An End-User Approach to Business Process Modeling

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Abstract

This paper discusses the main differences between humanistic and mechanistic business process modeling. While the mechanistic approach requires strict process formalization, emphasizes technical details, and constrains the modeling task to technology experts, the humanistic approach is more centered on the end-user. We developed a modeling approach and a collaborative tool supporting end-user business process modeling. Design storyboards were adopted as a paradigm for knowledge representation and visual composition. The main contributions from this research include the knowledge representation structure and a collaborative tool supporting visual composition of business process models.

Keywords

Humanistic Business Process Modeling, Collaborative Modeling, Modeling Tool.

1. Introduction

Business computerization has been constantly increasing in the last decades [1]. The main reasons for this are that computer use increases data management, distribution, parallelism, integration, and timely control over a large number of processes, thus exceeding the human capacity for efficient information processing. For instance, computerization has been supporting much faster organizational response to business changes resulting in increasing customization, wider reaching, flatter control structures, and more intensive decision-making [2], which in turn foster the expansion of the service industry [3]. However, computerization also brings new risks. Such risks derive from additional complexity and dependence on technology [4]. Complexity makes it more difficult to understand what is going on in an organization, and technology dependence also means that both human and technological failures may spread more easily throughout an organization. These two problems are intrinsically connected and may therefore be difficult to disentangle.

Business Process Management (BPM) systems are at the center of these problems. BPM has been developed to support increased organizational complexity [1]: automating business processes, coordinating tasks, managing data and other resources—including human—and integrating other organizational systems like databases and data processing systems. BPM technology accomplishes all this through messaging and service composition based on process representations [5]. But BPM also increases technology dependence: since all organizational resources, including human and technological components, are becoming fully integrated in massive BPM systems, a failure in any one component may have a catastrophic impact on the whole system, the organization and the society.

Research has been addressing this problem from many different angles. One important research stream considers preventing malfunctions caused by erroneous human action [6, 7]. This research stream has, for instance, proposed techniques to improve flexibility [8-10], exception handling [11], change management [12], and distributed operations [13], just to mention a few.

In spite of all these developments BPM still faces one critical problem which is the main challenge underlining our research:

> *Although BPM deals with the integration of humans and technology, the main focus of BPM modeling is still more concerned with technological constraints than with human needs. As in many other technology development fields, technology seems to have a strong influence and control over the development process, even when technological and human needs should be considered on par.*

Many researchers have expressed their concerns over this situation:

1. The "automating a fiction" problem [14]: existing BPM systems focus on predefined behavioral patterns and strict control over task execution while disregarding informal communication and collaboration, which are often necessary to accomplish the task goals.
2. The "model-reality divide" [15]: Even when BPM models are well designed, they may not be used in practice because of lack of acceptance from end-users. Some authors go even further saying that BPM systems often lack consideration for the end-users [16-18];
3. The "model-consistency" problem [19, 20]: The close link between process modeling and execution enforces technology compliance and makes it more difficult to handle issues like exception handling at the modeling level;
4. The "collective intelligence" problem [21]: Many gaps and incongruences faced by expert modelers could be easily solved by combining the collective intelligence of the crowd, but modeling tools have yet to make use of such collective intelligence;
5. The "lack of flexibility" problem [22]: The time required to plan, develop and deploy highly detailed business processes conflicts with the current needs of agile enterprises;
6. The "missing tacit knowledge" [23]: When aligning business modeling and organizational strategy, it is often assumed that knowledge can be captured and modeled at the macro level, neglecting the end-users' tacit knowledge, inventiveness and capacity to make decisions at the micro level.

This paper suggests a reconsideration of the way business processes have been modeled. Our standpoint is that business process modeling should not depend on the underlying technological constraints but should preserve the human ability to handle ingenuity, variations, exceptions, and unique contexts. Our research is focused on the development of a humanistic approach, integrating two fundamental requirements: knowledge representation and visual composition. The former addresses the need to represent business processes in a way that preserves ambiguity and contextualization. The latter requirement concerns the visualization of business processes in a way that preserves strong attachment to reality and does not alienate the end-users. The proposed approach adopts a narrative structure inspired by design storyboards, which provide rich information about a work setting in a very informal way. We developed a tool offering: 1) support for collaborative end-user business process modeling; 2) graphical composition of business processes using storyboards; and 3) a library of reusable/configurable scenes that may be used to describe business processes. The main contributions of this research include an innovative knowledge representation structure, which adopts the humanistic perspective, and a collaborative business-process modeling tool.

The paper is organized as follows. In the following section we discuss the main distinctions between humanistic and mechanistic business process modeling. In Section 3 we describe our approach focusing especially on knowledge representation and visualization. Section 4 is dedicated to describe the developed tool. In Section 5 we discuss some remarks derived from using the tool. In Section 6 we discuss other research developments related with our approach. Finally, the last section is dedicated to discussing the research results and providing some concluding remarks.

2. Humanistic Versus Mechanistic Business Process Modeling

We define six criteria to help understanding the main differences between humanistic and mechanistic business process modeling (Table 1). We organize the criteria according with two main categories: specification and execution. The former concerns issues related to how the business process is specified and the latter is related to business process execution.

Table 1 - Humanistic versus mechanistic business process modeling

Criteria	Definition	Humanistic BPM	Mechanistic BPM
Formalization	The stating of formal rules in a business process specification	Low	High
Detail	The level of detail in a business process specification	Low	High
Agility	The capacity to adapt a business process specification to various external conditions	High	Low
Operationalization	The stating of operations involved in executing a business process	Low	High
Implicitness	What is implied when executing a business process	High	Low
Flexibility	The responsiveness to contextual changes when executing a business process	High	Low

In relation to process specification, we identify three important criteria: formalization, detail and agility. Formalization expresses the stating of formal rules in a specification. Mechanistic BPM requires a high level of formalization, mostly because the underlying technology must control the dependencies between tasks and conditions that must be fulfilled to determine if a task can be initiated or not [24]. On the other hand, humanistic BPM tends to rely on lower formalization. For instance, a surgical process may only refer in very generic terms what actions will be applied but not necessarily how. An air traffic control process may refer what tasks should be accomplished using generic terms but not precise actions. In both these examples the level of formalization is low. Therefore we can say that humanistic BPM tends to have low formalization while mechanistic BPM requires high formalization.

Another important criterion related to process specification concerns the level of detail expressed in the specification. Most mechanistic BPM systems require a high level of detail, mainly because it is necessary for the underlying technology to have the details of exactly which tasks should be executed, who is responsible for executing the tasks, and what are the expected inputs and outputs, timing, conditions, etc. On the other hand, humanistic BPM systems may rely on ad-hoc decisions to determine the fine-grained details. For instance, a process describing how a company communicates with its clients does not require fine-grained details regarding communication media, tools, timing, etc. Thus we may consider that while mechanistic BPM requires detailed information about business processes the humanistic view mainly deals with high-level concerns.

Still related to process specification, we find the notion of agility [22]. Agility is the capacity to redefine a business process in order to adjust it to changing external conditions. What is under stake here is the effort and time required to adapt an existing business process. In the case of mechanistic BPM, adaptations may take a long time to accomplish and require a significant effort. The main reason is that changes in the BPM system must be carefully managed at the technical level so that the transition to the new system does not create operational problems. In the case of humanistic BPM, agility may be easier to accomplish since changes do not involve the technical level. Of course we should consider that the adaptation cost is also partially dependent on the required levels of formalization and detail, which gives some advantage to the humanistic approach. For instance, there may be no effort associated with adaptation in the case of a system using ad hoc workflows to implement a business.

