Humanistic Approach to the Representation of Business Processes

David Simões[1], Pedro Antunes[1], José A. Pino[2]

[1] Faculty of Sciences, University of Lisbon, Portugal
[2] Department of Computer Science, Universidad de Chile, Chile

***Abstract*—This paper describes a collaborative tool supporting humanistic business process modeling. The tool adopts group storytelling and design storyboards in order to ease knowledge externalization and representation. This humanistic approach diverges from the existing approaches requiring strict process formalization and emphasizing technical details, which constraint the modeling tasks to technology experts. The paper presents the fundamental theoretical concepts underlying the humanistic approach and illustrates how they have been implemented in the tool.**

***Index Terms*—Business process modeling, group storytelling, design storyboards.**

I. Introduction

Most modern organizations have been rethinking their structures and processes to benefit from the possibilities offered by computing technology. The movement known as Business Process Management (BPM) is especially focused on developing information systems to improve work coordination, resource management, and communication, while automating routine human work and fostering organizational change when the implementation is made.

BPM has however one fundamental problem: organizations must formalize their business processes down to the task-level details required by BPM systems, notwithstanding the fact that such formalization is often expensive to obtain, error-prone and potentially harmful to organizational behavior. BPM may lead to what is often called "automating a fiction" [1]: adopting predefined behavioral paths and strict control over process execution, while disregarding the ambiguous, informal and often unexpected interactions between what is occurring inside and outside the organization.

Most organizations implementing BPM systems realize this problem and face a dilemma: either change their nature to comply with the technological constraints; or restrict BPM to the most routine, bureaucratic and careless parts of the organization.

Both possibilities raise their own problems. Making organizations comply with BPM systems may reduce resilience and alienate personnel, while delimiting BPM to the peripheral parts of the organizations may lead towards the wrong strategic directions, emphasizing tactical over strategic goals and neglecting the effects on organizational behavior.

This paper was supported by the Portuguese Foundation for Science and Technology (PTDC/EIA/102875/2008 and PTDC/EIA-EIA/117058/2010).

The main goal of this research is tackling the conflicts between the technological and humanistic views of BPM. Effective BPM should retain the human flexibility to adapt and improvise while supporting the technological capability to manage large-scale information and distributed services.

Our standpoint is that we need to represent organizational processes in a different way, which does not depend on the underlying technological constraints, which preserves the human ability to handle variations, exceptions and unique contexts, and which may still be translated into formalized activities whenever it is necessary.

Our research is focused on two recent and very promising humanistic techniques: group storytelling and design storyboards. Group storytelling is a text-based knowledge externalization technique that uses an almost universally familiar narrative structure to elicit the main structural and contextual elements of a "story". Design storyboards use an intuitive scene-by-scene structure to express the coordination of activities. We hypothesize that the combination of these techniques may support the specification of organizational processes both in humanistic and technological ways.

The tool described in this paper offers: 1) a knowledge externalization model elucidating the fundamental relationships between the humanistic and technological views of BPM; 2) support for collaborative specification of business processes; and 3) the mechanisms needed to reconcile the humanistic and technological representations.

The main expected contributions from this research are twofold: 1) an innovative technique to capture and represent business processes; and 2) significant research contributions to the integration of the technological and humanistic views of BPM.

II. Related Work

Several researchers observe that computerization has been increasing and organizations are becoming more dependent on computing technology [2]. All along with this increasing dependency we find out that organizations have become more complex, adopting new transformation processes, higher temporal demands, wider distribution and span of control, increased skills and more intensive decision-making [3]. A great part of this complexity is held up by BPM systems.

BPM supports business automation, task coordination, data and resource management, messaging, and service composition based on process representations [4]. Since the origins of BPM, which aimed to exploit existing document management systems [5], research has focused on developing an integrated infrastructure to efficiently enact and manage business processes and to integrate workflow management with client applications [6].

Other important early research streams included support for ad-hoc changes while preventing system malfunctions caused by erroneous human decisions [7, 8], developing techniques to improve robustness when facing unexpected events [9], supporting change management [10], and supporting enterprise-wide, heterogeneous, autonomous, and distributed operations [11].

However, many early BPM systems faced difficult acceptance by organizations [12, 13]. Much of the blame for it is attributed to lack of consideration for the human role in BPM [14-16].

