Eliciting and Modelling Business Process Stories

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Abstract

Most business process modelling tools being used today encourage the rendition of lean, prescribed and clearly coordinated activities, which often clash with far more intricate business realities. In this paper, we evaluate an alternative approach that adopts concepts from storytelling and sensemaking theories to elicit process stories. The viability of this approach is tested in a case

study involving sixteen individuals from the same organisation in telling their personal views about a business process, which gathered a total of twenty process stories. The obtained results suggest that process stories may increase the meaningfulness, contextualisation and overall richness of process models.

Keywords: business process modelling, organisational storytelling, process stories, modelling tools.

1   Introduction

A defining characteristic of Business Process Management (BPM) is that it requires accurate representations of operational and managerial activities for enactment in process-aware technology such as workflow, document management, enterprise resource planning, and supply chain management. Several modelling techniques and associated languages have been adopted to represent business processes, including Flowcharting (Lakin et al 1996), Petri Nets (Schnupp and Muchnick 1992), Role Activity Diagrams (Holt et al 1983), IDEF (Mayer et al 1995), Event Driven Process Chain (EPC) (Scheer et al 2005), UML Activity Diagrams (Object Management Group 2011), YAWL (van der Aalst and Hofstede 2005), and the Business Process Model and Notation (BPMN) (Object Management Group 2013). The research literature provides several comparisons of the different techniques and languages, showing how they address a wide range of business needs, such as redesigning the way organisations do their business, and also a wide range of technical needs, like information systems integration and automation (Hommes and van Reijswoud 2000; Giaglis 2001; Aguilar-Saven 2004; List and Korherr 2006).

However, several weaknesses have been identified in the existing modelling techniques and languages (Russell et al 2006; Wohed et al 2006). In particular, many researchers have expressed concerns with the lack of flexibility in process models, which often lead to systemic failures caused by unexpected events and conditions, and ad hoc business needs (Pesic 2008; Antunes and Mourão 2011; Jonnavithula et al 2015). Also related to flexibility, some researchers have discussed the dilemmas of control, i.e. how control should swing between humans and machines to adapt to work constraints (Cabitza and Simone 2013). Moreover, several studies mention that often process models are regarded as overly prescriptive, when in reality organisations use them as information resources, useful but competing with other equally useful resources (Lindsay et al 2003; Recker et al 2006; Krogstie 2007; Riemer et al 2014).

The lack of consideration for contextual knowledge in process modelling and execution has also been pointed out as an important limitation of current process modelling approaches, languages, tools and systems (Caetano et al 2005; Rosemann et al 2008; Brossard et al 2011; da Cunha Mattos et al 2014). By combining work procedures with additional knowledge about constraints, deviations, operative scenarios, and past positive and negative outcomes, which may influence the specific details about how a particular process may unfold in a particular context, one may help to reduce gaps between model and reality (Antunes et al 2013).

In our research (Antunes et al 2013; Simões et al 2016), we have adopted the perspective that contextual knowledge should be an integral part of business

process management. Our standpoint is informed by organisational theory, in particular the sensemaking (Weick 1993; Weick 1995) and organisational storytelling (Denning 2000; Denning 2006) theories, which suggest that decisions made by people in organisational settings are influenced by perception, recognition, past experience, and also purposeful action and feedback. In particular, the storytelling stance suggests that process models should extend their representational abilities beyond the strict representation of activities, conditions and flows, towards what we designate by process stories. Process stories may hold contextually richer, diversified information about the activities being modelled. For instance, process stories may combine typical with atypical situations in the work routine, identifying expected and unexpected events that have occurred in the past, mentioning the considerations and decisions that were then made, while highlighting the organisational culture, rituals and practices affecting them.

In our prior research, we developed a tool supporting the elicitation and modelling of process stories (Antunes et al 2013). We proposed a meta-model which incorporates elements from storytelling theory with elements typically found in traditional process modelling languages and tools. Furthermore, we integrated the concept of process story with a visual narrative scheme inspired by comic strips, using textual/visual elements and rich metaphors to express contextual knowledge (Short and Reeves 2009). In particular, the tool helps externalising organisational knowledge related to business processes in a visual way, using generic pictures of business situations, like having a meeting or working on a document, in combination with other textual and visual elements

such as dialogue lines, which help characterising places, activities, actors, business objects, thoughts, decisions, and other intervening factors. The use of sketches and storyboards are particularly well suited for storytelling-based process modelling, as they (1) integrate graphical shapes and textual elements leading to more effective design representations (Recker et al 2010), (2) abstract away detail and the sense of finality that would be present in a photograph to trigger creativity, imagination and immersion in the story (Williams and Alspaugh 2008), (3) ease user identification with the characters – "the stylized character is, […] an empty shell that we inhabit" (McCloud 1993), (4) are intuitive and enhance memory retention (Gershon and Page 2001).

Even though the tool has already been informally tested and provided good indications about the viability of the approach (Antunes et al 2013; Simões et al 2016) we lacked insights from a more thorough study demonstrating the utility of process stories. The current study aims to cover this gap. We are specifically interested in answering the following research questions:

RQ1: Is it feasible for stakeholders to elicit meaningful business processes without the participation of expert modellers?

RQ2: Is business process context extractable from process stories?

RQ3: How do process stories improve the modelling of business processes?

The paper is structured as follows. The next section presents background information regarding related work, the role of process modelling, and prior experiments using our modelling approach. In Section 3 we discuss the case

study design including objectives, research questions, data collection procedures, and analysis. Section 4 presents the results from the case study. Lastly, we present some conclusions and future work directions.

2   Background

2.1   Related Work

Business process automation, integrating execution, analysis and reengineering activities, can arguably be considered the ultimate goal of business process modelling, contributing to deeper understanding and systematisation of the network of activities, prescribed or otherwise, that compose a business (Kock et al 2009; Dumas et al 2013). The utility of process modelling is not however limited to automation. A common goal for process modelling efforts is to increase knowledge and shared awareness within the organization (Bandara et al 2005).

Fleischmann et al. (2012) recognized that the transference of knowledge between stakeholders and expert modellers is often flawed, leading to losses of information and inconsistencies reflecting actual work procedures. Their subject-oriented approach (S-BPM) puts stakeholders at the centre of attention. During S-BPM analysis, natural language and its structuring elements are used to identify activities and the intervening actors and business objects. Our approach is consistent with the S-BPM perspective. It too is subject-oriented and regards process context as important to modelling. However, while S-BPM is mainly centred on control flows (Fleischmann et al 2013), we are mostly

focussed on the more diverse information brought by process stories. Besides, we elicit process stories directly from the stakeholders, without mediation from modelling experts, thus avoiding potential gaps in knowledge transference and translation to modelling languages. We argue that process modelling should ideally be left to the stakeholders, so they can describe business processes from diverse, complementary perspectives.