Let us now move on to issues related to process executions. Operationalization is the first criteria we consider. It refers to the transformation of a process specification into the set of operations necessary to execute the goals implied by the process. In the case of mechanistic BPM the operationalization is usually very high, mostly because these systems have been designed to maintain a close relationship between specification and execution through a set of formal rules [24]. Rules that state, for instance, that a process must have one single beginning and one single ending serve exactly to maintain such close relationship. On the other hand, humanistic BPM may have lower operationalization. Systems can take advantage of the human capability to make decisions when determining the set of operations that should be executed [25]. For instance, a process describing how firefighters should engage in a fire necessarily relies on the high expertise and training of the firefighters, so that the rules of engagement do not have to make visible the whole set of decisions that need to be made when facing the situation.

Implicitness is another important criterion. It refers to contextual information necessary to execute the process but not explicitly stated in the specification. Most often humans infer contextual information from tacit knowledge [23]. For instance, an emergency evacuation process does not have to describe how to get out of a building, as it is assumed that people know how to do it; it just has to remind the reader where the meeting point is and that the lifts should not be used. Therefore implicitness is necessarily much higher in humanistic than in mechanistic BPM.

The last criterion we consider is flexibility. It is related to the ability to respond to contextual changes while processes are being executed. Here the advantages of humanistic over mechanistic BPM derive from the human capacity to interpret contextual changes and adapt their responses accordingly.

In summary, we observe that humanistic BPM tends to polarize towards low formalization and detail, and towards high agility, implicitness and flexibility. On the flip side, mechanistic BPM tends to polarize towards high formalization and detail, and low agility, implicitness and flexibility. Somehow the operationalization criteria seems challenging to humanistic BPM. Unlike the mechanistic process models, which are much closer to execution, the humanistic process models may be more difficult to implement in a technical system.

3. Humanistic Business Process Modeling

Preliminary considerations

Our humanistic approach to process modeling is based upon several theoretical considerations about knowledge representation. Explicit knowledge may be defined as the kind of knowledge that can be expressed in words and numbers, and shared by exchanging data such as formulae, manuals, specifications, and so forth [26]. Tacit knowledge, on the contrary, is not easily transmissible and can arise in two separate dimensions. The technical dimension refers to functional skills emerging from experience, whereas the cognitive dimension denotes the values, beliefs and mental models developed by people in the course of their life when interpreting reality.

We assume that mechanistic BPM systems already capture a significant portion of explicit knowledge [23]. Indeed that explains why we rated them high in the formalization and detail criteria. By contrast, the main challenge for humanistic

BPM regards capturing tacit knowledge. This can be done with a process known as externalization [27]. Typical externalization techniques involve direct elicitation from employees, for instance, using debriefing meetings and meetings where the participants develop group stories [18].

Tacit knowledge is typically distributed among several employees. That is why the best approaches to eliciting tacit knowledge are collaborative: employees from several structures within the organization may share their own views of a business so that a collective construction may express the whole contextual richness. Of course this may expose quite different and even conflicting views about the organization. However, unlike in the mechanistic BPM approach, we can assume that capturing inconsistencies and conflicts may actually enrich business process modeling.

We also consider that knowledge externalization follows several principles associated with what communication theorists designate by storytelling [28]. These principles capture universal, often unconscious, structures beyond stories: they have a beginning and an end, they set the scene for events, they trigger visual memories of past events, and they build awareness about the events and associated context [29]. Humanistic process modeling should incorporate these storytelling elements. One standing issue is how to derive business process models from user stories that are situated and episodic in nature. In addition, employees produce stories that are often fragmented and personal. Once again, our assumption is that the best way to address these problems is through collaboration support. When dealing with conflicting stories, information sharing, communication, collaboration, and negotiation contribute to clarify what is the most common work process and what are the most relevant exceptions and variations.

We finally note that a humanistic perspective over business process modeling must necessarily emphasize visualization [30]. Visualization is a powerful mechanism, which concerns the way people view, interact with and reflect over information [31]. The visualization of interrelated elements like actions, actors, conditions and information flows helps developing analytic skills and is fundamental to decision making. Other elements like visual signs may contribute to elucidate the details, contextual conditions and relationships among several business processes. And finally, visualization also contributes to developing a strategic view of complex data collections, which humans could find difficult to perceive in any other way. The problem however, is that some of what goes into the visualization may not go into the representation of business processes and vice versa. Rosemann [32] identifies some of the potential pitfalls that may be found, such as the “lack of details”, “lost in translation” and “lost in a drawing tool” problems. The gap between visualization and representation may be one of the main explanations why the BPM technological and humanistic views have not yet been fully integrated.

Scenes

The proposed modeling approach is organized around scenes. The concept is inspired by previous research on group storytelling [33], which used stories as a natural mechanism to collectively recall organizational knowledge. A scene is at the same time a unit of knowledge [33] and a fragment of a story [34]. As a unit of knowledge, the scene defines a particular work context, which may involve a set of actors and events occurring in a particular time and space. As a fragment of a story, a scene contributes with elements that give narrative structure, for instance explaining how the story enfolds.

We avoid making a scene a highly formal piece of information. As we often see in good storytelling, the information conveyed by a scene is a combination of communicated meaning and imagination from the reader [28].

Let us define in more detail the main attributes of scenes: **specific setting** links a scene to the particular setting where it occurs (e.g. an office or department); **actors** are persons or external systems participating in the scene; **artifacts** are physical or virtual objects handled by actors (e.g. tools and documents); **events** occur during a scene; and **actions** are executed by actors in a scene. We note however that as we often see in good storytelling, the information conveyed by a scene can be a combination of communicated meaning and imagination from the reader [28]. Therefore a scene may have much more semantic information than what we strictly consider in this data model.

Stories

For practical purposes, we define **story** as a sequence of scenes. This minimal structure basically serves to help the writer putting a narrative together. We define **process** as the sequence of scenes within a story that have events and/or actions. This sequence provides temporal relationships necessary to elucidate how a process unfolds along time. Note that we intentionally avoid a strict relationship between process and story, i.e. a story may have much more than the process. For instance, it may include the actors' biographical information, alternative endings, etc. This diversity is indeed suggested by the notion of contextual richness previously discussed.

Let us now characterize the story and process elements in more detail. A story has the following attributes: **beginning**, is the scene that starts a story; **sequence**, gives an explicit order to the scenes belonging to the story; and **ending**, is the scene that closes a story. A process has the following attributes: **description**, summarizes the work accomplished by the process (e.g. processing a sale); **primary trigger**, is the event that usually triggers the process; **alternative triggers**, refer to other events that may also trigger the process.

Compared with typical business process modeling approaches, we observe that having processes within stories gives more narrative freedom to modelers. Just to illustrate the point, we note that modelers may start by setting the scene, presenting the main actors. Then they may mix scenes focused on actions with scenes dedicated to describing problems, contexts and decisions. And finally, they can also highlight some problems that may occur after completing the process. These non-task-oriented scenes do not usually appear in traditional business process models. Furthermore, we note that scenes also introduce another element of flexibility to the process description, since we do not define temporal relationships to the actions specified in a scene.

