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Enriching Knowledge in Business Process Modelling: A Storytelling Approach

David Simões[1], Pedro Antunes[2], Jocelyn Cranefield[2]

Abstract The main goal of Business Process Management (BPM) is conceptualising, operationalizing and controlling workflows in organisations based on process models. In this paper we discuss several limitations of the workflow paradigm and suggest that process models can also play an important role in analysing how organisations think about themselves through storytelling. We contrast the workflow paradigm with storytelling through a comparative analysis. We also report a case study where storytelling has been used to elicit and document the practices of an IT maintenance team. This research contributes towards the development of better process modelling languages and tools.

Keywords Business Process Management, Process Modelling, Storytelling, Collaboration.

1 Introduction

A recurring issue in knowledge management research is how to effectively externalise or codify organisational knowledge. This is inherently difficult because externalising knowledge involves attempts to convert knowledge that is strongly tacit (embedded in the practice of individuals and groups, and therefore strongly contextual and experiential) into knowledge that is explicit (documented or codified) for the sharing, combining and understanding at higher levels of the organisation (Nonaka 1994; Nonaka and Takeuchi 1995). Within the process-based stream of knowledge management (one of six streams identified by Binney (2001)) the key concern in this problem space is how to effectively codify and

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share knowledge about business processes, with the ultimate aim of improving organisational knowledge, strategy and practice.

In recent years, Business Process Management (BPM) has come to be seen as a mature, valuable management approach to process work (Harmon and Wolf 2014, 2011). Beyond a simple instrument increasing automation and managerial control, BPM has also become an enabler of business strategy through coordination of change efforts. An important driver of success is the way that BPM has bridged the human and technical sides of organisations by covering the whole lifecycle of business process analysis, modelling, enactment and management (van der Aalst 2013). This is evidenced by a recent industry survey reporting that organisations primarily perceive BPM as “a top-down methodology to organise, manage and measure work”, “a systematic approach to analysing, redesigning, improving and managing a specific process”, and as a “cost-saving initiative focussed on increasing productivity”. They only secondarily saw BPM as “a set of new software technologies that make it easy for IT to manage the execution of process workflow” (Harmon and Wolf 2014).

Several reasons may explain this successful trajectory. Perhaps the approach is particularly well aligned with the dynamic context that organisations are facing today, or maybe task-technology fitness is increasing (Trkman 2010). Researchers are still developing explanatory theory about these phenomena (e.g. (Trkman 2010; Ariyachandra and Frolick 2008; Antonucci and Goeke 2011)). We argue that the emergence and use of a new kind of IT artefact is significantly contributing to this success: process models.

Process models are not mere by-products of BPM; they are instrumental in materialising the BPM method through the analysis, modelling, enactment and management lifecycle (Recker et al. 2009; van der Aalst 2013). Some emphasis has historically been put in the later stages, where process models mainly contribute to automating business activities by translating business rules into instructions specifying a set of workflows, which can then be uploaded and executed by process aware information systems (van der Aalst 2009). More recently, some emphasis has also been put in the early BPM stages, where the process of process modelling (Green and Rosemann 2000; Aguilar-Saven 2004; Forster et al. 2013) handles all the activities necessary to eliciting, documenting, visualising, analysing, simulating, and also thinking and designing an organisation. This new trend focussing on the early lifecycle stages of BPM positions process models at the intersection between knowledge and process management by helping executives to analyse and reflect about their organisations’ work practices.

Despite the promise of BPM modelling, a number of problems arise from its reliance on the workflow paradigm that is used for the specification of work processes, which emphasises procedure over a more ecological perspective embracing human skills, organisational practices and collaboration (Caetano et al. 2005; Silva and Rosemann 2012). The differences between the procedural and ecological views suggest there is a need to reconsider how process modelling is done. It appears that BPM models are permeated by a set of principles, goals and constraints that are enforced by automation technology, even when the main goals of BPM may not relate to automation.

We propose an alternative approach to process elicitation and modelling, in the context of BPM, with the goal of overcoming the problems associated with the workflow paradigm. Our approach emphasises storytelling, i.e. the telling of business stories. Inspired by the use of storyboards to communicate between product designers, clients and future users (Lelie 2006; Memmel and Reiterer 2008), the approach builds on the tradition of research into how storytelling can build organizational meaning, extending it to the process realms. Furthermore, we leverage this alternative modelling foundation by supporting collaborative process modelling and empowering end-users to model business processes.

In our research, we are mainly concerned with the potential contributions of process models to understanding how organisations think about themselves, and less so with promoting organisational changes through process automation and management control. As such, we aimed to explore and assess whether rich work models can be produced by centring the modelling on knowledge representation while deemphasising workflow modelling. Specifically, we considered and investigated the following three research questions:

RQ1: Can meaningful business processes be elicited through storytelling?
RQ2: Can storytelling enable and incite users to externalize tacit knowledge and preserve contextualization?
RQ3: Can storytelling contribute to improve process modelling?

The chapter is organized as follows: In the next section we introduce the main theoretical concepts and discuss related work. In Section 3 we outline the two modelling approaches, workflow and storytelling, the former concerning the procedural specification of work processes and the latter concerning the organisational narrative of work. In Section 4 we discuss a case study where storytelling was adopted to elicit and document procedural knowledge from an IT maintenance team. Data collection and analysis procedures are driven by the research questions we have put forward in this introduction. Finally, the last section is dedicated to some concluding remarks.

2 Main Concepts and Related Work

2.1 Process-oriented knowledge management and the role of process-modelling

Since Binney (2001) highlighted the process-based stream of knowledge management, interest in process-oriented knowledge management has grown on the part of both academia and business (Jung et al. 2007). This particular type of knowledge covers what Binney designated by "engineered assets," which include work practices, procedures and methods. The need for knowledge management of business processes recognises the role of processes as part of an organisation's intellectual capital (Bassi and Van Buren 1999) and a source of strategic value. BPM is an important tool for process-oriented knowledge management because it supports the transformation of informal knowledge into formal knowledge and facilitates its externalisation and sharing (Kalpic and Bernus 2006). Process modelling is a foundational aspect of BPM.

A number of comprehensive reviews on process modelling have been published (Curtis et al. 1992; Aguilar-Saven 2004; Melão 2009; González et al. 2010; Aldin and de Cesare 2011; Kirikova and Makna 2005). Since they cover about 20 years of research in this area at different milestones, they also give insights on how the perception of process modelling has been changing through the years. Curtis et al. (1992) discuss the wide range of goals that process modelling often has to accommodate, from understanding the organisation to automated execution support. Because of such wide range, they suggest a separation between two different paradigms: 1) programming, more rigorous; and 2) scripting, more pragmatic. The authors also analyse the main advantages and drawbacks of these two paradigms using a set of properties, formality, granularity, precision, and fitness. The focus on these properties highlights a fundamental concern with the process modelling language.