Harman et al. (2015) presented a role-playing approach to process elicitation where stakeholders navigate a virtual world and perform process-related tasks. The method aims to assist in memory recollection. Common to our approach, process information is gathered without support from expert modellers. However, while this role-playing approach is centred on formally modelling process activities, our approach is focussed on capturing the context of such activities. By eliciting context, we aim to gain a better understanding of business processes, especially beyond the "happy path" scenario.

Nardella et al. (2014) adopted a storyboarding technique to create 3D visualizations of process models, with the goal of improving communication between expert modellers and stakeholders with no modelling experience. In our approach, storyboarding is used not only to show process information to stakeholders, but also and most importantly, to help stakeholders in building the process stories themselves, and in sharing and discussing these stories to increase process knowledge and awareness.

Mayer's (1989) work on cognitive theory and learning demonstrated that models improve conceptual retention while deemphasizing verbal retention, and

improve problem-solving transfer skills. The learning process is dependent not only on the contents being transmitted, but also on the way it is presented and the individual characteristics of the audience. Based on Mayer's research, Recker and Dreiling (2007) investigated whether familiarity with a particular modelling language would play a role in model understanding, but found no significant differences in performance by modellers specializing in either EPC or BPMN when interpreting models expressed in each language. Figl and Recker (2014) found an overall tendency among business users of process models to prefer diagrammatic representations over text (both structured and free-form), and to prefer iconic representations when task settings relate to understanding and communicating process models. Mendling et al. (2010) suggested using icons to complement textual labels representing activities, with the aim of easing model understanding. In our approach, we use graphical illustrations to represent business situations as part of process stories. However, we refer to business situations in a wider scope. It may describe one or more process activities, or portray contextual information about the process. We use these illustrations to complement textual descriptions (the narrative) with the purpose of improving model comprehension and user engagement in the story.

Ottensooser et al. (2012) studied the comprehensibility of design notations, comparing the BPMN notation with textual notations (in the form of written business process descriptions). The study shows that both expert modellers and stakeholders benefit from textual descriptions of business processes followed by the corresponding BPMN diagrams. Moreover, for stakeholders, BPMN diagrams taken alone did not significantly increase process understanding

beyond their background knowledge of the domain. These results show that diagrammatic representations such as BPMN are needed to convey precise semantics but complementary, more familiar, text-based representations can also play a valuable role in model comprehension from the stakeholders. The lack of intuitiveness of diagrammatic representations and the complementary role of text-based representations has been underlined in recent research (Chakraborty et al 2010; Dumas et al 2013; van der Aa et al 2015a). In this context, efforts have been devised to approximate the two approaches, either by generating natural language texts from process models (Leopold et al 2014), or by automatically detecting inconsistencies between diagrammatic and text-based descriptions of the same business processes (van der Aa et al 2015b).

2.2   Proposed method and modelling tool

In our approach, we deemphasize the role of expert modellers and rely on the stakeholders to do the elicitation and modelling work. The central aspect of our method is to get stakeholders to recollect their daily work activities and to develop business stories describing actual procedures in contextualized settings. According to van der Aalst's (2013) classification, our method handles descriptive process models. However, these descriptions avoid the typical formalisms used by most process modelling tools like AND-splits, AND-joins, XOR-splits, etc. (van der Aalst et al 2003). Instead, inspired by organisational storytelling theory, models are organized around scenes. Specifically, stakeholders are invited to create stories by visually assembling a sequence of

scenes portraying business situations and providing context by enriching scenes with dialogue and narrative content.

A scene is a unit of knowledge that conveys contextual information about business activities. The proposed storytelling model, represented in Figure 1, defines the following attributes of a scene. It has a **specific setting**, indicating the physical location where activities occur, e.g., an office or department; and also indicating the particular situation or setting, like communicating, signing a document and making a business decision. A scene may involve several **actors**, either persons or machines that directly intervene in the scene. Physical and virtual **artefacts**, like tools and documents, may also be involved in scenes. Several **events and actions** may be reported in a scene; they drive the storyline in terms of purposeful action. Finally, dialogue lines can be added to actors to better express their involvement in the scene, e.g. making decisions and externalising knowledge.

A scene incorporates a cartoon-like **graphical illustration** and **scene-specific metadata** providing an abstract structure for the situation being depicted. The stakeholders are not expected to sketch these scenes. Instead, they select them from a library of over 100 generic, reusable scenes covering most common business settings, which are then configured to express a particular business process. For instance, the library contains a generic "waiting scene" illustration, which includes scene-specific metadata expressing the notion of time. The combination of time with the other metadata elements present in the waiting scene, in particular actors and events, allow expressing how long the actors are

expected to wait and what actions will be executed when either the expected event occurs or the time limit is reached. There are additional types of generic scenes depicting common business situations and actions, such as making decisions, sending or receiving business artefacts, taking formal or casual meetings, signing documents, and communicating information (see Figure 1). These major types of scenes and related metadata are implicitly mapped to different process constructs such as activities, conditions and events. Scenes are contextualized in the story by identifying the business artefacts present in the scene, mapping actors to organizational roles, and adding dialogue lines and narrative remarks. The story emerges as a sequence of scenes describing a process scenario that has occurred. A representative set of stories covering different scenarios and diverse points of view forms the process model.
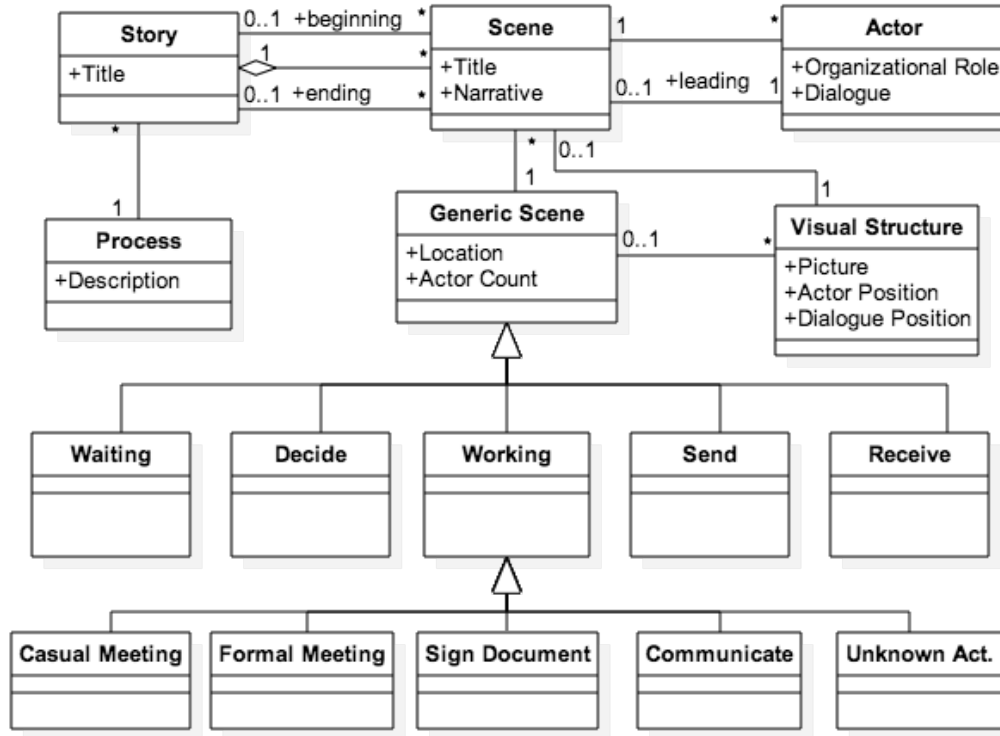
Story
+Title

0..1 +beginning *
0..1 +ending *
1

Scene
+Title
+Narrative

1 *
0..1 +leading 1

Actor
+Organizational Role
+Dialogue

*
1

Process
+Description

* 0..1
1

Generic Scene
+Location
+Actor Count

0..1 *
1

Visual Structure
+Picture
+Actor Position
+Dialogue Position

Waiting

Decide

Working

Send

Receive

Casual Meeting

Formal Meeting

Sign Document

Communicate

Unknown Act.