Visual structure

Visual structure increases models' contextual richness and helps deal with the ambiguity introduced by our definition of story, process and scene. Firstly, we define several attributes that help describe the scene's visual contents: **primary picture** is a picture illustrating how actors and artifacts are related in some particular context (e.g. a meeting); **alternative pictures** convey the same meaning of the primary picture and may be used to avoid dullness; **number of actors** and **number of artifacts** specify the number of distinctive elements in a picture that may be associated with specific actors and artifacts, respectively; **location of actors** and **location of artifacts** specify the coordinates of visual elements in a scene. Basically, this type of information is necessary to create placeholders on top of pictures for other contextual data (see dialogue lines and annotations below).

Secondly, we define several attributes that serve to attach contextual data to a scene: **dialogue lines** are visual elements that associate conversation with actors shown in a picture in a way that is similar to bubbles seen in comic strips; **annotations** are visual elements that serve to place explanations in a picture, for instance, they can be used to name actors and artifacts, or to describe what actors are doing; **positions of dialogue lines** and **positions of annotations** indicate the relative positions between these visual elements and actors and artifacts, which help interpret what is shown by a scene.

Finally, we define two additional attributes related to the visual characterization of a scene: **generic setting** describes the scene in a way that is independent from the modeled organization and task goals (e.g. "actor handing over an artifact"); **generic location** describes the scene's location in a way that is independent from the modeled organization (e.g. meeting room). As described later, these two attributes are mostly useful for searching scenes.

In Figure 1 we summarize the main elements of the proposed modeling approach. When compared with other approaches, we observe the data model offers fewer technical elements (e.g. join/fork) to privilege the composition of text and pictures. Furthermore, the relationships between visual elements shown by pictures (actors and artifacts) and elements placed atop pictures (annotations and dialogue lines) should be implicitly perceived and interpreted by the readers. Thus the model does not enforce a strict formalization of business processes. No claim is made concerning completeness or unambiguity. However, the combination of pictures and text helps describing processes in very flexible ways, for instance using annotations such as "alternatively", "every three months" or even "to be completed".

We finally emphasize that the model assumes that business processes can be composed from generic scenes describing common business situations. It is assumed that modelers are responsible for composing scenes into a meaningful story, grounding scenes in reality through dialogue lines and annotations. For instance, a scene describing a face-to-face meeting can be contextualized with the participants' names, meeting location and specific documents under discussion. The model does not describe how to draw scenes. It only concerns composition and configuration. Of course a library of scenes should be conveniently available before starting modeling. This library should provide a range of scenes covering decision-making events (decision meetings, informal decisions, expert consultations, etc.), communication events (phone talks, face-to-face meetings), coordination events (forwarding documents, applying rules), individual activities (completing forms, signing documents), and automated tasks (gathering data from databases, information processing). We discuss this issue in the next section.

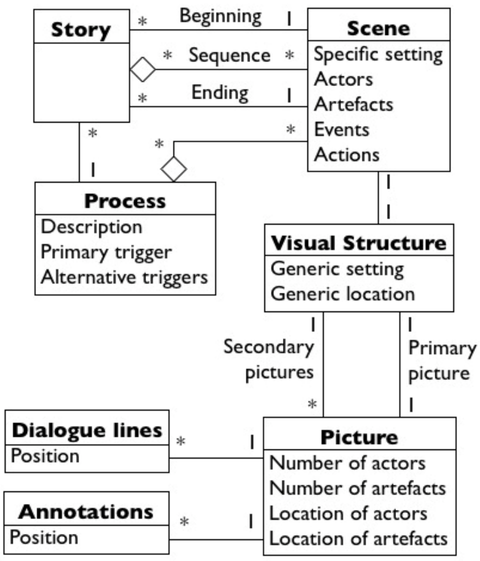


Figure 1 – Main elements of the proposed humanistic business process modeling approach

4. Implementation

We developed the BPMerlin tool to validate the concepts described in the previous section. BPMerlin was implemented with Web technology, which enables rapid deployment for testing scenarios and provides a well-known client-server architecture supporting simultaneous access for local and remote users. We used the Microsoft ASP.NET 4.0 framework, with Linq and Microsoft Entity Framework over an SQL Server database to manage data persistency.

We also used jQuery for synchronization and GDI+ API to draw text and graphical elements over JPEG pictures, which materialize the scenes discussed in the previous section. The adopted programming language was C#. AJAX was used to animate user-interface elements.

As prescribed in the proposed approach, BPMerlin combines scene and story composition. Besides that, the tool also supports some configuration management activities that simplify the modeling task. Let us start the discussion with configuration management.

Configuration management

Since stories associate generic elements in scenes with specific organizational actors and artifacts, BPMerlin provides separate management of these organizational entities. Typically before starting a modeling task, a configuration manager should specify the organization's structure in BPMerlin. The tool supports multiple organizational configurations such as networked, decentralized and the more common hierarchical organizations using departments, department heads and groups, all the way down to the level where individual persons and roles may be specified. Specific artifacts used by target organizations at these various levels may also be named (e.g. office request forms). They provide shortcuts for naming what appears in scenes. Figure 2 illustrates how organization structures may be defined.