Five years later, Aguilar-Savén (2004) suggests considering both technical requirements and political/social requirements when discussing process modelling. Focussing on the latter, the author brings forward two additional properties: customer orientation and ease of use. An interesting consequence resultant from the first property is expanding the list of stakeholders involved in process modelling from modellers, employees and managers towards the customers, who may find themselves involved in the design, remodelling or automation of their relationships with suppliers. Ease of use is suggested by Aguilar-Savén as necessary to bring process modelling closer to organisational goals such as understanding, learning and strategizing. Proposing a framework similar to the one developed by Curtis et al. (1992), Aguilar-Savén (2004) divides the spectrum of modelling purposes in four categories: to learn about a process, to design and develop a process, to control a process, and to execute a process. Ease of use is considered particularly important when addressing the first two categories, since process models must support capturing and understanding organisational knowledge with the internal and external stakeholders.

Another five years later, Melão (2009) presents an updated review of this subject. The author observes that process management has been evolving from a technology-centred view towards a more holistic approach, which encompasses technology as an enabling factor among many others. In particular, the author discusses how organisations extend their business through e-business, i.e. offering services based on the interaction and composition of human and automated functions, usually based on Internet technology. Once again, this view emphasises customer orientation as an important property to consider when evaluating process models and modelling practice. However, Melão also brings forward two new properties: flexibility and effectiveness. Flexibility concerns avoiding monolithic customer interactions, which usually require multi-channel communication, loose coupling, and dynamic behaviour of all involved actors, both human and automated. The effectiveness property puts some emphasis on the successful implementation of e-business processes. Melão (2009) notes that "there is evidence that e-businesses have not always been successful" and also that "managers need to be more sensible about the claims of ICT gurus and popular press statements." Of course the effectiveness of process modelling concerns technical issues. For instance, the adoption of e-business standards, including process modelling languages, process interoperability and information exchange, contributes to effectiveness. But Melão also refers other drivers such as the capability to adapt process models to the BPM lifecycle (through configurable model constructs) and to different modelling techniques and tools (through the combination of generic and niche support).

Aldin and Cesare (2011) provide a more recent overview in this area. They suggest that organisations are nowadays striving for agility, i.e. being able to "more readily and flexibly adapt" to changes in the environment, increasing competition, expanding markets, and new customer expectations. The authors also note that current procedural approaches to process modelling tend to generate large and complex models, and that the emphasis on procedural knowledge can result in over-specification, which may adversely affect striving for agility.

To summarise, this short historical overview shows that process modelling has been evolving from being centred on technical matters towards the inclusion of social issues, and from targeting modellers towards targeting various additional stakeholders including internal users and customers. This evolution is illustrated by the proposition of new and more challenging properties, including in particular ease of use, effectiveness, flexibility and agility, according to which modelling techniques and tools are evaluated.

2.2 Workflow paradigm

The workflow paradigm in BPM precludes a functional, deterministic view of work in organisations, representing what is being performed and what flows of information and control are necessary to process work (Curtis et al. 1992; Melão and Pidd 2000). Aldin and Cesare (2011) characterise its main constituents as a collection of seven elements: process, activity, service, role, goal, event, and rule. This characterisation is consistent with others found in the research literature (e.g. (van der Aalst 2013)). Several researchers argue that this paradigm dominates BPM (van der Aalst 2013; vom Brocke et al. 2011; Melão and Pidd 2000; Rosemann et al. 2009; Balzert et al. 2012; Recker 2010), a view that is supported by industry surveys (Harmon and Wolf 2011).

Of course any paradigm proposes a restricted view over a complex phenomenon, usually adopted with the purpose to efficiently accomplish certain goals. However, as previously discussed, process modelling not only has to serve a wide range of goals but has also been evolving to accommodate new requirements. So an issue to discuss is whether the workflow paradigm is still as relevant as it was in the past (Adams et al. 2003; Rangiha and Karakostas 2013).

The workflow paradigm has been thoroughly analysed by Recker et al. (Recker 2010; Recker et al. 2012; Recker 2012). Their survey of current practices in process modelling indicates that users find the workflow models lacking and often have to complement the models with narrative descriptions. Users also find modelling languages difficult to use. One concrete example is given by the use of pools and lanes in BPMN (Business Process Modelling and Notation) to indicate who is responsible for a process or activity, an approach that is considered a burden by users (Recker 2010). Another example is the inadequate representation of state-based concepts, which often constitute the basis of business rules (Recker et al. 2010). The authors found out that BPMN, in comparison to other leading process modelling grammars, affords the highest level of representation completeness (which we relate to language) but also the lowest level of clarity (which we associate to ease of use) (Recker et al. 2010). Another study reports an interesting conflict between IT and business people, with IT people demanding the use of more symbols, increasing expressiveness and rigour, and business people becoming satisfied with simpler models (Recker et al. 2006).

Recker et al. (2012) also investigated the use of different representational schemes by students. The results indicate that flowcharts, combining abstract graphics like boxes and arrows with text, performed better. This would suggest that the workflow paradigm is actually the best approach to process modelling. However, the experiment collected data after 13 weeks of training in business process modelling, which probably biased the students towards that paradigm.

Often process modellers operate according to a worldview that filters out ecological information (Wahl and Sindre 2006; Silva and Rosemann 2012). This attitude can be related to the historical roots of the field, when process modelling essentially served a subsidiary role supporting systems integration and automation.

Following the same line of reasoning, we note that the historical relationships between process modelling and automation lead modelling languages to be permeated by a set of rules strictly imposed by automation (Antunes and Mourão 2011; Antunes 2011; Recker et al. 2009). For instance, model completeness and soundness may not be important in the early BPM stages, but are nevertheless enforced by most process-modelling languages. Such forced adherence to automation rules can make it more difficult to capture organisational knowledge. An example concerns exception handling, which is recognisably difficult to handle with existing modelling approaches but easily handled by humans (Antunes 2011).

2.3 The storytelling approach

Long-associated with the transfer and preservation of knowledge in human civilisations, storytelling has more recently been seen as a useful tool for organisational knowledge management. In the 1970’s organisational stories were recognized as valuable resources for enriching understanding (e.g. (Clark 1972; Mitroff and Kilmann 1976)). Since then, researchers in diverse disciplines have investigated the use of storytelling to express and manage organisational meaning at both an individual and collective level, to “nurture and create meaning” and to “reinforce control and manipulate meaning” (Boyce 1996). For example, Swap et al. (2001) view the use of storytelling and mentoring as a means to transfer core competencies, whereas Denning’s work on storytelling focuses on the creation and framing of shared knowledge with the goal of organisational change (Denning 2005, 2001).

Storytelling uses stories to elicit and document organisational knowledge, norms and practices (Brown et al. 2004). A key characteristic of storytelling is its contextual richness: stories convey great quantities of information in simple ways, can take advantage from uncertainty and imagination, and make the readers or listeners feel engaged in the story (Gershon and Page 2001). Storytelling is of increasing interest as a way of helping organisations to externalise knowledge that has a tacit component (Perret et al. 2004). Because the knowledge in organisations is typically distributed, group storytelling has been suggested as a convenient knowledge management approach (Santoro et al. 2010; Borges and Pino 1999). Perret et al. (2004) used a group storytelling tool to help externalise knowledge from software projects, and Carminatti et al. (Carminatti et al. 2005) found that group storytelling was more effective than interviews at eliciting collective knowledge. Santoro et al. (2010) used group storytelling to elicit knowledge from stakeholders about business processes. Although a group storytelling approach may also expose inconsistencies and conflicts, this can be regarded as an opportunity to enrich organisational knowledge: Boyce (1996) has emphasised the value of taking multiple perspectives into account in storytelling research. Our study builds on this stream of interest, focusing on the application of group storytelling to process modelling within BPM.