The most modern views over BPM attribute equal importance to technology and humans, assuming the complementary roles of automation and discretionary human behavior, the former offering guidance and accountability, and the later contributing with openness and flexibility [17]. Both Antunes [18] and Antunes and Mourão [19] discuss the impact of human discretion on BPM and propose an integrated view based on the resilience concept. Bruno et al. [20] also discuss how to extend BPM technology to embody the human roles.

Process representation is at the core of this discussion, as it serves the dual objective to automate the business and empower humans. However, our examination of the state of the art highlights that process representation is conditioned by three fundamental conflicts [18].

The first conflict concerns formalization and responsiveness. As previously noted, BPM requires some degree of formalization. High formalization turns organizations less responsive to turbulent environments, because changes must be analyzed, integrated in the BPM system, and deployed in the organization; but less formalization challenges the ability of BPM technology to effectively manage business activities.

The second conflict concerns detail and flexibility. BPM requires very detailed representations about what, how, when, who, and where tasks should be executed. However, it has been shown by various ethnographic studies that humans often prefer ambiguity over detailed task prescriptions, so they may be able to define strategies and make their own decisions according to the peculiarities of the real-world context [21].

Finally, the last conflict addresses intentionality and implicitness. To represent a process, one has to operationalize the intricate relationships among information flows, control flows, human activities, automated activities, workflow conditions, and work contexts. This naturally requires the involvement of technology experts [22]. However, the process representation also transforms implicit into explicit knowledge, which requires domain experts, i.e. people who work in the target organizations and know the business. Thus the consideration of who participates in process representation is problematic, especially if the representation language is considered inadequate by domain experts, or vice versa.

To summarize, we observe that process representation tends to polarize towards: 1) On the one hand, high formalization, detail and intentionality; and 2) On the other hand, informality, flexibility and implicitness. Evidence of the former case may be found in [23], while an example of the latter case may be found in [24].

One of the first attempts to relate the two process representations is reported by [25]. In that scenario, the members of a group externalize their knowledge by telling the activities they do in a narrative. Pairs of pieces of text are linked by explicit semantic arcs to convey relations between text elements, for instance “it is a consequence of…”, “it is contradicted by...”, or “it is previous to...”. The whole exercise can be formally viewed as a directed graph where each node contains a candid text story.

A more recent research clearly separates informal elicitation work and its formalization [26]. The authors divided process representation in two phases, the first one dedicated to elicit information from domain experts and the second phase supporting transformation by technology experts. Santoro et al. [26] implemented the first phase using group storytelling, a text-based humanistic technique that allows capturing tasks and roles through a small set of informal constructs such as scenes, events and actors. No computational support was developed for the second phase, and neither the technical complexity associated with representation transformations has been addressed. Our research will thus contribute to solve these important problems.

Besides group storytelling, another humanistic technique named design storyboard will be researched. Design storyboards use sketches, cartoons, and other familiar visual elements, in combination with text, to represent interaction [27]. This technique has been developed to visualize system requirements during user-centered design workshops [28]. It has been suggested that it may help eliciting business processes [24], although experimental evidence has not yet been provided. Our research will thus contribute to validate that suggestion.

III. THEORETICAL CONSIDERATIONS

The humanistic approach to process representation is based upon several theoretical considerations about knowledge externalization. Explicit knowledge can 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 [29]. Tacit knowledge, on the contrary, is not easily transmissible and can arise in two separate dimensions. The technical dimension refers to functional skills that emerge from experience, whereas the cognitive dimension denotes the network of values, beliefs and mental models developed by the individual in the course of his/her life in order to interpret reality and operate in the work environment.

Organizational memory shares characteristics from both explicit and tacit knowledge. It reflects the shared knowledge of the organization, and can be retained from individuals, organizational culture, its structures and transformations, and information archived in internal and external repositories [30].

The underlying challenges of persisting organizational memory concern capturing tacit knowledge and disseminating it across organizations, not only to avoid deviations from organizational culture but also to learn from past mistakes and successes. An obvious solution to this problem is to transform tacit knowledge into explicit knowledge, in a process known as externalization [31]. Typical techniques used for externalization include elicitation from employees, external consulting, reporting, best-practices documentation, and learning stories. Implicit knowledge is typically distributed among several organizational workers; that is why we adopted a collaborative approach for knowledge externalization: several workers may have to share information about how they view a business process and how they collectively contribute to its realization. Of course this externalization will expose conflicting views and we assume that the process representation should allow multiple inconsistencies and conflicts, which may actually enrich the representation. Furthermore, workers typically avoid complete rationalizations of their work, often relying on the "auto pilot", especially when tasks are repetitive, trained-for, or easily matched to known procedures and skills. This lack of rationalization turns it more difficult to externalize knowledge. Consequently, we assume that knowledge externalization may cycle back and forth, may concern different levels of detail, and may expose significant knowledge gaps.