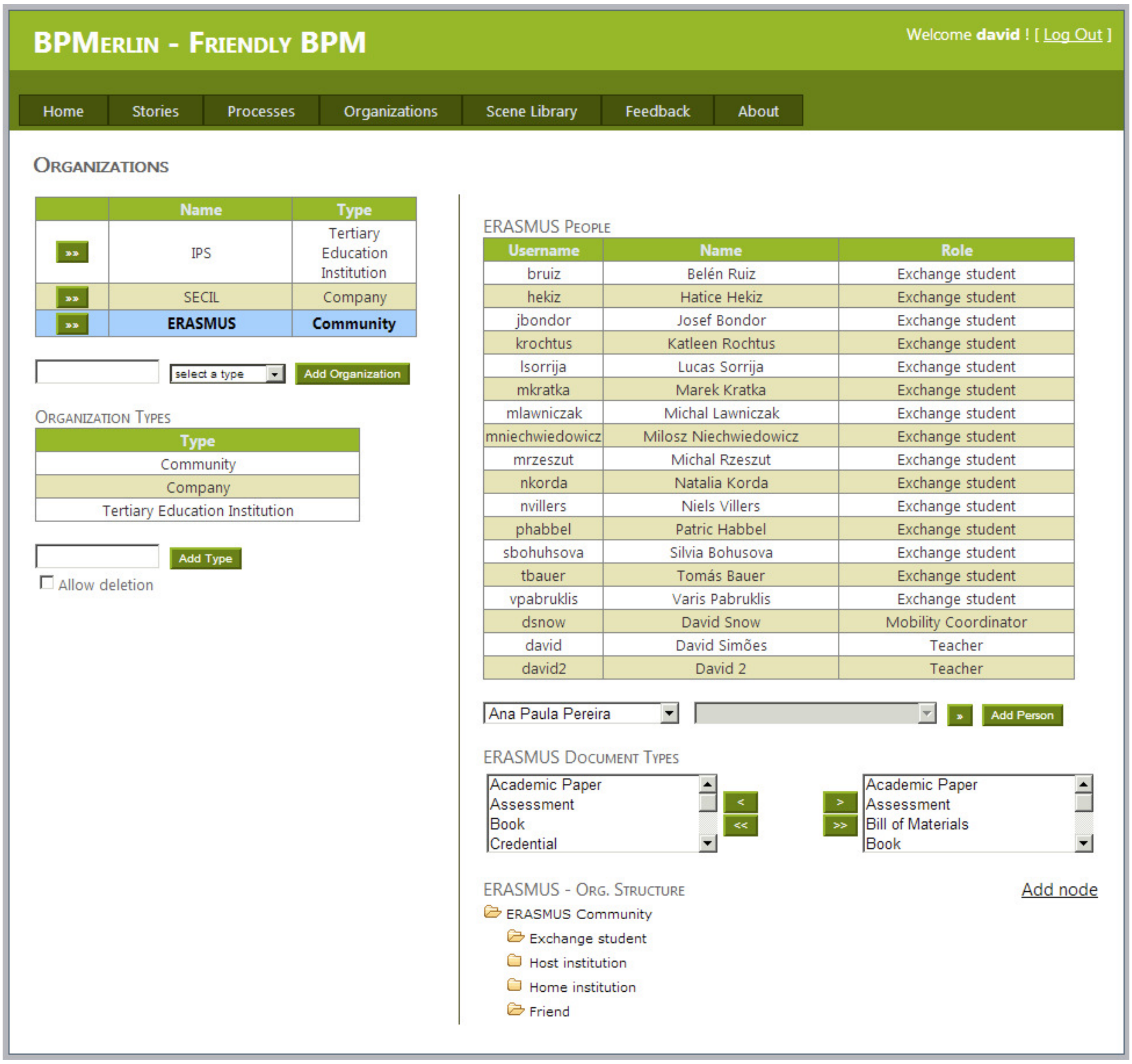


Figure 2 – Managing organizational structures

Several types of organizational structures may be specified including, functional, product, market, and geographical structures. Dependency relationships may be established between several organizational nodes to define vertical, horizontal and mixed hierarchies. When configuring the tool for a particular organization, employees are given user accounts that are mapped to their specific roles in the organizational structure. It is also possible to customize the types of artifacts that will be available for modeling, including specific documents types, software tools, etc.

Another relevant functionality pertaining to configuration management is automatically assigning end-users to processes being modeled. BPMerlin manages a list of processes under development and uses information about the organization structure to automatically associate processes with end-users. When an end-user logs on the tool, only the relevant processes are displayed and can be modeled (Figure 3). This functionality assumes that the modeling activity is done company-wide, i.e. all relevant persons belonging to the organization and related to a process are entitled to participate in the process modeling task.

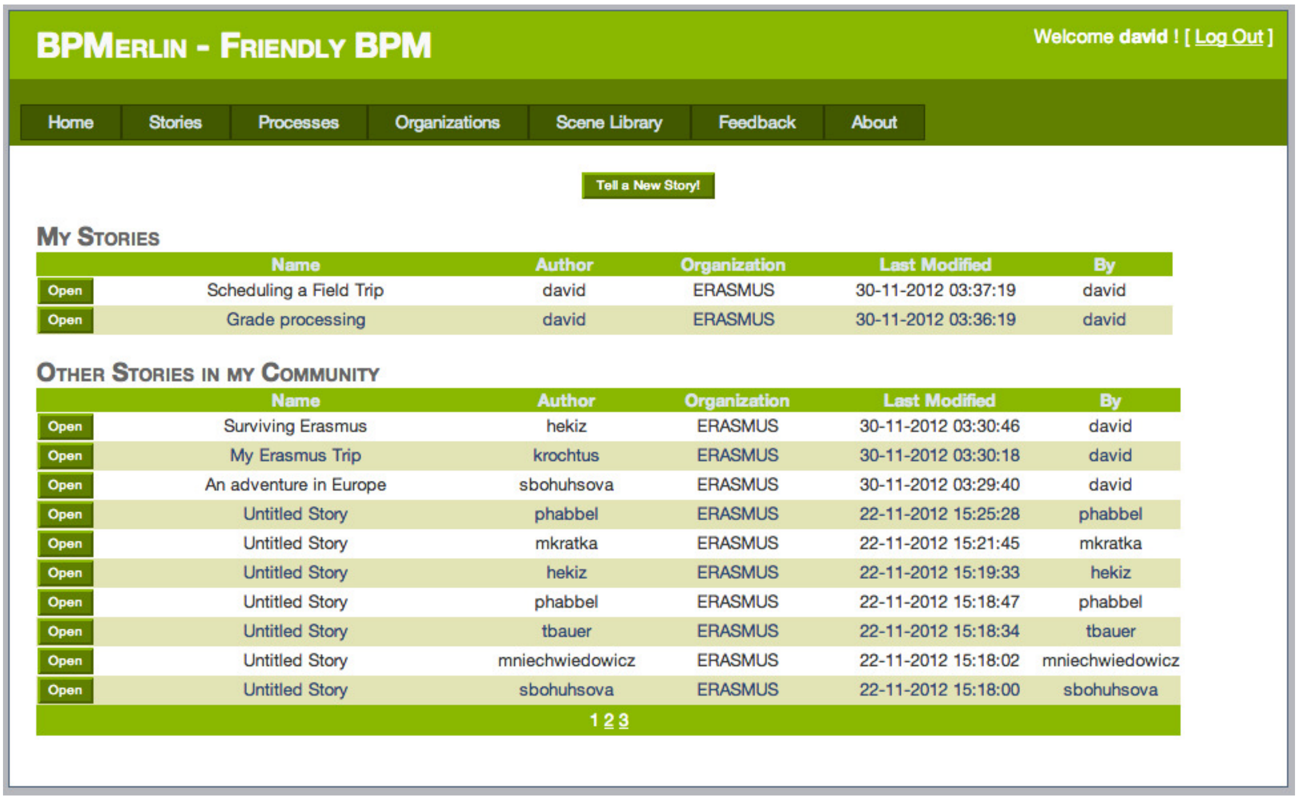


Figure 3 - List of processes relevant for a particular end-user

Story composition

Story composition involves the following functions:

- Describing the business process;
- Defining the primary and alternative triggers;
- Defining the beginning and end of the story;
- Selecting scenes from the scene library and adding them to the story;
- Composing the scenes to describe the business process as a story.

The scene library is at the core of story composition, since most of the modeling work consists exactly of selecting scenes from the library and composing them into a story. Two distinct features have been implemented regarding the scenes library. The first is the mechanism that allows populating the library with new scenes (Fig. 4). This involves uploading a picture and specifying the visual structure, which includes identifying the number of actors and artifacts represented in the picture and indicating where they are located. The location information helps automatically define placeholders for dialogue lines and annotations. When presenting a scene to end-users, BPMerlin automatically determines where to place dialogue lines and annotations. It also draws lines between dialogue lines and annotations and the picture elements, which helps visualize the whole work situation. We note that enriching the library with new scenes does not require having an expert.