When combined with the use of a collaborative tool, we suggest that group storytelling can also facilitate the integration of personal knowledge into collective organisational knowledge and intelligence. (In the case of Web 2.0 tools, Razmerita et al. (2014) have shown how collaborative tools can support such integration.) We follow Newell et al.'s (2009) definition of collective knowledge as knowledge of the shared organisational environment of rules, laws and regulations, extending it to include processes and the ways in which things are done. Collective intelligence is the shared intelligence that emerges during, and from, the collaboration process. In this case, the collective intelligence of interest is based within process-based stories.

The adoption of storytelling in process modelling raises several theoretical and practical challenges. A fundamental issue is that a model presupposes some ontological constructs, such as state tracking (Wand and Weber 1995); otherwise we would be talking about diagrams or even sketches. However, these ontological constructs may conflict with storytelling. For instance, stories are often episodic, evocative, situated and may have significant gaps between the narrative elements. In addition, often stories are not task- or time- oriented, which makes it difficult to track states.

3 Process Modelling with Storytelling

3.1 The modelling tool

In response to the issue outlined above, our approach to storytelling is based around the use of storyboards to capture and convey stories. Storyboards capture stories in a visual way, combining text with visual elements to emphasise expressiveness (Gershon and Page 2001). A storyboard can be related to reality, including things, events and transformations. It also suggests a particular way of reading a story, which can be used for state tracking. We therefore argue that storyboards have the ontological structure necessary to bridge the gaps between modelling and storytelling.

We developed a collaborative tool supporting the integration of storytelling and business process modelling through storyboards. From now on we refer this tool as the "storytelling tool". The storytelling tool provides a database of generic pictures that can be selected to build a storyboard. A storyboard developed with the tool consists of a linear sequence of images selected from the library and configured individually. Each generic picture is characterized by metadata depicting situation, location, and presence of specific objects including business objects. Pictures are then given context through dialogue lines, descriptions and contextualized metadata to compose a scene belonging to the story. Fig. 1 depicts the characterization of a waiting scene, where specific metadata is used to register the basic justification why the actor is waiting in that particular situation, as well as a time limit that may trigger a reactive action. Further details about the scene may be given in the narrative. As shown in the figure (on the right), scenes are arranged sequentially in a storyboard. Notwithstanding, parallel story lines are also supported. At the end of each scene the storyteller is given a number of choices concerning the flow of action, and a special display mode is used to expose the story structure (see Fig. 2). Fig. 3 in the following section, and Fig. 5- 7 throughout the chapter provide more examples. They show people interacting in typical business situations, with events and activities such as having a meeting, signing a document, sharing information, etc. They also show typical business objects such as documents and computers. The tool allows users to assign specific names to the "generic" people and objects appearing in pictures (see the example in Fig. 5), add dialogue lines to people (see example in Fig. 6), and associate captions with pictures (see example in Fig. 7); features which contribute to document interaction, events and states.

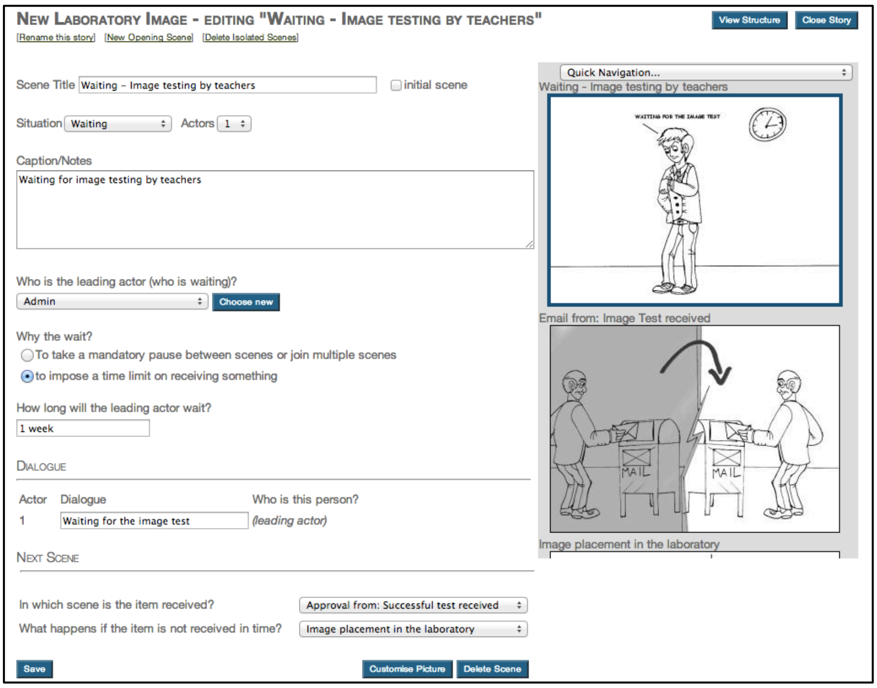


Fig. 1 Sequential display of scenes (composer view).

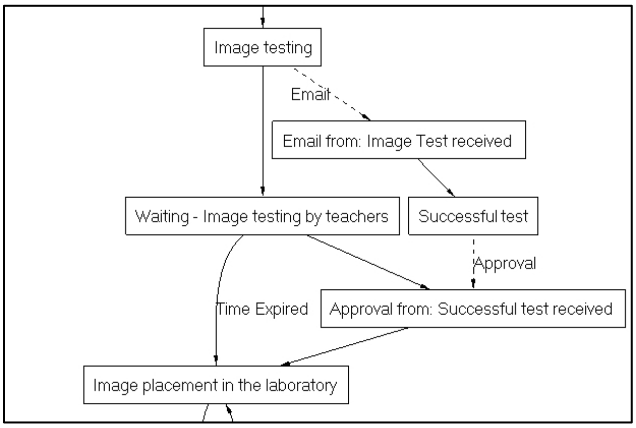


Fig. 2 Parallel story lines (structure view)

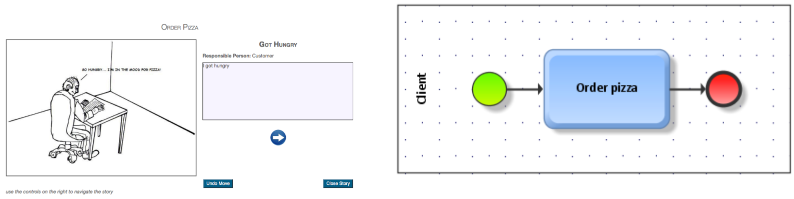
Storyboards can be concurrently developed by a number of users, contributing diversity to story building. In a previous publication (Antunes et al. 2013) we discuss the tool in more detail, describing its information model and functional features. Details about the tool design and implementation are not repeated here and interested readers are pointed to the aforementioned paper.