Figure 1 – Storytelling model (some classes and attributes are omitted for clarity)

We stress that scenes should be seen as templates and are meant to be reusable, and this is why we resort to drawings instead of images from the workplace in question. Of course, scenes explore the visual properties of graphical illustrations. They depict business situations in evocative ways and have to be interpreted, i.e. business people are expected to recognise and associate a scene to a particular business situation, activity, or rule. To develop a process story, users pick generic scenes from the library, organize them in sequential order, and then customize each scene according to the metadata outlined above. The outcome is a process story resembling a comic strip, where the plot (outlining a

specific business process scenario) is unveiled and explained throughout the scenes using attributes like settings, actors, dialogues, events, actions, artefacts, and time stamps.

Our modelling tool offers a web-based authoring environment for visual composition and sharing of process stories (Borges and Pino 1999; Perret et al 2004; Santoro et al 2010). Figure 2 shows the tools' user-interface for composing a scene according to our approach. The user starts by selecting the type of situation from a dynamic list. Based on the selected type of situation, the tool asks for more specific information, which depends on the scene-specific metadata. In Figure 2, the selected situation was "Send"; hence the tool asked details about what had been sent (e.g. an artefact) and who was involved in the exchange. The user could complete the scene by adding dialogue lines.

Upon saving a scene, the tool picks a picture from the database portraying the situation and presents it to the user, who is left free to focus her attention on developing the process story. Often the database has several alternative pictures for the same situation and the user is allowed to choose one of them. The complete process story is then viewable either in a booklet printable form or interactively, moving forth and back the list of scenes.

Figure 2 - The modelling tool's user-interface. 1) The title of the scene; 2) Narrative description of what happens in the scene; 3) Actor identification and mappings to organizational roles; 4) Scene dialogue; 5) Flow to the next scene; 6) Control over picture selection and dialogue positioning; 7) Visual representation and navigation between scenes.

2.3   Prior evaluation studies with the tool

In a previous article (Antunes et al 2013) we report a preliminary evaluation study of the modelling tool and process stories. The study suggested that the stakeholder-centric elicitation of business processes through process stories was feasible however hindered by several constraints imposed by the tool's limited usability.

Later on (Simões et al 2016), we reported a case study with a revised tool where a small team was involved in the analysis and design of an improved business process that was critical to them. All team members were involved in generating process stories, including the team leader. Then the leader used the individual process stories to suggest a converged process model, which was finally discussed and acquiesced by the team.

The results from these studies showed that meaningful business stories could indeed be elicited and modelled by the stakeholders without mediation from modelling experts. Nevertheless, even though there were some positive indications about the method of process modelling through storytelling, we found out that stories lacked or were poor on the depiction of unexpected situations, personal views, and situated reasoning, which are the foundations of process contextualisation. In the abovementioned study, the team scarcely used dialogue and was heavily reliant on traditional activity flows, when we were expecting rich stories full of exceptional events and insights about what happens in reality. That is, although the method and tool were found to be viable for business process modelling, our main hypothesis that process stories could enable process contextualisation was not validated.

Two factors have emerged as possible reasons for these less desirable results. The first aspect that we noted was that, by chance, the team was specifically seeking to create a completely new business process, and thus their stories reflected more how they thought the process ought to be rather than what actually was happening in day-to-day situations. As such, the stories were

prescriptive as opposed to contextualized and episodic. Moreover, the fact that the participants were skilled IT practitioners, all with backgrounds in software engineering, may have also affected the way they conceptualised the business process. In particular, the participants revealed an inclination for abstracting processes using typical computer-science paradigms (e.g. decomposition, separation of concerns, iteration), which favour the traditional representation of activities, conditions and flows. The study reported in this paper addresses these concerns.

3   Case study design

We followed case study research methodology from Benbasat et al. (1987) and guidelines from Runeson and Host (2009). Throughout this section we address site selection, unit of analysis determination, case study protocol, ethical considerations, data collection, triangulation, metrics, data analysis, and validity.

We considered three major requirements for the case study design that drove the choice of the target organization and selected business process. These are described in the following paragraphs.

The first requirement concerned process complexity. We needed a minimum level of complexity for the process being analysed to avoid investigating a near-trivial problem and to maximise the potential for grabbing contextually rich business stories. As such, we needed a process with multiple lingering steps, several task interdependencies, and also requiring problem solving. Most

importantly, the process should summon the participation of various people across different business units. The intervention of multiple stakeholders from different units is usually a good source of complexity and enables the emergence of different, complementary and often conflicting, personal views, which again are recognisable sources of complexity.

Another requirement we had to consider concerned modelling bias. The study participants should not possess any specific expertise in computer science that would bias the modelling task, other than basic computer literacy and experience with worksheet software. The main reason was that in the previous study we found out that process modelling may have been affected by the participants' background in that field, which may have contributed to an emphasis on abstraction and decomposition.

The third requirement was that the target organisation should be looking to model existing process knowledge. This again contrasts with the prior study where the participants were seeking to develop a completely new process. As already mentioned, the focus on new process knowledge seems to emphasise prescriptive rather than descriptive process stories. Hence, for the current study, we were looking for study participants with an interest in documenting an existing process and no immediate plans for process reengineering or enactment.

The selected organization was the Polytechnic Institute of Setubal, hereinafter referred to as IPS, and the unit of analysis was the process by which a student requests and receives a course certificate or diploma upon completion of a

study cycle. This process will be named the "diploma process". The study's participants were administrative staff belonging to the IPS Academic Division (AD), which is the process owner.

The AD is organized in three separate working units. The Front-Office establishes the interface between the AD and the students. Its responsibilities include receiving student requests, preliminary checking several requirements, communicating with administrative personnel, and following-up on processes by contacting students whenever necessary. The Treasury Office handles all payments made to the AD, including tuitions and request emoluments. The Back-Office unit processes the requests. This comprises validating all requirements, contacting staff from other organizational units to track missing information and to comply with mandatory rules, emitting legal documents, and managing electronic records.