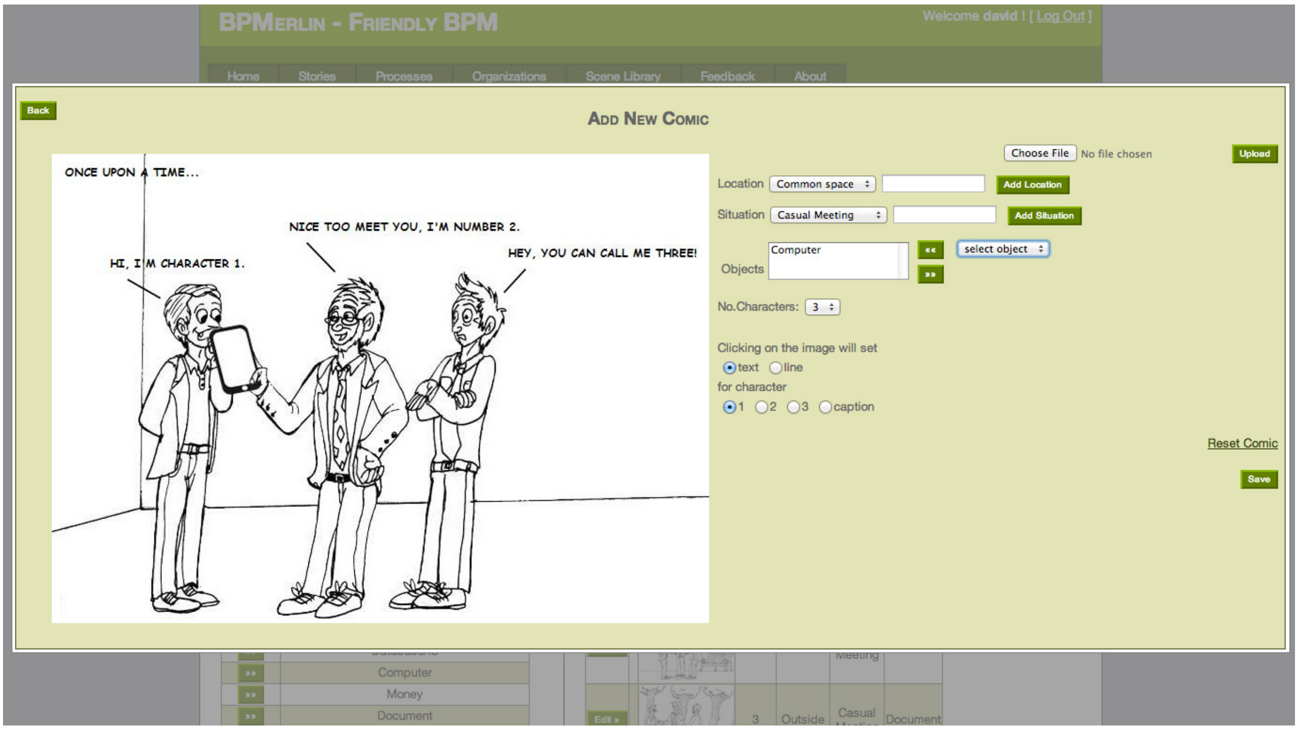


Figure 4 - Adding a scene to the library

Figure 5 - Selecting scenes from the library

Figure 6 – Process composition canvas showing scenes composed by end-users

Once the library is populated, end-users can pick scenes and use them in their stories. Searching and filtering the library with words provided in the generic scene and generic location descriptions helps the selection. As shown in Figure 5, BPMerlin displays thumbnails to help searching the library. When a scene is selected, it is placed on the composition canvas, which displays the sequence of scenes. The scenes in the canvas can be rearranged, edited and deleted. Figure 6 shows the composition canvas for a process describing how a student enrolls in an exam. This particular example highlights that the process model can be much more than just a sequence of well-defined steps since many side notes and even humorous remarks may be added to the specification. Moreover, remarks and explanations about exceptional flows may be defined in a natural and integrated way, enriching the story by conferring tension and revealing scenarios that are less prone to be elicited by more traditional means.

All in all, we note that with this approach business process modeling is a more creative activity than a data intensive task. End-users are not required to comply with too many constraints and can use scenes, dialogue lines and annotations in many different ways. In particular, we note that typical fork/join constructs, instead of being explicitly modeled have been substituted with more informal constructs, using a combination of visual elements and text, elucidating how processes flow within stories.

Scene composition

Scene composition involves the following functions:

- Associating generic actors and artifacts shown in a picture with concrete elements belonging to an organization;
- Adding dialogue lines to actors;
- Adding annotations to a scene;
- Associating specific organizational events and actions to a scene.

BPMerlin allows end-users to select a scene on the canvas and edit it using point-and-click functions. They can add dialogue lines, which are automatically placed in an appropriate position in the picture (Fig. 7). Nevertheless, end-users can move the dialogue lines to different places using the pointer. Clicking on a button associated with an actor and then selecting a role from a dropdown menu couples that role to the actor shown in a scene (Fig. 8). The roles appearing in the dropdown menu are defined in the configuration management phase.

The same type of interaction can be done to associate an artifact shown in a picture with a specific organizational artifact. We note again that end-users do not draw scenes. Instead, they configure existing scenes to model a particular work situation.