3.2 Storytelling versus workflow

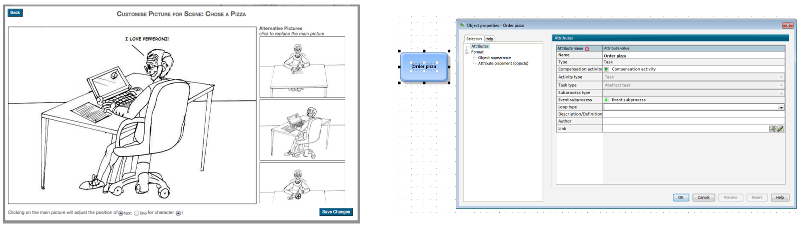
We now provide a comparative analysis of main differences between the storytelling method and the workflow paradigm. To represent the workflow paradigm, we selected the BPMN notation and ARIS tool. BPMN is currently the dominant notation for process modelling, reportedly having 60% of industry penetration (Harmon and Wolf 2014), and ARIS is representative of how visual tools typically support BPMN. For instance, ARIS is very similar to Visio and Visual Paradigm. The storytelling tool is used to represent the storytelling approach.

In Fig. 3 we compare screen dumps from the storytelling tool and ARIS for six modelling situations. The process being modelled is the Pizza Collaboration, which is discussed in BPMN documentation from the Object Management Group (OMG 2010). In brief, the Pizza Collaboration outlines the various steps involved when a client contacts a store to buy a pizza.

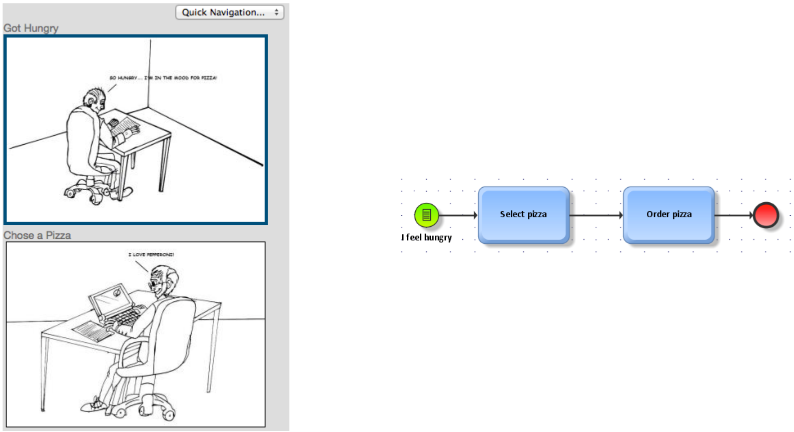
a


Order Pizza
Got Hungry
Responsible Person: Customer
Client
Order pizza

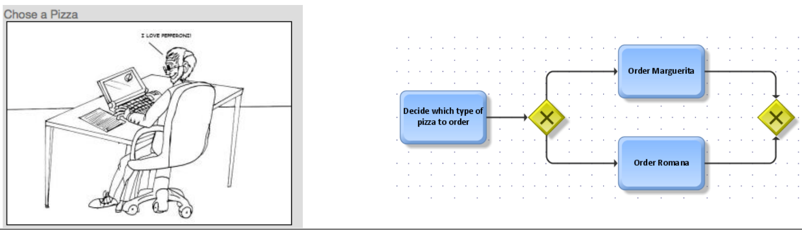
b


Customise Picture for Scene: Chose a Pizza
I LOVE PEPPERONI!
Alternative Pictures

c


Quick Navigation...
Got Hungry
Chose a Pizza
I LOVE PEPPERONI!
Select pizza
Order pizza
I feel hungry

d


Chose a Pizza
I LOVE PEPPERONI!
Decide which type of pizza to order
Order Marguerita
Order Romana

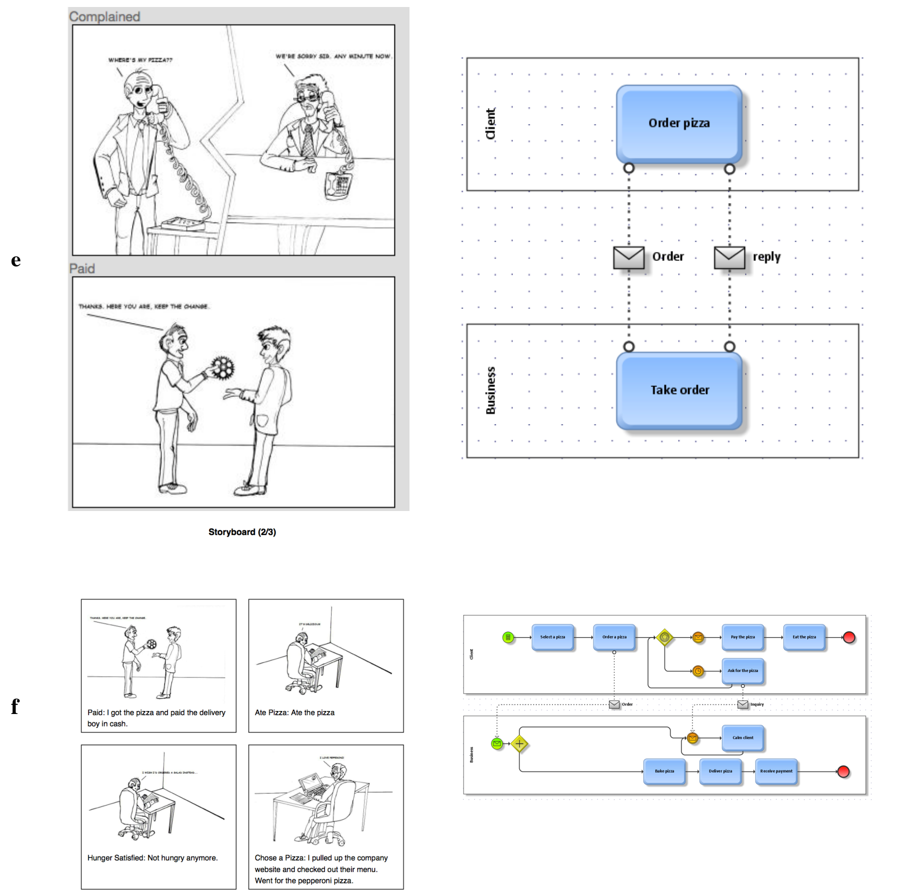


Fig. 3 Comparison between the storytelling tool (left) and ARIS (right)

In the analysis that follows we compare properties of the storytelling tool and ARIS, focusing on how they differ in respect to specifying activities, adding context, dealing with sequence flows, dealing with conditions and flows, supporting communication and collaboration, and overviewing business processes.

a. Specifying activities According to BPMN (OMG 2011), activities are one of the three main constituents of processes, which also include events and gateways. ARIS follows the BPMN convention of representing activities with rounded rectangles. The activity shown in Fig. 3.a is ordering a pizza. The storytelling tool uses instead a more complex element, named scene, which comprises a picture plus textual and visual elements on top of the picture. The activity is therefore implied by what the picture implicitly evokes and what is explicitly commented with text. Combining pictures with textual elements on top implements a storytelling mechanism usually seen in comic books and graphic novels.

Scenes, besides providing richer visual information than activities, also afford conveying more than procedural information. For instance, a scene may be used to introduce the narrative, describe a work setting, present the participating actors, describe the social atmosphere, etc. Such information may be added in ARIS using annotations, but the advantage of using scenes is integrating such information with activities in a more natural way.