This study had the participation of all AD's staff. This included the head of the AD (designated Chief of Division), and fifteen workers allocated to the three units outlined above: five persons in the Front-Office, three persons in the Treasury Office, and seven persons in the Back-Office. Among the latter group, one person designated as Back-Office Coordinator is responsible for the operations at the AD and reports directly to the Chief of Division. Excluding the Chief of Division, all participants used the modelling tool.

The participants used the tool as an authoring environment for telling business stories. Other than a brief presentation session, we avoided direct contact with the participants, and used second-degree data collection techniques to obtain the

user stories and associated data (Lethbridge et al 2005). The participants in this study created their stories autonomously and data was collected at a later time from both the tool's print outs and raw usage logs. We resorted to a goal-based metric technique similar to the methodology proposed by Basili and Weiss (1984) to analyse the data. The specific measurement goals were aligned with the research questions established for this study. We then specified several questions and metrics necessary to evaluate the goals. The research questions, goals, questions and metrics involved in the data analysis are shown in Table 1.

Table 1 - Goal-based measurements

RQ	Goal	Questions	Metric	Type of Data	Measurement Scale
1	Evaluate meaningfulness	Did the subjects create detailed stories? Could workflows be derived from user stories?	Number of scenes	Quantitative	Ratio
			Scene density (no. of scenes vs. no. of process activities)	Quantitative	Ratio
			Word count (narrative[1])	Quantitative	Ratio
			Word count (dialogue[2])	Quantitative	Ratio
			Structural complexity[3]	Qualitative	Ordinal (Low/Medium /High)
			Story verifies process validity requirements (see (Antunes et al 2013))	Qualitative	Nominal (Yes/No)
2	Evaluate contextualization	Did participants express contextual judgement? Were unexpected situations depicted? Was contextualized knowledge applied?	Presence of personal views in the dialogue/narrative	Qualitative	Nominal (Yes/No)
			Depiction of unexpected situations	Qualitative	Nominal (Yes/No)
			Detachment from prescribed procedure	Qualitative	Nominal (Yes/No)
3	Evaluate model richness and adequacy	How detailed were the activities? How many distinct scenarios were portrayed? Does the model verify organizational requirements?	Number of activities	Quantitative	Ratio
			Number of organizational roles	Quantitative	Ratio
			Number of decision steps	Quantitative	Ratio
			Model reflects intended procedure	Qualitative	Nominal (Yes/No)

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[1] We define narrative as the textual report made by the narrator of the story. In the modelling tool, narrative is registered in the text field labelled 2 in Figure 2.

[2] We define dialogue as the direct discourse depicting individual thoughts or remarks, or spoken interactions amongst actors in the story. In the modelling tool, dialogue is registered in the text field labelled 4 in Figure 2 (one text field per actor in the scene), and appears in the visual frame representing the scene.

[3] Qualitative assessment of structural complexity is based on metrics from RQ3.

To ensure validity, the case study design was developed with knowledge and feedback from the Chief of Division. Furthermore, the study also received explicit agreement and commitment from all participants. This ensured that the study was aligned with the IPS goals and the target process and activities were considered adequate and relevant both for our research and the target organization.

The participants were briefed on the study protocol, including timings and data acquisition procedures. Ease of communication and alignment between researchers and participants' views on the case study were also favoured by selecting a familiar target organization, i.e. the researchers had in-depth knowledge about the organisational culture and the participants were also aware of the constraints imposed by research practice.

Reliability and internal threats to validity were addressed as follows. We ensured that subjects understood the tasks they were about to perform by running a preliminary session with all participants where tasks were explained and the tool was demonstrated (more on that later). By not intervening during the modelling activities, we also ensured that the researchers did not influence the participants during the creation of their stories. Factors that could affect causal relations were also isolated, such as whether the participants were correctly using the tool, and the tool's adequacy for authoring business process stories.

We used different forms of triangulation to increase the quality of data analysis. We gathered data from multiple sources, namely from the tools' print outs

(storyboards and structure diagrams), from raw system logs, and from the participants' feedback. We took both quantitative and qualitative measurements whenever possible, and data was analysed independently by two researchers.

Ethical considerations included informed consent from all participants, who were briefed on the associated risks, privacy issues, and possible benefits brought by the study to the organization. As an added measure for ensuring a reasonable level of confidentiality, we configured the tool to optionally submit anonymous stories. This procedure was deemed appropriate considering the sensitive content potentially held in stories, such as diverting from established rules or even critiquing accepted practices.

Data gathering was conducted in three phases (see Figure 3). The preliminary phase consisted on a single, on-site motivational session with all participants, presenting the process story concept and having a quick hands-on demonstration of the tool use, with time for answering questions. This session lasted approximately one hour.

In the second phase, the participants were split into four groups of three to four persons. On a certain day, a group would be asked to individually use the modelling tool to tell a story about a concrete situation that involved the diploma process. Each session was then finished with a short group discussion about modelling with storytelling. These sessions lasted about one hour and ten minutes, with about one hour dedicated to working with the modelling tool.

This arrangement, having participants working individually in small group sessions, was necessary to allow the organisation to keep functioning, while at the same time avoiding low participation levels. These sessions were held during office hours.

The groups were intentionally kept small to facilitate support to users, should any problem arise. When the participants where developing their process stories, we restricted our interventions to resolve technical and usability issues, avoiding any interference on anything related to how they would do it.

As we were interested in learning how participants reacted to the modelling method, we observed them during the sessions. Whenever relevant reactions, comments or dialogues were identified, we silently took notes. This qualitative data is reported together with the case results in the next sections, whenever appropriate.

The participants were allowed to submit more than one story; and they were also allowed to attend more than one session, if necessary to finish their stories. In between sessions, the tool was available on the Internet and participants were encouraged to use it to complete or submit additional stories.

In parallel with the group sessions, we interviewed key staff to gather information about the diploma process. Our aim was to build a reference process model using traditional methods. Besides the interviews, we also witnessed running processes and analysed data records.

In the third phase of this study, we reconciled the various individual stories and built an integrated process model based on the converged narrative. This model was then analysed against the reference process model in order to assess on whether the storytelling-based elicitation retained the essential characteristics of the process.
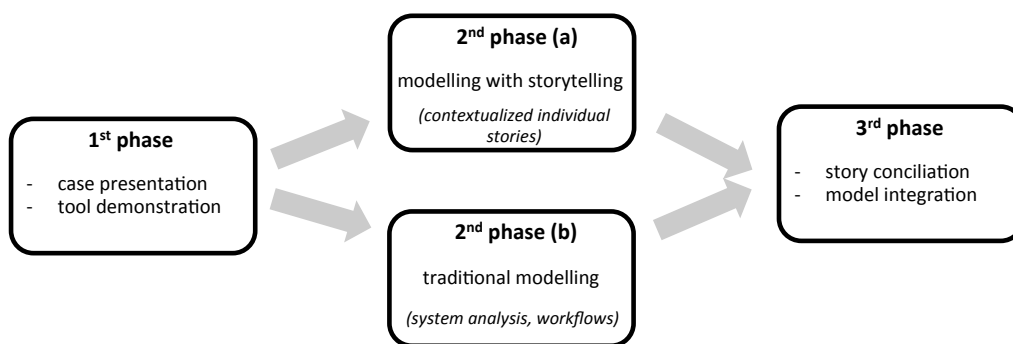