We also consider that knowledge externalization follows several principles associated with what communication theorists designate by storytelling. 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 [32]. Thus process representation should also incorporate storytelling elements.

Of course knowledge externalization also deals with visualization. Distinctive visual elements may serve to characterize actors, actions, context and communication. Text may be associated with visual elements in various ways to convey implicit and explicit relationships, to describe communication, to represent interaction, to annotate scenes and events, and to express opinions and clarifications.

One standing issue is how to derive work models from user stories that are situated and episodic in nature. In addition, workers produce stories that are often fragmented and personal. When dealing with conflicting stories, negotiation and group interaction techniques are needed to determine a consensual flow of action. Finally, techniques are needed to transform user stories into processes that can be technically deployed in a BPMS.

The problem then is that the ontological dimension of this humanistic approach seems quite distinct from the typical ontological dimension of BPM, the latter being focused on precise distinctions between processes, activities, roles, conditions, resources, process instances, and many other elements required by workflow modeling. This conceptual gap may be one of the basic reasons to explain why the technological and humanistic views of BPM have not yet been fully integrated.

IV. TOOL REQUIREMENTS

The developed tool implements collaborative business process representation support based on the theoretical considerations made in Section III and the following requirements:

1) It adopts a **scene-by-scene knowledge representation structure** providing narrative structure and temporal relationships. This scene-by-scene structure is inspired on previous research on group storytelling and design storyboards. The scenes should avoid excessive detail and strong attachments with the real world in order to focus users on the essential aspects of the business processes being represented.

2) Each scene combines **visual and textual elements**. The relationships between these elements should be implicitly perceived and interpreted by the users. Thus a strict formalization of the business processes is not enforced.

3) The tool supplies a **library of generic scenes** expressing typical workflow elements such as: 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).

4) The library may have to incorporate **contextualized scenes**, which are specific to particular contexts and organizations. Some types of organizations demand highly sophisticated knowledge management processes, for instance hospitals, while others only require trivial document management functions, as typical in highly bureaucratic organizations.

5) The user who integrates a scene in a story needs to **ground** it to the specific situation being described. Thus, a scene describing a face-to-face meeting should be contextualized with the participants' names and meeting location.

6) The tool is not a drawing utensil, since the scenes will not be drawn. It is a **composition and configuration tool**. To represent a business process, the users pick scenes from the library and arrange them in a shared canvas, while configuring some of its visual and textual elements (for instance, who say what and where).

7) The tool should support various **collaboration modes**, including face-to-face, remote synchronous and remote asynchronous collaboration.

8) Optionally, the tool may display a **semi-formalized specification** of the business processes being represented in the canvas. This specification may highlight potential omissions, conflicts and errors derived from the transformation from humanistic into technological representations. This functionality allows technology experts to immediately analyze how an informal representation is being transformed into a detailed workflow specification and apply any adjustments or additional specifications that may be necessary to clarify or improve the processes being represented.

9) No claim is made concerning the **completeness** of the description. In particular, the sequencing and coordination of tasks may not be complete or may be described in words, such as, "alternatively..."

V. TOOL IMPLEMENTATION

A. Conceptual structure

The tool is structured in three functional layers. As shown in Figure 1, each layer offers a unique perspective over the modeling task. The data model handles the logical representation of users' stories. It is responsible for persisting the user data and representing it in a coherent way, with a beginning, a sequence of events, and an ending.

The domain layer offers a meta-model where ontologies relate modeling elements such as events, actions, actors, artifacts and annotations. The semantics provided by this layer allows converting user stories into executable business processes.

The visualization layer offers a user-friendly authoring environment where users can build and visualize their stories. Users can manipulate graphical elements, add text annotations, and sequence action to construct a narrative, which is, as stated above, represented and maintained by the data model.

The visualization layer also supports the manipulation of the meta-model, so it may be tailored to the target organization. For instance, an actor in a story can have a certain role in the organization, and a given artifact can be mapped to a specific type of document.