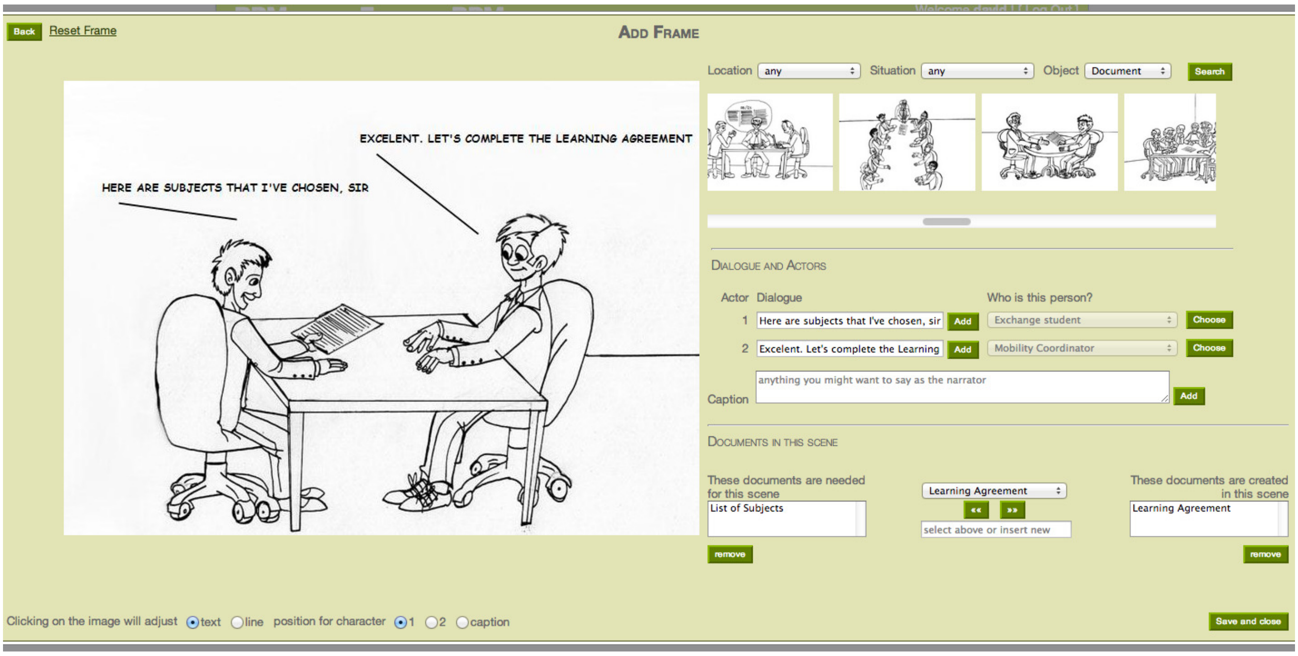


Figure 7 - Configuring scenes with dialogue lines

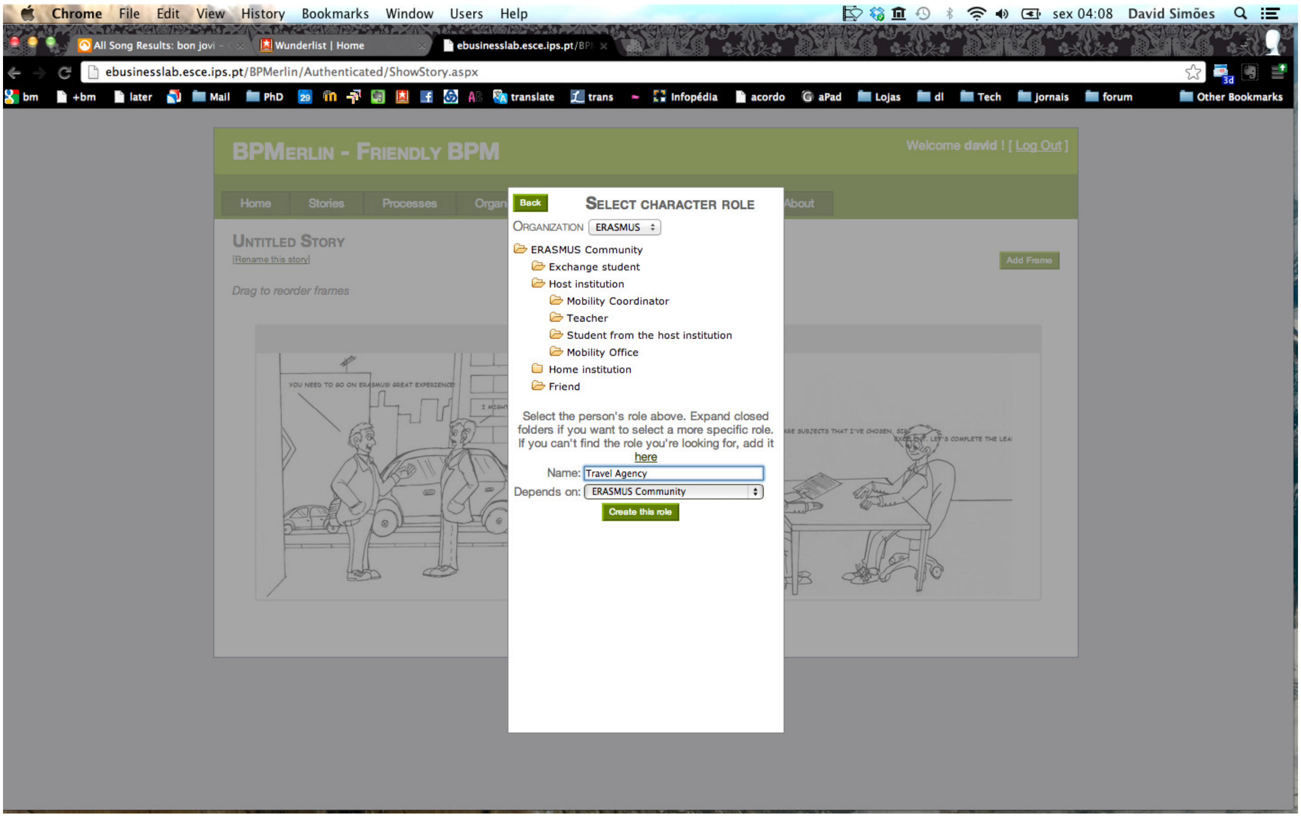


Figure 8 – Assigning specific roles to actors appearing in scenes

Collaboration support

BPMerlin supports collaborative modeling, though with some limitations. The server supports several client connections (Web browsers). This way several end-users can access the same story, view what is going on and participate in the story composition. However, scene composition is not shared and more sophisticated collaboration features are not supported, e.g. collaboration awareness and voice/text communication. The main reason is that the tool was designed to support company-wide contributions from employees, not small teams working on the same scene. If several end-users wish to focus on the same business process, then they should use external tools to improve awareness and coordination.

5. Developments and Preliminary Evaluation

BPMerlin scene library was developed with a small set of frames taken from business-oriented comics available on the Internet [35]. This library served mainly to prototype the tool. Several empirical tests with end-users were done to evaluate the interaction support and resulted in numerous improvements to the user-interface. In particular, we improved the method used to insert dialogue lines and comments in scenes after realizing that the relationships with the actors appearing in pictures could be equivocal. The lines shown in Figure 6 connecting the dialogue lines to the actors resulted from these empirical tests. The tests also served to validate the technological infrastructure, especially regarding the visual configuration of individual scenes and the composition of scenes on a canvas. We can report that scene composition can be done using standard Web technology and browsers. We consider this important for the promotion of enterprise acceptance of our approach.

Our initial tests also revealed the importance of having a library with a significant collection of scenes. The integration of new scenes, although possible during a modeling task, should be regarded as a workaround, since having to constantly add new scenes to the library may disrupt the end-users' main goal, which is to model a business process. We also found it difficult to come across good pictures for new scenes whilst avoiding the library becoming a patchwork. Thus the best approach seems to consist in trying to build up a coherent library of representative scenes. The problem then is how large this library may become.

In order to get a better understanding of this problem, we decided to apply our approach to a real-world organization and from that case we developed a representative collection of scenes. The selected organization was a tertiary educational institution (polytechnic). This institution was seeking to extend the existing system with a more process-oriented structure, which would allow reengineering several functions related to the management of staff, students and courses. However, they had not yet developed a clear process-oriented perspective, and neither had they specified any business processes. Therefore we approached this organization with two goals in mind: 1) helping the organization identify and characterize existing business processes; and 2) at the same time learning how to model business processes using the tool. This work was done with the participation of several members from the organization. The work was organized in the following steps:

1. Help the organization identify and characterize their main activities, not yet considering how they could be systematized in business processes;
2. Characterize the scenes associated with each activity;
3. Populate the library with a representative collection of scenes;
4. Help the organization tell the stories behind their main activities using the tool;
5. While having the employees tell these stories, help them reengineer the business processes;
6. Use this storytelling process to get feedback about the tool and scene library.

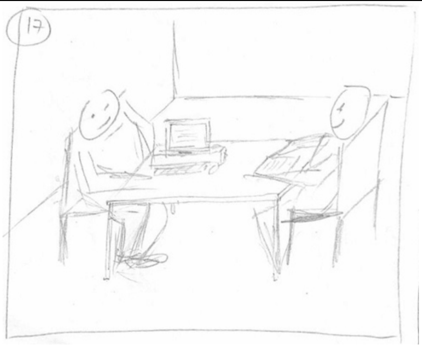
Steps 1 and 2 described above took about four weeks to accomplish. By the end of step 2 we had a document with 118 pages revealing the following information:

- 104 main activities performed by the target organization;
- 61 different documents either manipulated or produced by the 104 activities;
- 8 physical artifacts identified as relevant to some activity;
- 7 different work settings identified as necessary for characterizing all 104 activities (working, formal meeting, informal meeting, send/receive, communicate, approve, sign);
- 48 different organizational units involved in activities and spanning three different levels;
- 24 individual roles, most of them identifying department and team leaders;
- Besides these 24 individual roles, 9 work groups were also identified as relevant to some activity.

So this organization has 81 different entities, contemplating units, groups and roles, distributed on three levels. They accomplish 104 distinct activities, which involve 69 different artifacts, 61 of them being documents. During step 2 we observed that, of the 104 activities, many were small variations of the same type of work. Therefore we considered that a smaller set of scenes could actually be used to cover the whole business. A set of 35 distinct scenes was then considered sufficient to cover all activities.