Figure 3 – Field procedures

4   Case description and results

The selected business process concerns obtaining a course certificate for a study cycle, which can either be an undergraduate or a master's course. In both cases, the process begins with a student approaching the academic division's front office (henceforth referred to as FO) with a request for a certificate. The worker attending the student then performs a number of verifications to ensure that all requirements have been met and the certificate can be issued. These include confirming that all course subjects have been completed, the respective marks have been issued, and that all tuition fees have been paid. The student's identity must also be validated and in case the request is being made on the student's

behalf, the requester must produce a valid authorisation. Once the request is validated, the student is forwarded to the academic division's treasury office (TRE) to proceed with payment. The treasury worker will later on hand over the process to the coordinator, who will distribute it to one of the administrative staff from the back office (BO). Thenceforth, the BO operative who receives the process checks again the student's academic history, calculates the course average mark, and issues the certificate. The operative then hands over the process to another BO staff member who checks all data for errors and sends the certificate to the Chief of Division, who in turn signs the certificate and sends it to the Dean's office (DO) administrator. The DO administrator signs the certificate and sends it back to the BO, where it is processed and mailed to the student by the same worker that originally handled the request.

As described in the previous section, the data gathering process was organized in three phases, as outlined in Figure 3. The following subsections present the results from each of those stages.

4.1   First phase – motivational session

From the initial motivation session we learnt that motivation amongst the fifteen participants was low to moderate, with few subjects expressing high enthusiasm towards this study. A stressful working environment where complaints are common, problems are often difficult to solve, and rules are not strictly defined, explained this. This scenario highlights that the diploma process, as described above, is an oversimplified description of the "happy path" (Correia 2014), thus missing many exceptions and variations.

About one third of the participants in the motivation session thought the tool would be difficult to use, with the rest of the group remaining cautiously optimistic. Two subjects were particularly apprehensive as they thought they would not be able to use the tool at all.

4.2   Second phase – building process stories with the tool

Regarding the second phase, we recall that we divided data collection in two parallel streams. We now report on the storytelling sessions (phase 2.a in Figure 3).

In two of the sessions, some participants revealed resistance in telling concrete details about their working practice, stating that the operating procedure was standard and thus there would not be anything to tell in a story. Even after some debate by the end of the sessions, they generally defended that there were no special cases featuring unexpected circumstances, so the stories would be uninteresting and redundant. However, other participants were more enthusiastic about their stories. This was reinforced by their involvement beyond the assigned sessions, as they were allowed to attend additional sessions and access their stories remotely. In one situation, interesting group behaviour emerged in which one participant belonging to FO was vocally commenting on the FO's viewpoint whilst composing the story with the tool. Our study protocol did not prohibit it, so we considered the phenomenon part of the modelling activity and kept to our observer status. The discussion that was sparkled around the peculiarity of the story led a fellow participant from TRE to submit an additional story to complete the original account with further details

from the treasury office. However, interactions amongst the participants did not occur in other sessions.

By the end of phase two, we received a total of twenty individual stories created with the tool. Of these, three stories described other processes in the organization and were thus not considered for all metrics specific to the diploma process.

Every participant was able to compose at least one relevant business story. About half of the participants asked for assistance during the modelling sessions but most of the times to clarify minor usability issues that were immediately addressed. Two participants were unsure how to structure their stories and asked how detailed should each scene be. Owing to our study protocol, we refrained from interfering and stated that any option would be acceptable.

Table 2 summarizes the collected data using the measures defined for our first research question (more detailed data is given in the Appendix). We are able to report that the participants used narrative and dialogue as the primary means of telling process stories. The total word count (narrative plus dialogue) for the process stories averaged 206 words, with a slight predominance of narrative over dialogue (118 versus 88). Standard deviations were moderately high at 122 for the total word count, and 59 and 79 for the narrative and dialogue word counts, signalling ample variations in the use of textual content. Interquartile ranges show a typical variation across stories of 69 words in narrative content and 93 words in dialogue. In both cases, as in the number of scenes, the mean

and median values are fairly close and the nonparametric skew is inferior to 0,15. The only possible outliers are word counts for narrative and dialogue in story 5, (274 and 319, respectively), which rise higher than 1,5 interquartile ranges above the third quartile. Most stories contained a relatively small number of scenes (they averaged 6 scenes per story with a standard deviation of 3), each using a roughly even combination of narrative and dialogue to describe multiple activities in the process. Despite the low number of scenes, many stories featured high scene density, which we defined as the number of identified process activities per scene. Twelve of the process stories included scenes encompassing five or more activities, and one of the stories was completely contained in one scene with 11 activities. Conversely, in some stories, a small subset of scenes did not map to any specific activities and were used for setting the context or detailing findings (stories 11, 20), or explaining thought processes (stories 2, 13, 14). These results are also relevant for RQ3 and are further detailed in section 4.4 with the results from phase 3.

None of the participants used explicit control mechanisms to structure their stories, relying instead on textual descriptions provided in scene metadata. These results support the view that the participants described actual procedures in concrete, real situations, rather than general views or idealized procedures. It also supports the view that, unlike participants with background in computer science (as in our second set of experiments), business people seem to be less focussed on coordination. In short, the participants told process stories according to their specific work context, not according to the business process as a whole. We observed that the complete process could only emerge from the

reconciliation of several stories in phase 3. We based our qualitative assessment regarding structural complexity on how many actors intervened in the story, and the number of decisions contained in the identified activities impacting process flow. For instance, story 3, which rated medium in structural complexity, featured three actors and described two relevant process decisions. All recorded stories verified the defined process validity requirements.

Table 2 - Collected data per story (n=20) at the end of phase 2.a (metrics for RQ1).

Variable	M	SD	Q1	Mdn	Q3
Number of scenes	5,7	3,0	3	5,5	7
Word count (narrative)	118,3	58,9	82	115	151
Word count (dialogue)	87,7	78,9	26,5	76	119

Variable	Low	Medium	High
Structural complexity	5	8	7

Regarding the metrics for RQ2, we now analyse the depiction of unexpected situations and the expression of personal views in the stories. Detachment from prescribed procedure will be analysed together with the results from phase 3. We found that fifteen of the twenty stories described unexpected situations, which shows that participants, when recounting concrete events in their work routines, were more prone to choose and highlight atypical situations, detailing the circumstances that led to unanticipated scenarios, and exposing the contextual reasoning that steered their actions.