Collaboration is supported in the visualization layer by providing users with mechanisms for collaboratively interacting with the model elements.

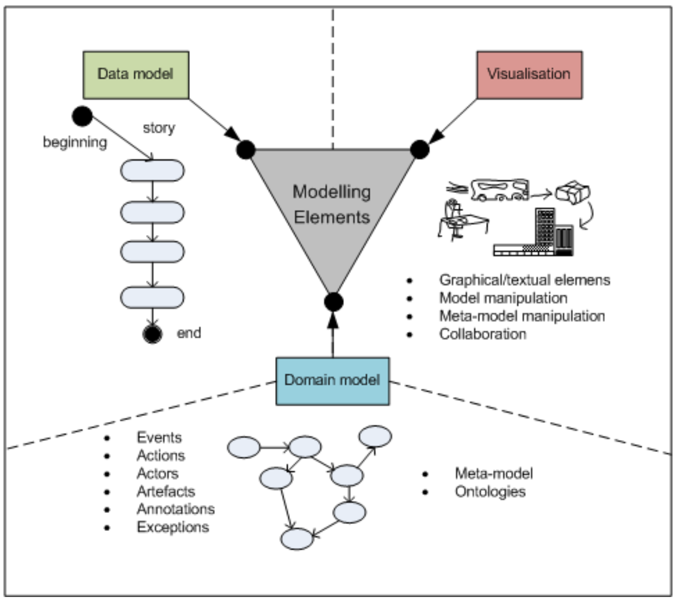

Figure 1. Information structure

B. *Implementation details*

The tool 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 SQL Server for persistency support. We also used jQuery for synchronization and the GDI+ API was adopted to draw text and graphical elements over JPEG images, which implement the scenes discussed in the previous section.

The adopted programming language was C#. AJAX was adopted to animate the UI elements.

C. *Functionality*

The tool supports collaboration by sharing the visualization layer among multiple users. The users may not only view each other's stories, they can participate in the development and refinement of flows, action and events. To enhance collaboration, users may use external tools to communicate with one another during the modeling process.

The tool can be configured with descriptions of organizational structures like departments, department heads, groups and individuals. These descriptions ease the contextualization of stories but are not necessary to create stories. They provide shortcuts for naming what appears in scenes. We note that these descriptions are often formalized by organizations and do not require substantive effort to collect and analyze. Figure 2 presents the screen where the organizational structure may be configured. Several organizational structures may be defined and their elements may be shared across structures.

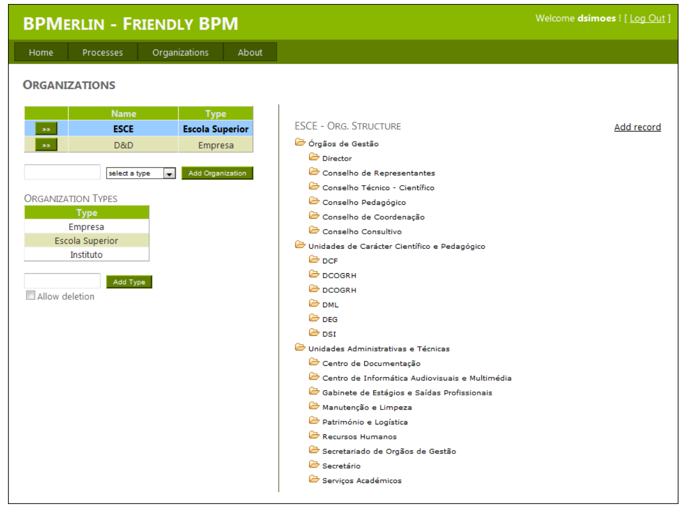

Figure 2. Organizational structure

Once logged in, a user can access the list of active processes being modeled (Figure 3) and can open them for editing. The work list only lists processes that should be visible to the user according to his/her organization and specific department. It includes the process name, owner, and a timestamp for the last modification and corresponding user.

Figure 3. List of processes

Figure 4 shows the modeling window, which appears after a process is selected for editing. This window allows modeling processes as a composition of scenes picked from the library. We note again that users do not draw the scenes. Instead, they configure existing scenes to describe and/or explain a particular work situation.