The way actors are associated to activities is also completely different in the two cases. In ARIS, actors are associated to activities through pools and lanes. Pools are represented with rectangles. The pool shown in Fig. 3.a indicates that the client orders the pizza. In the storytelling tool, actors are anthropomorphic and can be named using the aforementioned textual elements on top of the picture. This is a more natural approach than using pools and lanes. All in all, scenes explore familiarity with existing storytelling mechanisms and the human capacity to interpret context, while the ARIS approach relies more on learning the language rules.

b. Adding context to activities Fig. 3.b illustrates how users can add contextual information to activities. In the case of ARIS, typical user-interface elements like text boxes and buttons are used, while the storytelling tool supports adding contextual information in a more interactive way. For instance, the text elements on top of the picture can be edited inline and moved with the pointer. This suggests that the storytelling tool emphasises visual composition rather than configuration. Besides, the mapping of attributes in the storytelling tool is visible to users, while in ARIS some attributes are hidden.

c. Sequence flows Following the BPMN notation, ARIS represents sequence flows between activities using arrows. These arrows have strong semantics attached: they explicitly define the order of activities. On the other hand, the storytelling tool does not have such a strong mechanism defining the order of scenes. Scenes are displayed in a sequential way in the storyboard, e.g., Fig. 3.c shows two consecutive scenes, got hungry and chose a pizza. Storyboarding has a convention that the story is read from left to right, but authors and readers can enrich and often subvert that convention. The end result is that the storytelling approach provides more narrative freedom.

d. Conditions and flows One fundamental characteristic of BPMN is showing how activities evolve over time by combining gateways with sequence flows representing the possible paths that a process may take depending on certain conditions. Fig. 3.d shows the case where a client decides to either order a pizza Margherita or a pizza Romana. On the contrary, the storytelling tool does not have explicit flows. It also does not have a formal way to represent conditions or gateways. This does not mean they cannot be specified, but users have to incorporate these elements in the storytelling using the available narrative elements. For instance, the scene shown in Fig. 3.d indicates that the client makes a choice towards a certain type of pizza. This scene can be used to describe what happens next as a consequence of that decision, and other scenes may be added to describe other decisions. But again, the storytelling tool privileges narrative over using specific modelling elements.

e. Communication and collaboration As previously mentioned, the workflow paradigm emphasises the sequencing of activities. However, often activities involve some communication or collaboration between actors. ARIS follows the BPMN specification, which represents communication with message flows between activities – the order and reply messages shown in Fig. 3.e. The specification requirements are relatively complex because they involve activities, two types of flows (sequence and communication) and pools.

Quite on the contrary, the storytelling tool relies on anthropomorphic information to describe communication and collaboration. For instance Fig. 3.e shows a specific scene with two persons communicating over the phone, which implicitly represents the communication flow. The tool's library includes various scenes describing different types of communication and collaboration, such as one-to-one contacts and face-to-face meetings. This approach is definitely less formal. It also avoids using different notations for sequence and communication flows, which may be difficult to differentiate in practice, especially for less experienced modellers.

f. Process overview Fig. 3.f illustrates how ARIS and the storytelling tool overview business processes. ARIS gives a procedural view with the whole collection of pools, activities, flows, gateways, and other modelling elements. On the other hand, the storytelling tool, besides generating a streamlined procedural overview (shown before in Fig. 2), also generates a storyboard with all the scenes and textual descriptions about what happens in each scene.

Table 1 Summary of main modelling differences

Characteristics	Storytelling tool	ARIS
Activity representation	Scenes, anthropomorphic, combining pictures and text, and having visible attributes	Rounded rectangles, hidden attributes
Actors	Anthropomorphic, blended in activities	Rectangles, separate from activities, add complexity to diagrams
Flows	Implicit in the scenes or in the sequence of scenes	Arrows, explicit
Communication and collaboration	Implicit, anthropomorphic, using specific scenes to convey meaning	Explicit, mixed with sequence flows
Overview	Structured overview and storyboard, with text and pictures, no formal notation	Structured, with all BPMN modelling elements

One advantage of ARIS over the storytelling tool is that there is no difference between the overview and the composition space, i.e. users overview the process while composing the model. During composition, the storytelling tool can only show a few scenes at a time, so users must navigate between scenes using a scrollbar. However, this limitation is compensated by the capacity to print out the storyboard. One significant advantage of generating a storyboard is that the output does not rely on a formal, technical notation to express the process.

In Table 1 we summarise the main differences found in the two approaches to business process modelling.

4 Case Study

We now outline and discuss a case study where we tested the storytelling method. We first present a set of considerations regarding the study design, including objectives, data collection procedures, analysis, and validity. We then follow with the case description and analysis.

4.1 Case study design

As detailed in the first part of this paper, our study was motivated by the problems that are imposed on BPM by the workflow paradigm, which led to a reconsideration of the way business processes are modelled. The objective of the study was aligned with our research focus: to investigate and evaluate the potential of the storytelling method. We used the case study method in the software engineering tradition (Runeson and Höst 2009), gathering a range of data in a real-world setting. The study design involved three phases and several data gathering methods (outlined later). We were interested in testing the storytelling approach in a typical scenario. As such, we sought an organization that was externalising their work procedures. The unit of analysis was the process being modelled. The specific type of organization was of no particular importance to the study design, since the requirements pertained mostly to the process under study: each process needed to encompass a minimum level of complexity to allow for rich stories addressing problem solving and unexpected situations, and it needed to span multiple roles in the organizational hierarchy in order to capture collaborative scenarios, which are central to most stories.

As discussed earlier in this paper, we had previously developed a tool implementing the storytelling approach. The study participants used that tool as an authoring environment for eliciting and modelling their business processes. As we were focusing on the ability to do the modelling autonomously, we avoided direct contact with the subjects while they were using the tool, and adopted an indirect method of data collection, classified by Lethbridge et al. (2005) as a second degree data collection technique. The subjects created their stories autonomously and data was collected at a later time, from both the tool's print outs and raw usage logs. We used a goal-based metric definition technique similar to the methodology proposed by Basili and Weiss (1984). The goals for the measurement activity were defined so as to provide relevant data to fulfil each of the research questions. Refined questions for each goal and corresponding metrics are shown in Table 2.

Table 2 Goal-Based measurements

RQ	Goal	Questions	Metric	Type of Data	Data Categories
1	Evaluate meaningfulness	Did the subjects create detailed stories? Can workflow be derived from user stories?	Number of scenes	Quantitative	(None)
			Use of narrative	Qualitative	Low/ Medium/High
			Use of dialogue	Qualitative	Low/ Medium/High
			Structural complexity	Qualitative	Low/ Medium/High
			Story verifies process validity restrictions (see (Antunes et al. 2013))	Qualitative	Yes/No
2	Evaluate tacit knowledge externalisation and contextualization	Did the stories portray emotion? Were unexpected situations depicted? Was contextualized knowledge applied?	Presence of emotional elements in the dialogue/ narrative	Qualitative	Yes/No
			Depiction of unexpected situations	Qualitative	Yes/No
			Predominance of contextual reasoning	Qualitative	Low/ Medium/High
3	Evaluate whether collaborative storytelling contributes to process modelling	Did sharing stories help the team better understand the process?	Sharing of stories helped collaboration	Qualitative	(None)
		Did the gathered stories influence the final adopted practices?	Stories enriched the organisational practice	Qualitative	Yes/No