We found that eight of the stories included personal views in the narrative or dialogue, signalled by emotional elements such as anger, disbelief, empathy, or

condescendence. For instance, in one story the parents of a student try to obtain their son's course certificate, but the FO operative discovers that the student is missing several courses and is still attending the first year. Unable to give out such information to the parents, the operative consults the BO coordinator and upon return denotes that the request cannot be accepted because "not all grades have been issued" (directly cited from the story's narrative). As shown in Figure 4 (left), the operative tries to empathize with the parent, saying that it would be "easier" if he gets a power of attorney. The narrator signals the operative's discomfort, indicating that the operative was "trying to avoid an awkward situation". The parent was however not satisfied and "contested the necessity for a power of attorney". The irritation behind the parent's reply in scene 3 further builds in the following scene (not shown in the figure for lack of space): in the dialogue, the operative states, "The student is of age", to which the parent retorts: "Can you tell us our son's situation?" The parent's indignation is confirmed in scene 5 (shown right in the figure).
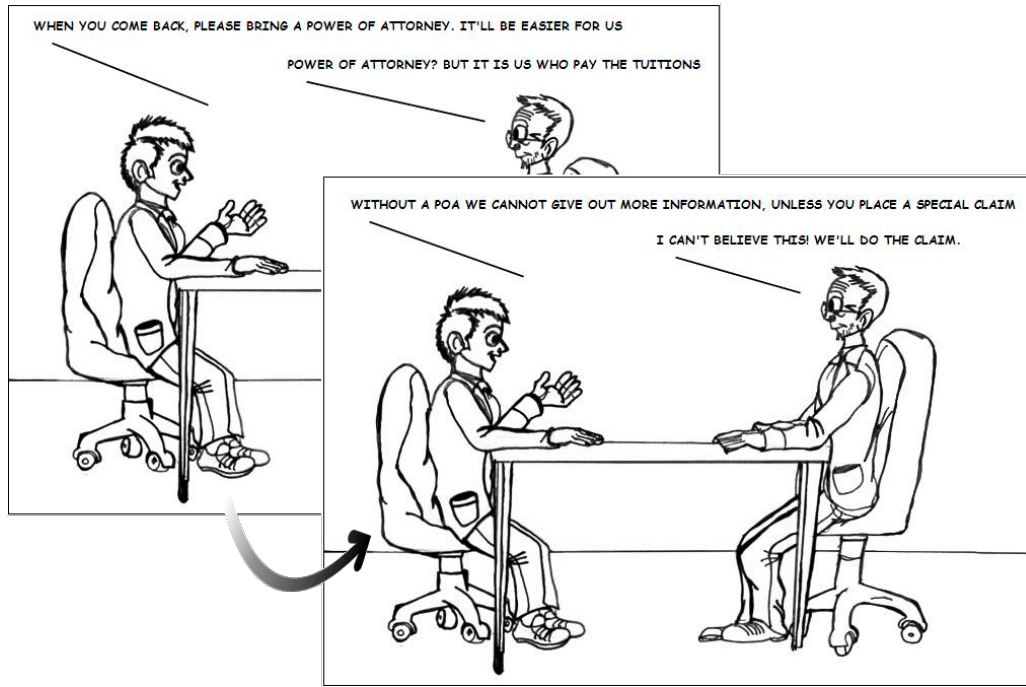
Figure 4 - Excerpts from a story exposing personal views (story 9, scenes 3 and 5, translated to English).

In Figure 5 we show another example of a scene bearing emotional traits that expose personal views from the actors. In this instance, an aggravated student repeatedly insists on being sent both a course certificate and a course diploma, even though the existing procedures dictate that course diplomas are handed separately, on a public ceremony. After some debate with the attending operative, the operative reluctantly concedes to the student's request and works with the back-office colleagues to accommodate this special request. The narrative passages associated with this particular story and the titles given to the scenes complement the emotional elements in the dialogue by framing them in the developing storyline, and underline the reasons behind the student's anger.

Among the narrator's remarks, we can read: "The student was unaware that he would not be taking the diploma", and "The student insists that he needs the diploma because he is going to work abroad".

Figure 5 - Excerpt of a story conveying emotion (story 18, scene 8, translated to English).
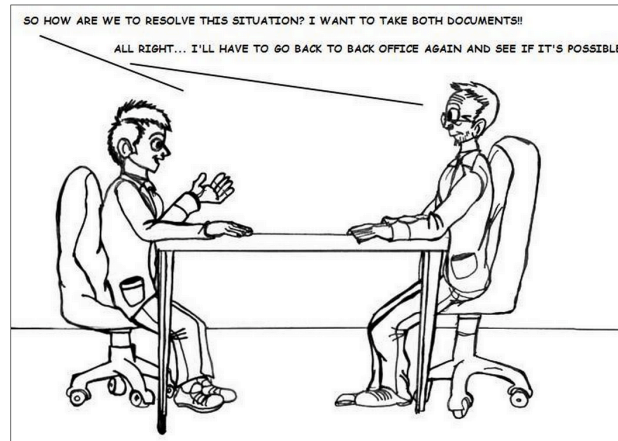
4.3   Second phase B – traditional modelling

Parallel to the individual storytelling sessions, in phase 2 we also interviewed the Chief of Division, the back-office coordinator and an experienced member of staff to model the standard diploma process using conventional techniques (phase 2.b in Figure 3). We found out that there were no written procedures for the diploma process. We therefore put together the process model from interviews, observation and document analysis. The Chief of Division offered a broad, top-level report of the happy process and even showed an application used to monitor the diploma processes being handled by the academic division. The Back-Office coordinator and staff member provided more thorough information, detailing each step in the process and describing the specific requirements for accepting requests, verification lists, service options and

pricing, and prescribed procedures across multiple scenarios. These descriptions were in accordance with the more general account provided by the Chief of Division and were remarkably similar, despite being highly detailed. Further analysis of these results and especially the reference process model created in this stage, will be presented in tandem with the discussion of phase three.

4.4   Third phase – story conciliation and model integration

In the third phase we conducted a thorough analysis of the process stories and combined them into a unified, generalized process story. We divided the individual stories into three segments, according to the type of content that was processed: 1) student attending (ATT), covering all activities related to dealing directly with the student and checking prerequisites; 2) payment handling (PAY); and 3) request processing (PRO), wrapping all activities leading to issuing a certificate and delivering it to the student.