Figure 5 illustrates how scenes are configured. The user can add dialogue lines, which appear in the scene according to predefined metadata. The users can however customize these locations by clicking the canvas at the desired points. The users can also assign specific persons and roles to the characters appearing in scenes.

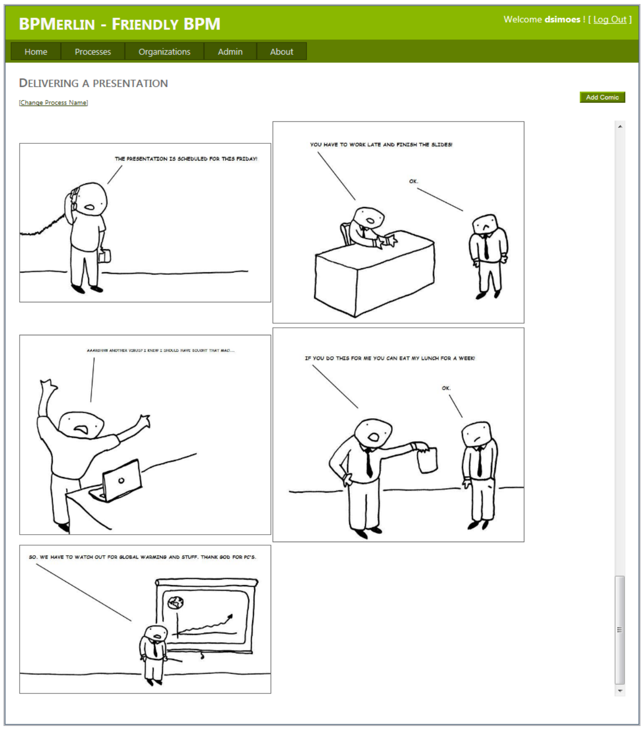

Figure 4. Modeling window, showing the scenes selected by the participants and the dialogue lines

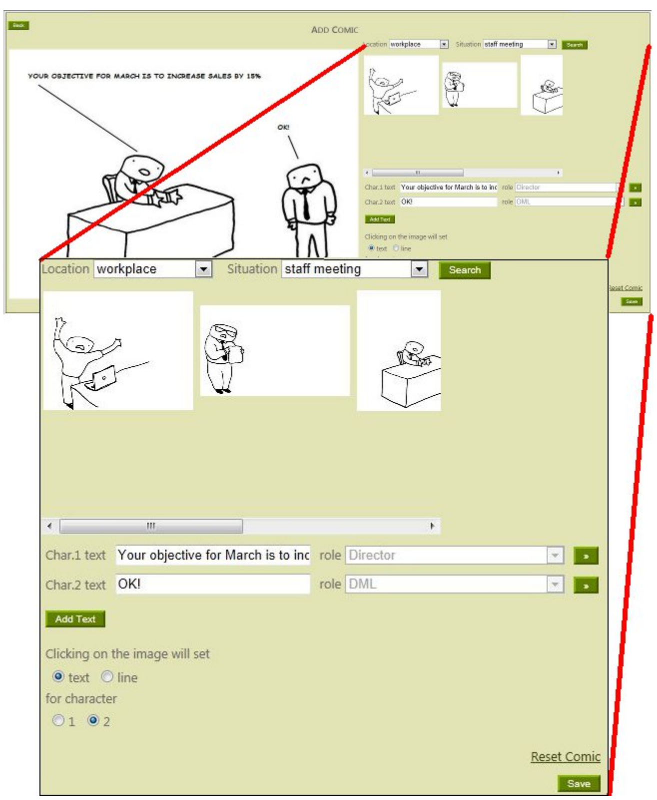

Figure 5. Configuring scenes with dialogue lines

The tool also offers a window for creating and configuring the scene library. This interface is similar to the one shown in Figure 5. The users create scenes by selecting and uploading images to the server and adding context-free metadata to characterize the scenes, namely the depicted situations, the number of actors and objects present in a scene, and their locations. When modeling a process, the tool automatically determines where to add text boxes from the location data. This approach allows enriching the scenes library with new pictures imported into the tool, something that does not require having an expert configuring the tool.

Figure 6 shows how the scenes database is accessed. In order to enhance searching, it is possible to filter the scenes in the database using context-free metadata, e.g. from descriptions of the depicted situations.