We took a number of steps towards addressing validity both during case study design and later through data collection and analysis. A case study protocol was developed with the engagement of all participants, detailing case objectives, field procedures and timings. This protocol was established with the intent of ensuring consistent data collection and addressing threats to validity, by aligning the researchers' and participants' views of the study and its objectives. This alignment was further pursued by choosing an organization well known to the researchers, with a long-term history of past cooperation. Reliability and internal validity threats were addressed by ensuring that subjects understood the tasks they were to perform and were not influenced by the researchers who conducted the study and analysed the data, and by isolating factors that could affect causal relations. Two key factors were whether participants were correctly using the tool and the tool's adequacy for authoring business stories. The latter is part of our study objectives and is evaluated through data collection and analysis. We addressed the former by devising a multiple phase field procedure strategy (Fig. 4), where we first explained the tool usage to the participants, and then engaged them in a test-run where subjects began telling their stories and tested the tool. After these initial sessions, we carried out individual unstructured interview sessions that served a dual purpose: 1) helping subjects overcome difficulties caused by incorrect use of the tool; and 2) identifying shortcomings or aspects of the tool that should be improved. Once both issues were addressed, we entered the second phase whereby subjects would develop their stories to completion with no further interference from our part. Finally, in the last phase, the subjects worked together to reach a unified story. We used different forms of triangulation to increase the quality of our measurements and data analysis. This procedure is of particular importance considering that in our research we must rely primarily on qualitative data, richer but less precise than quantitative data points. We gathered data from different data sources, namely from the tools' print outs (storyboards and structure diagrams), from raw system logs, and from the subjects' feedback in interviews. We took both quantitative and qualitative measurements whenever possible, and data was analysed independently by two researchers.

Fig. 4 Field procedure

External validity threats are also acknowledged, specifically the extent to which we can use our findings in the present study towards building a generalized storytelling approach to process modelling. We deliberately chose a specific process as the unit of analysis abstracting organizational-specific aspects, and the subjects were selected among the participants in the chosen process.

We nevertheless report issues regarding the higher level of technological literacy of our subjects in comparison with a broader, more typical organizational environment. We also suggest that the particular environment and leadership of the selected organisation may influence the obtained results. The strong research orientation of the organisation and the leadership by a researcher in the field of Computer Science may have influenced the observed modelling practices. We therefore recognise that further research is necessary involving other types of organisations.

4.2 Case description and results

Our study took place at an IT supporting unit belonging to the Faculty of Sciences of the University of Lisbon. Many courses taught at the university depend on computer laboratories supported by this unit, which covers around 1,000 students. Some of these laboratories have to comply with specific software and hardware requirements presented by various courses running at the same time and changing every six months. Therefore, such requirements must be reported by the teaching staff to the IT team prior to the beginning of each semester so that the appropriate operating environment is ready for use by students when classes commence.

Because resources are limited, the laboratories cannot be dedicated to a single course, so a set of base image files must be created and configured by the IT team and replicated and installed across all computers available in the laboratories. This is an intricate process encompassing a series of activities involving the preparation of base configurations, requests for requirements, analysis of technical problems, negotiating requirements with teachers, approvals, generation of images, upgrades, compatibility tests, deployment, and final tests.

Since there is currently no process model supporting these activities, difficulties are not uncommon. For instance, with no mechanism for retaining knowledge year after year, the IT team often works on the same problems and devises repeated solutions. What is worse, it is troublesome to keep track of communications going back and forth between teachers and the IT team, often leading to conflicts, unnecessary delays and incorrect configurations. Furthermore, because procedures are not well defined, the IT team ends up receiving new requests throughout the semester, and such exceptions are not easily handled.

In this context, the leader of the IT unit decided to use the storytelling tool with the objectives of improving consistency, efficiency, transparency, accountability, and learning. The team was invited to use the storytelling tool to describe the desired IT configuration process. Again, keeping with our stance of focusing on the operators' knowledge and points of view, we reserved our involvement to a minimum. After a brief explanation on how the tool worked, all IT team members including the leader were asked to, in their own time, tell and record a story about the configuration process.

As explained in the previous section, work with the tool was divided into three phases. In the first phase, lasting one week, the subjects tested the tool and began using it for telling stories. Following the interviews and the analysis of these first stories, we identified a few issues regarding the tool use. For instance, one subject was unsure how to associate the actors in the story with the respective organizational roles—he solved it by using the dialogue lines to identify each actor

(Figs. 5-6). Another subject experienced difficulties structuring his story because he wanted to describe parallel story lines and the scene frames were displayed sequentially. He later found out there was an option whereby the tool would show the relations between the various scenes, thus exposing the parallel activities.

Fig. 5 Using dialogue lines as identification tags

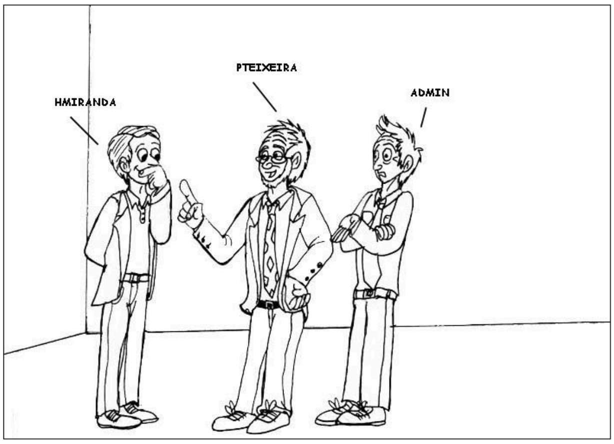
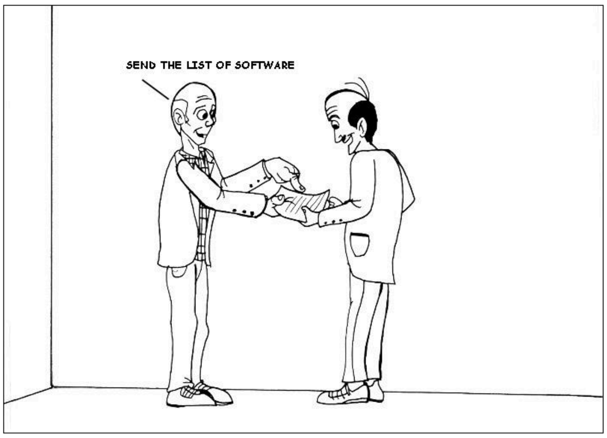


Fig. 6 Typical scene with dialogue line



Another discovery that was made by inspecting the initial stories was that all subjects told stories about how they thought the process ought to function, as opposed to producing concrete narratives based on recollections of past, specific occurrences. We later found out that this was a deliberate approach by the team: they had agreed that they were not happy with the existing configuration process and were seeking to implement a whole new process. (Owing to our study protocol, it was inappropriate for us to intervene.)

In phase two, lasting roughly two weeks, the team members were invited to use the tool to outline their stories. Table 3 provides a quick summary of the six stories that were produced by the end of phase two. Since the participants were purposely trying to model a desired process, most stories were poor on implicitness and heavily reliant on structure. In fact, the team felt the tool was not powerful enough to model complex story lines and asked us to improve the support for scenes representing decisions (the tool only supported simple yes/no type decisions initially). Two team members did not use dialogues at all, and all of them used structure as the primary means of telling a story. Most team members adopted narrative to describe what happened in a scene and for connecting scenes when using non-sequential patterns. In a few stories, narrative was also used to convey implicit story elements such as uncertainty, frustration and disbelief (see examples in Fig. 7).