We found out that the participants dedicated varied levels of attention to these story segments, giving ample "story time" to the description of activities that were directly tied to their work responsibilities, while deemphasising or completely ignoring other parts of the process. The level of detail given to each segment followed the same trend – as it is shown in Figure 6, the level of detail across segments was heterogeneous in all stories, with participants from the FO and BO groups giving more detailed accounts of the ATT and PRO segments, and subjects from treasury providing more thorough descriptions of the corresponding segment in their stories. In story 17, we could observe highly

detailed explanations in both the ATT and PRO segments, which was explained when we found that the author of story 17 collaborated closely with both groups (that particular story was created by the BO coordinator). None of the stories that focus on the PAY segment provided detailed accounts of the remaining parts of the process, due to the relatively independent role of the treasury group within the academic division (all stories were created by subjects from TRE). As we will see subsequently, we were able to combine elements from all stories to obtain a balanced, highly detailed converged description across the three story segments.
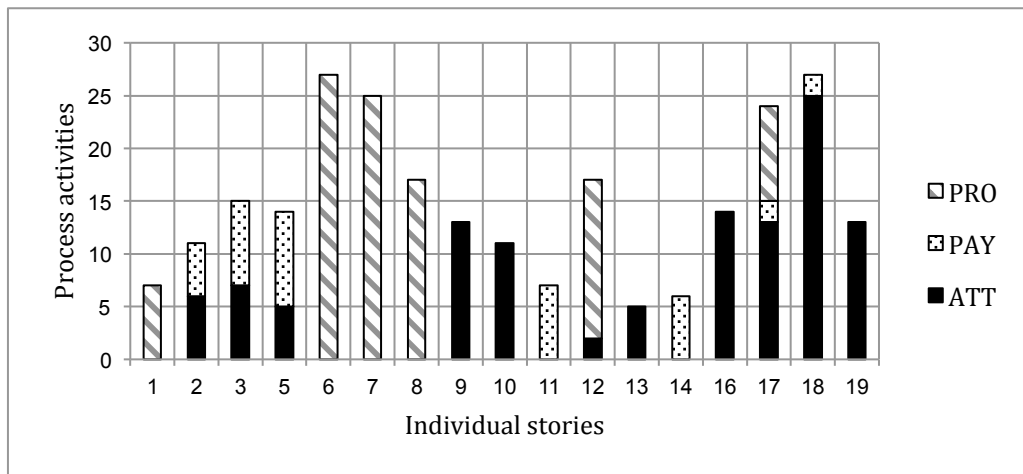

Figure 6 - Level of detail for each segment in the stories. Stacked blocks show the coverage of process segments across individual stories. (Stories 4, 15, 20 were not considered because they did not describe the diploma process).

To produce an integrated model from the various individual stories, we first created a BPMN model for each individual story. Due to space constraints,

these models are not shown here. Instead, in the Appendix we provide one of the BPMN models as an example and some quantitative data on all models.

To the best of our knowledge, there is no proposed methodology to transform and integrate scene-based process stories into standard process models. Our approach is similar to the technique proposed by Kabicher and Rinderle-Ma (2011), built on content analysis from written process descriptions and aggregation of elicited process activities. Based on a preliminary analysis of the stories, we identified the three story segments outlined above. We then classified groups of scenes into each story segment and analysed narrative and dialogue content, actors, artefacts, and other metadata in each scene in order to identify key process elements – activities, roles, decisions, and events. We then used these elements together with the structure embedded in the story and the sequencing of scenes to form one process model per story.

By comparing the number of activities in the synthesised models with the number of scenes in individual process stories, we can conclude that scenes do not map directly to activities. Most process stories display high scene density, with each scene encompassing multiple activities (six to seven in some cases). At the other end of the spectrum, there are scenes that do not translate to any activity, as they are used to describe the context, explain findings, or depicting interactions through dialogue. Looking at the breakdown of activities per story segment, we found out that stories were typically focused on specific parts of the procedure, which is consistent with the fact that the participants were describing concrete scenarios that happened in their daily routine. All but one

story ignored at least one of the segments in the complete procedure, and ten stories were completely dedicated to a particular segment. The standard process elicited in phase 2.b through traditional process modelling techniques was in average more detailed than the stories in all segments (if we discard the stories that did not address each segment, it was still above average in the ATT and PRO segments), but was surpassed by individual accounts in all segments. However, the standard process embodied more decision steps than any of the individual accounts.

Interestingly, all individual stories included situations or details that were not present in the standard process. For instance, story 13 depicts a case where a student requests a duplicate course certificate due to a name change, a situation that the standard process does not predict. In contrast with the more high-level description in the standard process, stories 2 and 16-19 provide ample details regarding verifying a students' application for a course certificate, which cover different situations where thorough analysis is required, as well as various steps necessary to overcome typical problems with the students' applications.

Furthermore, six of the stories contained elements that went as far as to contradict prescribed procedure. For instance, in stories 17 and 18 students are allowed to request a course certificate even though the services cannot verify that all courses have been completed. In both stories, the attending operatives ask a student to provide a signed declaration acknowledging that the certificate would only be issued upon confirmation that all course marks had been issued. Story 18 deviates again from the standard process when a student insists on

being mailed both the course certificate and the course diploma (recall the scene illustrated in Figure 5).

Once all individual process stories were converted to process models, we integrated the various models into a converged process model with information from all stories. We handled different labelling of activities and artefacts by identifying common elements in overlapping stories, analysing their frequency of occurrence and adopting inductive elaboration of labels (derive labels from text and generalize). We handled variations in granularity in two steps. The first step, *summarization*, was performed when converting each process story into a process model. Neutral or decorative textual elements were removed and a summarized activity description was produced from dialogue passages and narrative content in the scene. The second step, *aggregation*, took place during model integration. Its objective was to combine overlapping activities while preserving detail. Multiple, complementary accounts of a procedure were unified into a unique sequence of activities (as shown in Figure 7), while at the same time preserving variations using exclusive gateways (as exemplified in Figure 8).
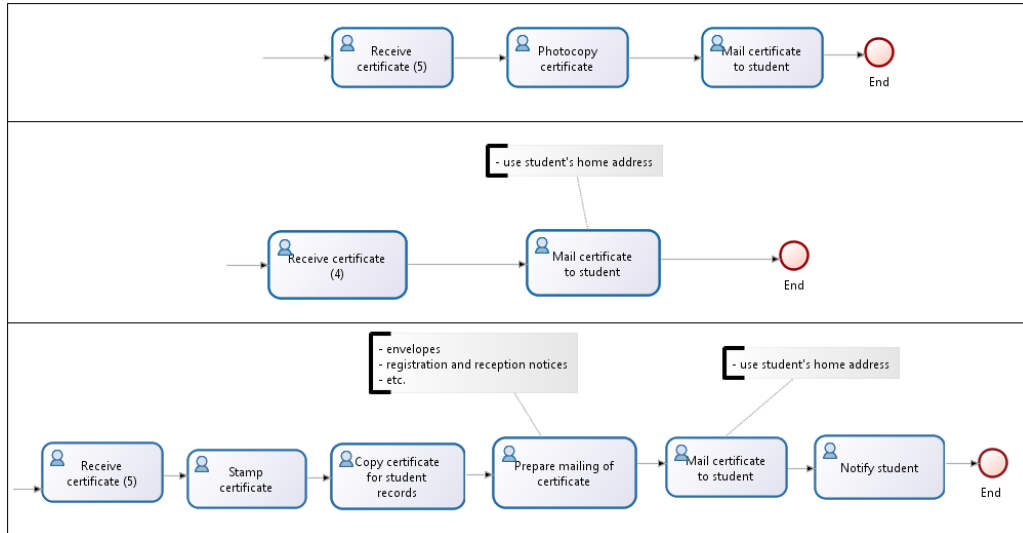
Figure 7 – Combining activity streams into a single sequence. Activities from story 6 are displayed top-left, story 7 is top-right, and at the bottom is the converged model (produced from scenes from two additional stories).