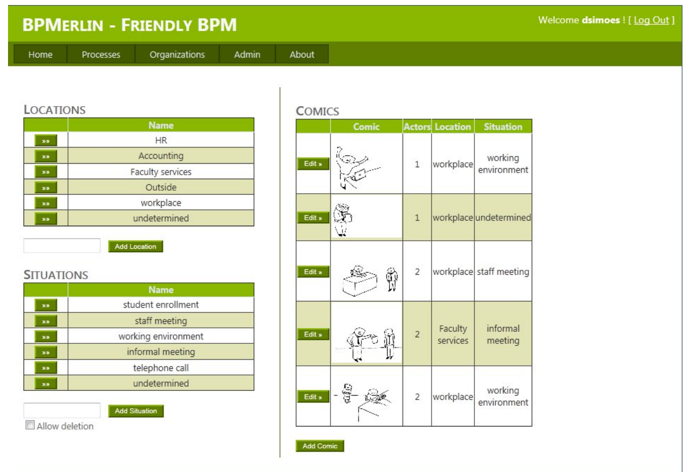

Figure 6. Scenes database

D. Data model

The data model considers various process-related data and two types of metadata. The first one is context-free metadata characterizing the scenes. This includes: 1) the general situation they refer to (meeting, waiting line, presentation, working environment, etc.); 2) the number of actors and artifacts in a scene, and their locations; and 3) the locations of text boxes and their relationships with actors and artifacts.

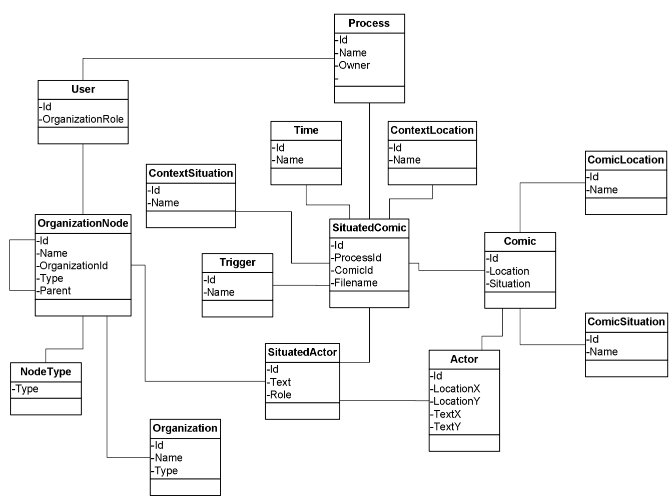

Figure 7. Data model

The second type of metadata is process-specific. It includes contextual locations, referring to physical places of the organization (e.g. a certain room in the billing department); and contextual descriptions about the scene (e.g. a steering board meeting) and the events triggering the actions depicted in the scene (e.g. a payment being processed).

As represented in Figure 7, the *Comic* entity stores the scene library. The *ComicLocation*, *ComicSituation*, and *Actor* classes hold the context-free metadata described above. Users tell their stories by assembling sets of *SituatedComics* from the scene library, which are associated with a given business process. Scene-dependent metadata is defined and held in the *ContextLocation*, *Time*, *ContextSituation*, *Trigger*, and *SituatedActor* entities. Each situated actor is tied to an *OrganisationNode*, which represents a certain role in the organization.

VI. Experiment

Some feasibility tests have already been accomplished with the tool. The current prototype uses a small set of scenes taken from cartoons available on the Internet. Additional work is necessary to understand what types of scenes are needed to cover a broad spectrum of organizational processes. New cartoon-like scenes are under development by a young artist who accepted to contribute to this work.

The feasibility tests have been focused on improving the user interaction, for instance adjusting how users insert text boxes in scenes to give actual meaning to what is being described. The feasibility tests have also contributed to consolidate the scenes' metadata, which is critical to improve reusability.

Thus far, the tests have validated the tool's technological infrastructure, especially regarding the scene-by-scene composition. The outcomes indicate that scene-by-scene composition can be implemented using standard Web browsers.

Formal experiments with the tool are being prepared. They require using people from real-world organizations. The main focus of inquiry will be on assessing the narrative construction of business processes, the strategies adopted by the users to collaboratively represent business processes, and the perceived value of the approach to the organization.

VII. Discussion and conclusions

BPM is seen as an opportunity to integrate various types of information systems, using process modeling as "organizational glue". Of course BPM has been highly influenced by the development of knowledge management, which highlights the importance of BPM as a sensemaking, decision-making and learning system. The effects resulting from modeling work processes are naturally reflected in organizations, which become more knowledgeable and sensitive to their operations.