Table 3 Collected data per story at the end of phase two (metrics for RQ1)

Story #	Number of scenes	Use of dialogue	Use of narrative	Structural complexity	Story verifies process validity restrictions
1	10	None	Medium	Medium	Yes
2	8	Low	Medium	Medium	Yes
3	37	None	Medium	Very high	Yes
4	14	Medium	Medium	High	Yes
5	13	Medium	Low	High	Yes
6	15	Low	Medium	High	Yes

Fig. 7 Expressing emotions

In the final phase, participants were asked to collaboratively produce a converged story. Since the storytelling tool allows viewing and changing each other's stories but does not support any explicit convergence process, the team had to improvise a way for reaching a common, agreed upon story. The improvised process began with the team leader gathering the stories from all participants for analysis and comparison with his individual story. He also suggested the team members to use the storytelling tool to study each other's stories in preparation for a convergence meeting where the final story would be discussed face-to-face. Actually, because of the unanticipated complexity of some stories, two meetings were necessary to complete the discussion. After these two meetings, the team leader used the storytelling tool to record the collective portrayal of the new IT configuration process.

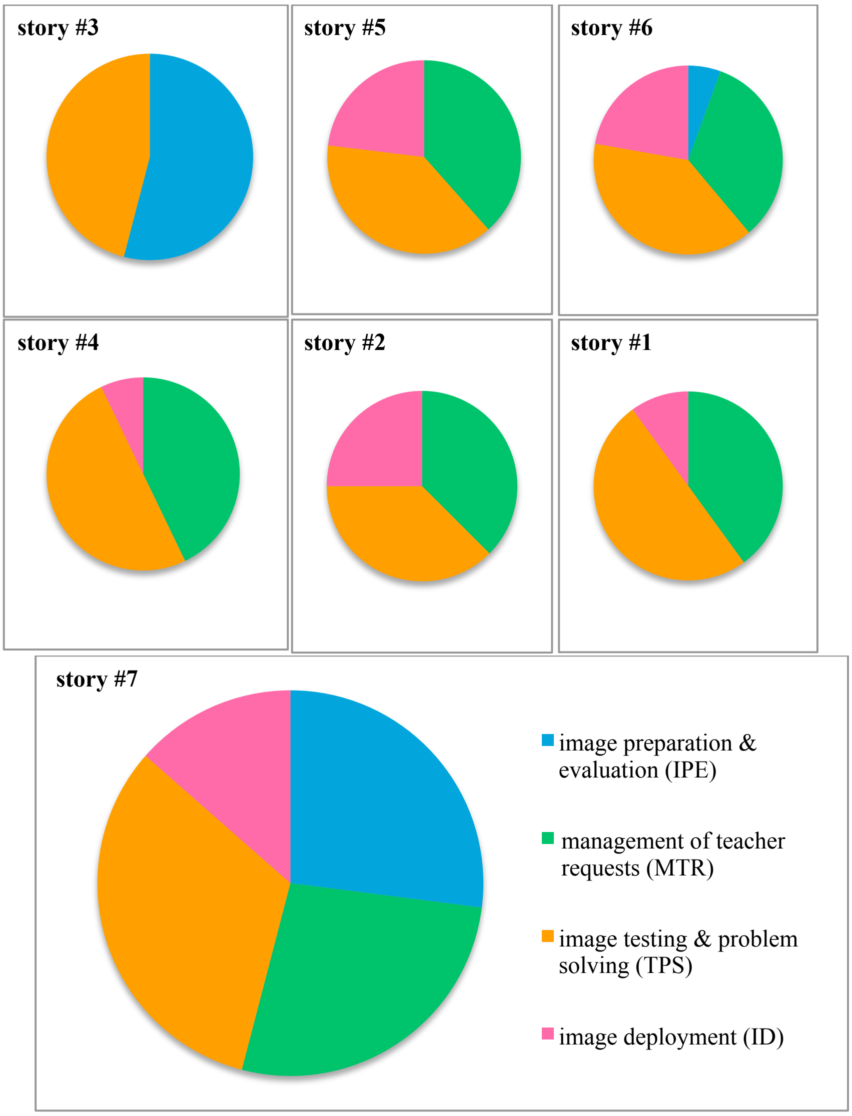


Fig. 8 Balance of story segments in individual stories versus the converged story

We found out that the individual stories played a significant role in these meetings, serving both as a key facilitator in exposing each participant's view on the process and, as multiple subjects accounted in interviews, as a tool to record and organize the participants' ideas, improving their own understanding of the IT configuration process being depicted.

To evaluate the impact of each individual story on the converged story, we analysed the storylines and identified four distinctive plot segments: image preparation and evaluation (IPE), management of teacher requests (MTR), image testing and problem solving (TPS), and image deployment (ID). We then analysed the relative weight of each segment in each story, including the converged story. As shown in Fig. 8, the coverage of these story segments was not homogeneous among all participants, with team members dedicating greater shares of their stories to the parts of the procedure they were more familiar with, and/or had an interest in changing.

Considering that the team leader developed an individual story and then developed the converged story, we paid particular attention to the differences between these two stories. The individual story developed by the leader is referenced as story #3 in Fig. 8. It shows that the leader dedicated the majority of storytelling to the first segment, which mainly involves planning activities, while omitting more operational activities such as dealing with teachers' requests and installing image files in the laboratories. In contrast, almost all other team members ignored the first segment and covered the remaining segments in varied proportions. However, what is interesting to observe is that the team was able to converge on a balanced account of the new IT process, which is clearly shown in story #7 (Fig. 8).

We also analysed the level of detail of each story segment, and constructed the parallel coordinate plot shown in Fig. 9. In the horizontal scale we list the four story segments outlined above, while in the vertical scale we consider a measure of detail in 5 levels, from none to very high. The polygonal lines show how the details of each story changed as the story evolved from preparation to deployment.

We find that the IPE and TPS segments are covered in very high detail in the leader's individual story (#3, shown as a dotted line in Fig. 8) but much lower detail in the other team members' stories. Actually, four stories do not have any details at all about IPE. The other team members portrayed the MTR and ID segments, which were not addressed by the leader, in low to medium detail.

The level of detail of the converged story (#7, shown as a dashed line in Fig. 9) shows a considerable balance when compared with the individual stories. Remarkably, the MTR segment of the converged story is more detailed than any of the individual stories. This was partially explained by the team members in the interviews, where they noted the convergence meetings allowed to discuss several issues about the management of teachers' requests, which were then integrated in the final story. These results suggest that sharing different views during the convergence meetings sparked discussion and resulted in a very detailed story segment.

