ontologies for Business Interactions, IDEA Group, 101-121. (2008)
4. Morgan, G.: Images of the Organization. Sage, Thousand Oaks, Canada. (1996)

5. Bohm, D: Wholeness and the Implicate Order. Routledge. London, UK. (1980)
6. Mitleton-Kelly, E. and Land, F. Complexity & Information Systems: Blackwell Encyclopedia of Management on Management Information System. Blackwell (2nd edition), London, UK. (2004)
7. Kauffman, S.: The Origins of Order: Self-Organisation and Selection in Evolution. University Press. Oxford, UK. (1993)
8. Heylighen F.: Self-Organization, Emergence and the Architecture of Complexity. In Proceedings of the 1st European Conference on System Science, (AFCET), , Paris, France, 23-32. (1989)
9. Habermas, J: The Theory of Communicative Action: Reason and the Rationalization of Society.Beacon Press, Boston, USA. (1984)
10. Inlayson, J. G.: Habermas. University Press, Oxford, UK. (2005)
11. Magalhães, R., Sousa, P., Tribolet, J.: The Role of Business Processes and Enterprise Architectures in the Development of Organizational Self-Awareness, Polytechnical Studies Review, Vol. VI, No. 9, 1-22. (2008)
12. Tribolet, J.: Organizações, Pessoas, Processos e Conhecimento: Da Reificação do Ser Humano como Componente do Conhecimento à "Consciência de Si" Organizacional, in Amaral, L (Ed.), Sistemas de Informação Organizacionais, Sílabo, Lisbon, Portugal. (2005)
13. Adamides, E.D., Karacapilidis, N.: A knowledge centred framework for collaborative business process modelling, Business Process Management Journal, Vol. 12, No. 5, 557-575. (2006)
14. Rittgen, P. Negotiating Models. In Krogstie, John; Opdahl, Andreas; Sindre, Guttorm (Eds.): Advanced Information Systems Engineering, 19th International Conference, CAiSE 2007, Trondheim, Norway, June 2007, Proceedings, LNCS No. 4495, Springer, Berlin, Germany, 561-573. (2007)
15. Borghoff, U., Schlichter, J.: Computer-Supported Cooperative Work: Introduction to Distributed Applications, Springer, Berlin, Germany. (2000)
16. Ssebuggwawo, D., Hoppenbrouwers, S., & Proper, E: Interactions, goals and rules in a collaborative modelling session. In The Practice of Enterprise Modeling. Springer, Berlin Heidelberg, Germany, 54-68. (2009)
17. Giorgio Bruno, Frank Dengler, Ben Jennings, Rania Khalaf, Selmin Nurcan, Michael Prilla, Marcello Sarini, Rainer Schmidt and Rito Silva: Key challenges for enabling agile BPM with social software, J. Softw. Maint. Evol.: Res. Pract. Vol. 23, John Wiley & Sons, USA, 297–326. (2011)
18. Gonzalez, P.P., Framinan, J.M.: Business Information Systems: Concepts, Methodologies, Tools and Applications, Vol. 4. Ed. Information Resources Management Association, USA, 636-648. (2010)
19. Ellis, C.A., Gibbs, S.J. and Rein, G.L. Groupware: Some Issues and Experiences. Communications of the ACM. Vol. 34, No.1, 38-58. (1991)
20. Castela, N., Dias, P., Zacarias, M. and Tribolet, J.M.: Collaborative maintenance of business process models, Int. J. Organisational Design and Engineering, Vol. 2, No. 1, 61–84. (2012)

Nuno Castela is an Assistant Professor at Polytechnic Institute of Castelo Branco, Portugal, and an Invited Researcher in Center for Organizational Design & Engineering of INESC Inovação. Currently he is Vice President of Polytechnic Institute of Castelo Branco and he was President of the Scientific Council (2012-14) at Technology School of the Polytechnic Institute of Castelo Branco, where he teaches several courses in the area of information systems. He holds an Electrical Engineer

degree (1996), from University of Coimbra, a Computer Engineer MSc degree (2001) and an Information Systems and Computer Engineering PhD degree (2011), both from Instituto Superior Técnico - University of Lisbon. His main academic interests are in the areas of Business Process Modeling, Enterprise Architecture and Enterprise Engineering, and he has published several refereed papers in those areas.

Paulo Dias is an Information Systems Technician and an Invited Teaching Assistant at Polytechnic Institute of Castelo Branco. He holds an Information Technology Engineer Degree and a Information Systems and Technology MSc degree, from the University of Beira Interior, Covilhã, Portugal.

Marielba Zacarias is a Computer Engineer (1982) with a MSc degree in Systems Engineering (1996), and a PhD in Informatics and Computers Engineering (2008). She has a professional experience of over 25 year in the Information Systems field. She is an assistant professor of Electronics and Informatics Engineering Department and member of Research Center for Spatial and Organizational Dynamics (CIEO), at the Algarve University. After her PhD, she has worked mainly in organizational modeling and ontologies, focusing particularly in modeling organizational contexts, and has published 28 refereed scientific papers in those areas.

José M. Tribolet is Full Professor of Information Systems at IST, (Instituto Superior Técnico), the Engineering School of University os Lisbon in Portugal, and holds a joint appointment as Full Professor at the Engineering and Management Department of IST. His main academic interests are in the areas of Enterprise Architecture, Enterprise Engineering and Enterprise Governance, with emphasis on IS Architecture, Business Process Engineering, Enterprise Transformation and Change Management. He holds a Ph.D. in Electrical Engineering and Computer Science from MIT (1977). He spent a full sabbatical year (1997-98) at MIT´s Sloan School of Management and was Visiting Professor at the University of St. Gallen, Switzerland, in the spring term of 2011-2012. – He founded in 1980 the first non-state owned research institute in Portugal, INESC – Institute for Systems and Computer Engineering. INESC is today a holding of six research institutes nationwide, three of them having become formal Associated Laboratories of the Portuguese Science System. Dr. Tribolet is the President of INESC. He is a founding member of the Portuguese Engineering Academy and a founder of the Informatics Engineering College of the Portuguese Engineers Professional Association.

Received: January 17, 2013; Accepted: May 30, 2014