Furthermore, BPM is also highly influenced by the semantic Web, which has been developing data management methods and standards for the representation, storage, composition, and transformation of data. The recent developments of what has been known as enterprise 2.0 seek to improve organizational behavior through innovative communication and collaboration services.

All in all, we view the proposed tool as an important contribution to integrate BPM, knowledge management and enterprise 2.0. We note that current BPM already encompasses some mitigated forms of integration support, mostly focused on data integration and task coordination. However, beyond these aspects, we should also consider that the integration of BPM, knowledge management and enterprise 2.0 must be founded on a reconsideration of the role of humans: from operators towards knowledge workers and from knowledge workers towards decision makers having full control over the organizational and technology design.

The proposed tool seeks this humanistic orientation: giving workers' control over technology design through collaborative process representation. When fully developed, the tool may have a strong impact on organizational practice. Currently, BPM technology requires contracting external agents to implement business processes. By transferring these activities to the internal actors, one may obtain significant economical gains, reduce the organizations' dependence, improve acceptance, and increase response time to turbulence [16].

The developed tool incorporates and extends state-of-the-art humanistic techniques, in particular group storytelling and storyboard techniques. Both contribute to bring process modeling beyond technology experts.

References

[1] B. Jennings and A. Finkelstein, "Flexible Workflows," in *Service Chain Management: technology innovation for service business*, C. Voudouris, G. Owusu, R. Dorne, and D. Lesaint, Eds. Heidelberg: Springer, 2008, pp. 171-185.

[2] E. Hollnagel and D. Woods, *Joint Cognitive Systems: Foundations of Cognitive Systems Engineering*. Boca Raton, FL: CRC Press, 2005.

[3] M. Hatch and M. Cunliff, *Organization Theory*. Oxford: Oxford University Press, 2006.

[4] A. Sheth, D. Georgakopoulos, S. Joosten, M. Rusinkiewicz, W. Scacchi, J. Wileden, and A. Wolf, "Report from the NSF Workshop on Workflow and Process Automation in Information Systems," *ACM SIGMOD Record,* vol. 25, pp. 55-67, 1996.

[5] U. Borghoff and J. Schlichter, *Computer-Supported Cooperative Work: Introduction to Distributed Applications*. Berlin: Springer, 2000.

[6] F. Leymann, "Web services and business process management," *IBM Systems Journal,* vol. 41, p. 198, 2002.

[7] G. Faustmann, "Configuration for Adaptation - A Human-centered Approach to Flexible Workflow Enactment," *Computer Supported Cooperative Work,* vol. 9, pp. 413-434, 2000.

[8] W. van der Aalst and T. Basten, "Inheritance of workflows: an approach to tackling problems related to change," *Theoretical Computer Science,* vol. 200, pp. 125-203, 2002.

[9] W. van der Aalst, T. Basten, H. Verbeek, P. Verkoulen, and M. Voorhoeve, "Adaptive Workflow: On the interplay between flexibility and support," in *Proceedings of the First International Conference on Enterprise Information Systems Frontiers*, Setúbal, Portugal, 1999, pp. 353-360.

[10] C. Ellis and G. Nutt, "Office Information Systems and Computer Science," *ACM Computing Surveys,* vol. 12, pp. 27-60, 1980.

[11] C. Bussler, "Enterprise wide workflow management," *IEEE Concurrency,* vol. 7, pp. 32-43, 1999.

[12] B. Weber, M. Reichert, and S. Rinderle, "Change patterns and change support features – Enhancing flexibility in process-aware information systems," *Data & Knowledge Engineering,* vol. 66, pp. 438-466, 2008.

[13] B. Mutschler, M. Reichert, and J. Bumiller, "Unleashing the Effectiveness of Process-Oriented Information Systems: Problem Analysis, Critical Success Factors, and Implications," *IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews,* vol. 38, pp. 280-291, 2008.

[14] A. Agostini and G. De Michelis, "Improving Flexibility of Workflow Management Systems," in *Business Process*

Management: Models, Techniques, and Empirical Studies. Lecture Notes in Computer Science, vol. 1806, W. van der Aalst and D. Oberweis, Eds. Heidelberg: Springer-Verlag, 2000, pp. 218-234.