A young artist was then engaged in our project with the purpose of conceiving pictures for the 35 activities. The main reason behind selecting a young artist was that we were seeking to obtain naïve pictures, which could evoke the depicted activities but without much attachment to the specific organization that we have studied. Simple descriptions accompanied by rough picture drafts of the scenes were provided to the artist. Table 2 illustrates the information delivered to the artist.

Table 2 – Example of activity description

Scene nr. 17 - Work done by two persons on a document and a computer	
Generic location	Individual or shared office
Actions	Working
Nr. of actors	2
Nr. of artifacts	2
Artifacts	Document, computer
Sample picture	

A small sample of the pictures made by the artist is shown in Figure 9. Versions were made in color and black & white.

Figure 9 – Some of the developed pictures

These pictures were then inserted in the tool's library, accompanied by the corresponding meta-data (step 3). Several persons belonging to the target organization where then engaged in process modeling with the tool (step 4). So far, 27 persons have used the tool, including 24 students, one lecturer, one department leader, and one unit coordinator. The students were engaged in collaborative modeling sessions (divided into two groups of 13 and 11 participants). One group modeled a process that sets the dates for mid-term tests, while the other group modeled the process that handles complaints on assessment grades. The other three participants were engaged in individual modeling sessions. These participants were committed to model more complex processes related to enrolling in exams and organizing the school's exchange program for foreign students. These processes were selected by the target organization because they were considered particularly troublesome.

Before starting the modeling task, all participants were briefly instructed on how to use BPMerlin. Handouts describing the tool usage were also distributed to the participants. Considering the different levels of complexity of the assigned tasks, a time limit for modeling sessions was not established. Figure 6 shows the output produced by one of these sessions (the one that involved a unit coordinator modeling the school's exchange program for foreign students).

Both groups and individual participants were observed during the modeling sessions. Field notes were taken reporting on notable events that occurred during sessions. This information was then complemented with notes taken from debriefing meetings held with the participants. We report the obtained results in two main categories, the first reporting usability issues, and the second focusing on a more reflective analysis of the proposed approach.

Usability issues

- One participant complained that several times he could not find an adequate scene in the library;
- One participant was unable to understand the details of scene composition. This was manifested by an indifferent use of dialogue lines and annotations, as well as an inadequate positioning of dialogue lines/annotations in pictures;
- Another participant could not find an adequate way to associate himself with an actor shown in scenes. This was revealed by equivocal references to himself and others in dialogue lines;
- One participant could not associate roles to actors shown in scenes (during the debriefing this was considered a usability problem caused by the tool's role mapping interface);
- Several participants had difficulties visualizing stories because of computer screens' low resolution and also because the browser would not let them scroll the page horizontally (they used an old version of Internet Explorer);
- Several participants complained that the tool does not provide adequate feedback when a search in the scenes library produces an empty list;
- One participant reported that often, when searching the library, the output included repeated pictures. This problem is caused by the use of picture thumbnails in search results, which makes it difficult to distinguish small details such as the placement of different objects in otherwise similar scenes.

Reflective analysis

- Although the participants could finish the assigned tasks, the obtained results showed significant variations in the level of detail. In particular, we noted that some descriptions were not connected to reality (too abstract) and missed contextual richness. Further research is necessary to understand the contributing causes for this lack of contextual richness;
- Scene composition requires too many user interactions both to search the library and to configure scenes, which makes it difficult for users to incorporate details into stories. These usability problems may significantly contribute to the lack of contextual richness. For instance, a unit coordinator took about one hour to model the school's exchange program, which resulted in a story with just eight scenes;
- One of the participants explicitly voiced that the modeling task was "mechanically slow", requiring too many steps to design a scene. Difficulties in designing scenes may result from the combination of drawing elements with data input from forms. Further research is necessary to optimize scene composition, for instance making organizational roles and artifacts more readily available;
- When composing stories, the participants often have to switch back and forth between story composition and scene composition, trying to reconcile different levels of detail. Being able to edit scenes during story composition would contribute to reducing this problem, although the problem may persist when the users develop very long stories;
- Several participants revealed preoccupation with the correctness of their stories, i.e. how far they might diverge from the processes formalized by the organization. This would suggest investigating how to develop organizational culture regarding end-user process modeling;
- The participants were not always able to portray some situations as they wanted. Some of them tried to depict precise working contexts (e.g., a casual meeting taking place in a formal work area), while the library only offers a limited set of stereotypes (e.g., casual meetings taking place in open spaces and formal meetings taking place in meeting rooms). However, the problem seems more related to learning how to exploit the tool and finding the most adequate level of abstraction than with stuffing the library with more scenes;

Overall, our preliminary results indicate that, although the main principles adopted by BPMerlin are easy to understand, some training and organizational learning are necessary to master the modeling task. We note in particular that users have to learn how to define the most appropriate level of abstraction, combine different opinions, exercise creative confrontation, and address their lack of knowledge about some parts of the process. It is also apparent that organizations must give more confidence to users, so they feel free to express their own views about the processes and to enrich process descriptions with more contextual information.

Furthermore, we also recognize that we need to improve the tool's usability and further investigate how to implement incentive mechanisms enticing subjects to make good stories. This would include incentives for composing scenes that are less abstract and more proximate to reality, scenes enriched with more information, and also stories that embrace more personal viewpoints.

6. Related Work

Acosta et al. [36] developed a tool for externalizing tacit knowledge using group storytelling concepts. The users externalize their knowledge by discussing activities they use in a narrative way. The tool has a strong emphasis on hypertext, allowing a group of users to link pieces of text telling stories in a way that resembles the well-known mind mapping approach. Nevertheless the approach revealed several problems. An important one is that it seems difficult to extend the approach to large groups. The authors have experimented with groups of three elements and speculate that beyond five elements the tool would be difficult to use. Another problem is dealing with a large hypertext structure and at the same time maintaining the coherence of the story being told. Compared with our approach, we note that conveying a story as a collection of pictographic scenes may help keeping a holistic view of the business process. Furthermore, BPMerlin was designed to operate company-wide.

Santoro et al [37] also adopted the group storytelling approach to knowledge externalization. They consider a sequence of three steps: gathering stories from employees, identifying facts, and linking those facts to formal process models. The first step is primarily done by end-users, while experts in BPM must do the other steps. This strategy addresses the problem of transforming stories into more formal business process models, although no experimental results are provided about the proposed solution. Focusing on the first stage, we observe it is again inspired by group storytelling, i.e. having a group explain tasks and roles using a small set of constructs like characters, events and documents. Stories are captured as a linear sequence of small pieces of text. Although it removes the complexity of mind mapping, it also makes it more difficult to express rich stories.

Moving beyond the group storytelling approach, we note that design storyboards have been suggested as a possible approach to business process modeling [38]. Design storyboards use sketches, cartoons, and other familiar visual elements, in combination with text, to represent interaction [39]. This technique has been originally developed to visualize system requirements during user-centered design workshops [40]. BPMerlin may be regarded as a tool supporting the development of design storyboards using predefined scenes instead of the hand-drawn cartoons typically seen in design storyboards. Thus

BPMerlin can be situated in this research stream, contributing to validate that suggestion. An alternative or perhaps complementary source of information for process modeling is of course mining legacy information systems [41].