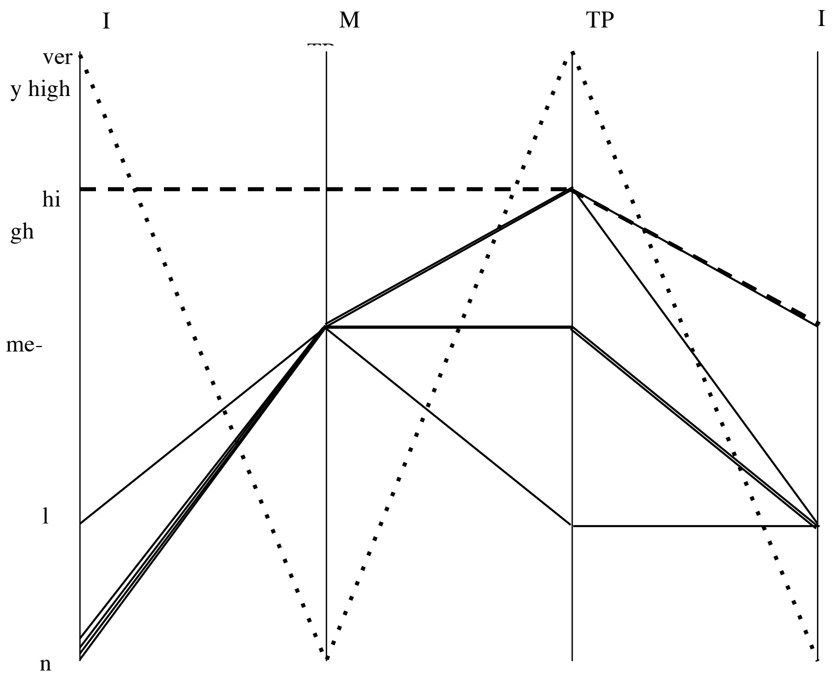


Fig. 9 Level of detail for each segment in individual stories. The dotted line corresponds to the leader's individual story, which is #3; Solid lines correspond to the other team members' individual stories; and the dashed line displays the converged story, which is #7

However, in the IPE and TP segments the opposite occurred. The simpler and more general accounts by the team members may have influenced the leader to streamline these story segments. Finally, the ID segment of the converged story closely follows one of the stories. A member recognised by the team as the most experienced with IT deployment practices developed this particular story. Therefore the ID segment reveals deference to expertise. Still, the team was able to add some information to the segment, which was related to documenting procedures.

To conclude this case description, we emphasise that the team's main goal was transitioning to a new IT configuration process. Both the individual and the converged stories were developed with this goal in mind, which explains why the stories had low implicitness and high levels of structural complexity. After finishing the converged story, the organisation used it to develop a more traditional business process model, using the BPMN notation, and started automating it using the Bonita Open Solution BPM platform.

5 Conclusions

The case study was set up to obtain answers to three research questions. It is now time to revisit them.

Can meaningful business processes be elicited through storytelling? The answer is a resounding "yes." After the short training period, the users were able to develop both individual and converged stories. Though the converged story required discussion in face-to-face meetings. Most developed stories combined pictures with medium-sized narrative descriptions. All stories had medium to high structural complexity. And most stories had low to medium use of dialogue.

Feedback obtained from the interviews indicates that the team was satisfied with the results. The organisation later on developed a more formal IT configuration process model based on the converged story, using the BPMN notation. This provides another positive indication that the storytelling approach can generate meaningful processes.

Can storytelling enable and incite users to externalize tacit knowledge and preserve contextualization? Based on the case study, the answer leans towards a "no." It was ironic that in the first phase of the study, users seized the opportunity to use the tool to create a fiction that they wanted to see, instead of telling the existing reality. If a process scenario has not been experienced, perhaps it is less readily outlined as a story in rich terms? This somewhat subversive use of the tool to outline prescriptive processes arose from information politics.

However, the fact that the majority of stories lacked the expected contextual richness seems to reinforce the "no" answer, even if we argue that some degree of externalization was achieved. We note that a future research question may involve asking *how* can the storytelling tool be used to elicit rich, ecological business processes from end users. It seems that a challenge with certain sets of users is to break the established frame of abstract process-based thinking so as to encourage a more narrative approach based on experience. In our case, the IT team and especially the team leader were highly entrenched in the workflow paradigm and the end results clearly show a predominance of that view. So, the tool itself may not be sufficient to establish a different practice. The combination of tool and training could potentially contribute to overcome this barrier. Another possibility would be providing exemplars of best practice to users.

A further challenge may be how to support users in converting narrative stories into visual stories. The participants in the study developed an emergent practice of emphasizing narrative over visual elements and so a possible recommendation for future tool development is to more fully support narrative integration into visual elements.

Can storytelling contribute to improve process modelling? The results from our study favour a "yes" answer. Our analysis of the story segments reveals that the converged story is not only broader in scope but also more balanced and detailed than the individual stories, while retaining and integrating the views from all team members.

Revisiting our validity concerns, it can be argued that any comprehensive team discussion, whether or not based on business stories, would surely contribute to an agreed upon, better process model. We elaborate on two factors that may counter that argument. Because the team members were tasked to tell their story, they were forced not only to reflect on how they thought the process ought to be, but also to materialize that mental model in the form of a business story. While we could not identify a predominance of tacit elements in the recorded stories, we argue that some degree of knowledge externalization has indeed taken place. This was confirmed by the capacity some team members had to influence the converged story developed by the team leader. The second relevant factor is that by reading each other's stories, the team became more aware of different if interrelating views of the process under study. This was evidenced not only by the inclusive converged story, but also by the focussed rather than exploratory nature of the discussion in the face-to-face meetings, and the central role played by the stories in driving conversations, revealing the team's comfort in dealing with information portrayed in this form.

This research contributes to overcome several constraints imposed by the incumbent workflow paradigm on business process modelling. In our comparison of the differences between the storytelling approach and the workflow paradigm we show that storytelling relies less on formalism and more on interpretation and familiarity. It also gives more latitude to complement procedural with contextual information. The case study shows that the modellers were capable to discuss the business processes in which they were involved using a less formal language, and could translate them into a formal language when such necessity arrived. Although the case provides significant qualitative insights about process modelling using an informal approach, we recognise that quantitative research is necessary to measure the gains, e.g. in terms of modelling efficiency, meaningfulness, and perceived value. Though as usual in many qualitative studies, the obtained results provide a significant baseline for future quantitative research.

Our case illustrates how business process models may capture contextual richness, narrative freedom and implicit flows. We note however that additional steps seem necessary to stimulate knowledge externalisation and contextualisation of business processes beyond procedural knowledge, for instance through training, group facilitation and incentive mechanisms.

The move towards less formal process models, closer to the business reality, also raises the interesting possibility of bringing end-users (employees, managers, executives, customers, etc.) to the process of process modelling. The expertise required to master incumbent process modelling languages has naturally lead to a situation where modelling became the exclusive playground of experts; and yet expert modellers often find it difficult to apprehend the knowledge and practice of every organisation (Cabitza and Simone 2013; Erol et al. 2010). Our case reveals a breakthrough not only allowing a team to develop individual process models, but most importantly allowing the team to integrate individual contributions into a balanced solution.

The opportunities brought by shifting process modelling from expert modellers towards end-users opens up interesting possibilities for both BPM clients and suppliers. On the client side, it could bring financial gains, increased agility, fewer privacy concerns, and increased participation and engagement in the BPM approach. On the supplier side, it raises opportunities to offer innovative modelling tools and services to clients. In particular, it may support remote modelling and massive modelling arrangements. It may also allow changing the traditional, fragmented, time-consuming approach to process discovery towards more innovative service provision schemes relying on crowdsourcing, coaching and group facilitation.

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