[15] S. Brahe and K. Schmidt, "The story of a working workflow management system," in *Proceedings of the 2007 international ACM Conference on Supporting Group Work*, Sanibel Island, FL, 2007, pp. 249-258.

[16] M. Borges and J. Pino, "PAWS: Towards a Participatory Approach to Business Process Reengineering," in *Fifth International Workshop on Groupware (CRIWG)*, Cancun, Mexico, 1999, pp. 262-268.

[17] R. Grinter, "Workflow Systems: Occasions for Success and Failure," *Computer Supported Cooperative Work,* vol. 9, pp. 189-214, 2000.

[18] P. Antunes, "BPM and Exception Handling: Focus on Organizational Resilience," *IEEE Transactions on System, Man, and Cybernetics Part C: Applications and Reviews,* vol. 41, pp. 383-392, 2011.

[19] P. Antunes and H. Mourão, "Resilient Business Process Management: Framework and Services," *Expert Systems With Applications,* vol. 38, pp. 1241-1254, 2011.

[20] G. Bruno, F. Dengler, B. Jennings, R. Khalaf, S. Nurcan, M. Prilla, M. Sarini, R. Schmidt, and R. Silva, "Key challenges for enabling agile BPM with social software," *Journal of Software Maintenance and Evolution: Research and Practice,* vol. 23, pp. 297-326, 2011.

[21] J. Bowers, G. Button, and W. Sharrock, "Workflow From Within and Without: Technology and Cooperative Work on the Print Industry Shopfloor," in *Proceedings of the fourth conference on European Conference on Computer-Supported Cooperative Work*, Stockholm, Sweden, 1995, pp. 51-66.

[22] F. Casati, S. Ceri, S. Paraboschi, and G. Pozzi, "Specification and Implementation of Exceptions in Workflow Management Systems," *ACM Transactions on Database Systems,* vol. 24, pp. 405-451, 1999.

[23] W. van der Aalst and K. van Hee, *Workflow Management: Models, Methods, and Systems*. Cambridge, MS: The MIT Press, 2002.

[24] H. Breitling, A. Kornstädt, and J. Sauer, "Design Rationale in Exemplary Business Process Modeling," in *Rationale Management in Software Engineering*: Springer, 2006.

[25] C. Acosta, C. Collazos, L. Guerrero, J. Pino, A. Neyem, and O. Motelet, "StoryMapper: a Multimedia Tool to Externalize Knowledge," in *Proceedings of the XXIV International Conference of the Chilean Computer Science Society (SCCC)*, Arica, Chile, 2004, pp. 133-140.

[26] F. Santoro, M. Borges, and J. Pino, "Acquiring knowledge on business processes from stakeholders' stories," *Advanced Engineering Informatics,* vol. 24, 2010.

[27] K. Goodwin, *Designing for the Digital Age: How to Create Human-Centered Products and Services*: Wiley, 2009.

[28] A. Williams and T. Alspaugh, "Articulating Software Requirements Comic Book Style," in *Third International Workshop on Multimedia and Enjoyable Requirements Engineering*, Barcelona, Spain, 2008.

[29] I. Nonaka and N. Konno, "The concept of 'Ba': building a foundation for knowledge creation," *The knowledge management yearbook 1999-2000,* pp. 37-59, 2000.

[30] M. Ackerman, "Augmenting organizational memory: a field study of answer garden," *ACM Transactions on Information Systems,* vol. 16, pp. 203-224, 1998.

[31] R. Perret, M. Borges, and F. Santoro, "Applying Group Storytelling in Knowledge Management," in *Groupware: Design, Implementation and Use. Proceedings of 10th International Workshop, CRIWG 2004, San Carlos, Costa Rica.* Lecture Notes in Computer Science, vol. 3198, G. Vreede, L. Guerrero, and G. Raventós, Eds. Heidelberg: Springer, 2004, pp. 34-41.

[32] P. Antunes, S. Silva, and M. Borges, "Alternative Dispute Resolution Based on the Storytelling Technique," in *Groupware: Design, Implementation, and Use. 13th International Workshop, CRIWG 2007, Bariloche, Argentina, September 2007 Proceedings*. Lecture Notes in Computer Science, vol. 4715, J. Haake, S. Ochoa, and A. Cechich, Eds. Heidelberg: Springer-Verlag, 2007, pp. 15-31.