Another emergent research stream that has caught significant attention from the research community considers applying social software to business process modeling [21-23]. Systems like Wikipedia have been very successful in making large communities effectively converge towards knowledge externalization. We find some philosophical aspects of social software quite compelling: the capacity to engage a very large community, the lack of technical complexity that makes social software inclusive, the lack of central planning and control and more fundamentally, the capacity to leverage the intelligence of the crowd [21] and reflective learning [42]. The adoption of semantic wikis affords developing collaborative and intuitive environments for business process modeling. Dengler et al [43] provide an interesting overview of seven different tools. As mentioned by the authors, "while all of the tools allow the users to express their process knowledge with natural language, only half of the tools provide an intuitive graphical interface for rendering and editing processes". We emphasize again that BPMerlin addresses exactly this problem in an innovative way.

7. Discussion and Conclusions

BPM is seen as an opportunity to integrate various enterprise systems and use process modeling as "organizational glue". Business process automation leverages organizations to become more organic (improved communication), sensitive to new societal trends (better response time) and take more profit from their knowledge assets (better collaboration). In order to make this possible we have to model business processes. The problem then is how to do it. Early approaches were revealed as too mechanistic and did not seem very successful in organizations, especially in managerial areas above administrative support. We would suggest this situation occurs because they promote mechanization, standardization and bureaucratization, which indeed contradict the major forces leading towards more knowledge-centered organizations.

The emergence of movements such as enterprise 2.0, knowledge management and collaborative/social computing reflects the need to leverage the collective intelligence of the crowd in business process modeling and management. The problem, then, is how to model business processes in this challenging environment. As stated by Rosemann [32], "process modeling is an area where artists (heavy right brain utilization) meet scientists (heavy left brain utilization), internal knowledge workers meet external knowledge owners, business meets IT". Our standpoint is that, in order to meet the stated dyads, we have to recognize and embrace the humanistic side of BPM. This means incorporating inconsistency, uncertainty, vagueness, omissions, conflict, nuance, plasticity, and tacit knowledge in the scope of business process modeling.

We suggest a set of criteria highlighting the main differences between humanistic and mechanistic BPM: formalization, detail, agility, operationalization, implicitness, and flexibility. Based on these criteria, we developed a humanistic business process modeling approach. The proposed approach structures the modeling activity around the notion of a scene: a pictorial description of a working situation. The small set of formalisms affords exploring various process narratives (instead of specifications), conveying not only information about the main and alternative paths, events, artifacts and actions, but also information about the interactions, decisions, attitudes, and other contextual factors.

As significant as the proposed approach, we have the modeling tool. The tool supports company-wide process modeling through the composition of scenes, transforming business-process modeling tasks into creative storyboarding activities. The tool transforms business process models from being highly technical specifications towards being real stories, as told by the actual performers.

An important functionality supported by the tool is the scenes library. This library offers a collection of typical work situations that may be configured to describe concrete activities such as elaborating, discussing or signing a document, just to give few examples. Currently the library has a collection of 35 scenes. These scenes were developed and validated in an action-research project that involved helping a real-world organization reconsidering their business through a process-oriented view. It involved the identification of a large set of organizational activities (more than one hundred), followed by a process of elimination of similarities and generalization of work situations. It also involved an artist drawing motivating pictures to express the identified working situations. Several persons belonging to the target organization used the tool to develop business processes.

Thus another important contribution of this research is a preliminary indication that business processes can be modeled by end-users. We regard this as another opportunity to increase the humanistic orientation of the proposed approach: giving back the control over technology design to end-users, this time not because they are allowed to participate in technology design but because they *metadesign* the technology. The emergent concept of metadesign [44] explores the end-users' capacity to design their own technology and is linked with a human-centred perspective over technology development.

The tool allows several end-users to collaborate in describing and enriching business processes. This may help eliciting different/conflicting/complementary views over business processes. Also, some users may review previous descriptions and the tool should keep the various versions. In the future, graphical local versions could be supported by the system likewise the "Stick-Ons" applied to plain text [45].

When fully developed, the tool may have a strong impact on organizational practice. Currently, BPM technology requires contracting external experts to model and implement business processes. By transferring these activities to the internal structure and democratizing its access, one may obtain significant economical gains, reduce the organizations' dependence, improve acceptance, and decrease response time to turbulence [18]. In particular, this approach could be advantageously used in supply chains [46, 47].

Of course we should also discuss some shortcomings and potential pitfalls of this research. Firstly, we recognize that more evaluation is necessary, with more users and more organizations involved. Such work is currently under way. We need to further evaluate the coverage of the scenes library to wide-ranging organizational needs, a difficult task since we observe such diverse types of organizations, especially with the emergence of virtual organizations. More focused research should also be targeted at determining what types of narratives the users will produce with the tool, and if they are capable of expressing the diversity of contextual elements that usually accompany organizational work.

Secondly, we should recognize the importance of integrating our approach with BPM technology. Our aim is not to model just for the sake of modeling, but modeling to implement BPM systems, so the link must be more thoroughly addressed. In our model, we establish this link by allowing users to identify events and actions that can then be associated with system functionality. However, more work is necessary to understand if this mechanism is sufficient and/or efficient.

Finally, we have to recognize that the proposed approach faces strong competition from the social-computing field, which has been proposing the adoption of collaborative tools like Wikis to develop business processes. So far, these approaches seem more focused on the technical side, but considering that the technology is intuitive and has wide acceptance in other areas, it may become prevalent in the BPM field. Of course the tool we propose may offer as an advantage the scenes library, which nevertheless will require further research to assess its reusability.

In our introductory remarks we identified six problems with business process modeling that researchers have been trying to explain. Now we can revise those problems in light of the outcomes from our research:

- The "automating a fiction" problem – End-users may elaborate their stories using creativity, nuance and ambiguity. As such, the models may come closer to what happens in companies.
- The "model-reality divide" – As previously stated, user acceptance must be further investigated. However, the results obtained from our case indicate the approach was well accepted by the end-users and considered useful by the organization.
- The "model-consistency" problem – The proposed approach specifically avoids introducing operational constraints into business process modeling, so the problem is avoided "by design" in our approach. However, further developments are necessary to integrate humanistic process models with BPM systems.
- The "collective intelligence" problem – The proposed tool supports collaboration and was designed to operate company-wide, allowing employees to combine different views about what is modeled. As such, the tool leverages the collective intelligence of the organization.

- The “lack of flexibility” problem – The tool promotes collaboration in process modeling, thus lessening this problem.
- The “missing tacit knowledge” problem – Considering that the modeled business processes retain their humanistic characteristics and especially do not require any unusual knowledge about process modeling, we would say that they can gather contributions from employees at different organizational levels, while at the same time contributing to retaining such distributed knowledge in a purposeful way.

Future work will address two main research lines. The first one concerns the subtle relationship between stories, processes, events and actions. As previously discussed, we define process as a sequence of scenes in a story containing events and actions. The order of events and actions within a scene is not specified and can be ambiguous. However, when we consider execution, we must establish that order. Several approaches must be investigated in the future. One option that we have already tested consists in having the tool propose a specific order and letting the user confirm or veto the suggestion. This would introduce some execution constraints in advanced modeling stages, while still avoiding a dependence on expert modelers.

The second research line requires conducting more case studies with the tool. In particular, we would like to investigate what scenes may be necessary to cover the majority of business processes we find in most common organizations. Providing a comprehensive library would certainly contribute to increase the tool’s perceived value.

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