**Figure 8 –
Combining
alternative scenarios
with an exclusive
(XOR) gateway.
From top to bottom:
activities from story
2, 3 and 10,
converged model.
The excerpt from
the converged model
was simplified for
clarity.**
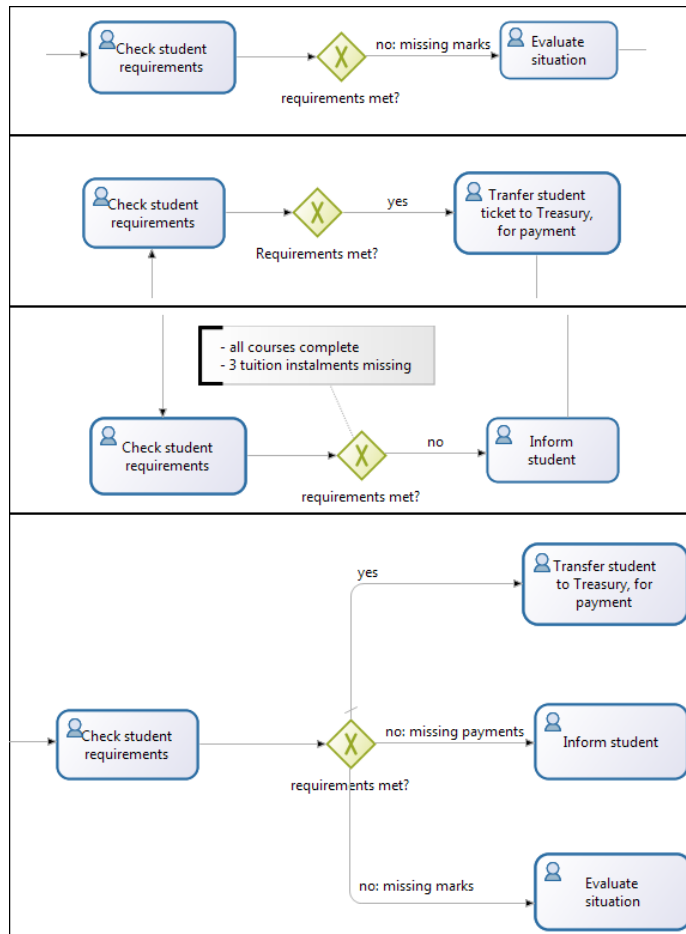
The final converged process model contained 125 nodes including 34 decisions. It incorporated individual contributions from 13 participants divided between different organizational roles. Table 3 shows measurements from story models (averaged), the prescribed procedure, and the converged model, using metrics

from Kunze et al. (2011) and the BPM Academic Initiative (BPMAI[4]) process collection (averaged) as a baseline. We use the number of nodes (*NN*) as the size metric, and three metrics for density: the coefficient of connectivity (*CNC*) as the ratio between edges and nodes, and the average and maximum degree of routing (*AvgDR* and *MaxDR*) as the average and maximum number of nodes a routing node is connected to.

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[4] http://bpt.hpi.uni-potsdam.de/BPMAcademicInitiative.

Table 3 – Measurements from individual process models (avgd), the BPMAI model collection (avgd), prescribed procedure, and the final converged model.

Model	Size *NN*	Density *CNC*	Density *AvgDR*	Density *MaxDR*
Story Models (Avg)	14,0	0,92	1,12	1,21
BPMAI (Avg)	15,6	0,79	1,15	1,84
Prescribed procedure	38	1,08	1,67	2,0
Converged model	125	1,46	1,56	3,0

These measurements show that the size of the diploma process (prescribed procedure) is considerable, containing more nodes than the BPMAI models on average. Observed values for all density metrics are also higher on average. Measurements from individual story models are comparable on average to BPMAI models. These measurements also indicate that the converged model provided a more detailed, richer representation of the diploma process, with 35% higher *CNC* and 229% increase in the number of process nodes when compared to the prescribed procedure. Nonetheless, we note that there are some details that can only be found in the standard process, suggesting that a combination of traditional and storytelling may yield the best results. Specifically, the converged model does not describe the scenario whereby a student requests to pick up the certificate in person. It presents the mailing of the certificate to the student's home address as the only option (recall Figure 7), in contrast with the standard process, which contemplates both scenarios. Apart from this subtlety, the converged model covers and surpasses in detail every other aspect of the standard process. This suggests that a relatively small number of process stories may be sufficient to model a business process.

The analysis of some process stories also suggests that iterating over time instead of capturing stories in parallel may avoid missing process details. For instance, the converged model describes the procedure taken when missing tuition payments are detected by the administrators. If all verifications fail (details not given here for brevity), the student is given the opportunity to present an ATM receipt and only after failing to do so is the certificate request denied. While this is considerably more detailed than the standard process, which only states that requests with missing payments should be denied, the story reveals that there are details that remain unknown. For instance, it is unclear what conciliating steps would have been taken if the student had produced the requested receipts. The gathering of additional process stories over time could capture such scenario.

4.5 Limitations

This study does not seek to provide a direct comparison between storytelling and traditional modelling techniques. Although during the traditional modelling phase we carefully observed procedures and analysed process documents, there were fewer participants involved in building the reference model. Therefore, it may be argued, it should be expected that there would be less elicited process activities. We acknowledge that limitation, but we note that stories gathered from subjects participating in both stages offered more detail than those offered during interviews. Additionally, we point out that the participants who were involved in establishing the reference model were precisely the ones responsible for defining the diploma process (Chief of Division) and

implementing the prescribed procedure (Back-Office Coordinator and the experienced staff member). The fact that we were seeking to elicit the prescribed procedure was the main reason why we restricted this phase to key personnel.

External threats to the study's validity are also acknowledged, specifically the extent to which we can use our findings in the present study towards building a generalized approach to process modelling. We addressed this problem by identifying issues in previous studies that could impact the generalization of our results. Using a different organisation from previous studies contributes to mitigate biases, even though we recognise that a cross case analysis would have been beneficial.

5 Discussion

We now evaluate the results from the case study by reconsidering our research questions.

Is it feasible for stakeholders to elicit meaningful business processes without the participation of expert modellers? The data we have collected clearly shows that stakeholders can indeed autonomously model their own work activities. Out of the twenty stories that were documented with the tool, seventeen depicted valid use case scenarios of the target process (two stories described other processes in the organization and one story could not be mapped to a process description). Unlike our previous studies, the participants were able and keen to create business process stories whilst fully adhering to

the approach. Despite being composed of relatively small sets of sequential scenes (ranging from 1 to 12), the generated process stories relied heavily on dialogue and textual descriptions to convey the storyline. Individual stories averaged a combined total of 206 words between dialogue and narrative text, each depicting up to 27 process activities in between up to 6 organizational roles. As it was covered in the analysis, we were able to translate these stories into a unified BPMN business process model.

Is business process context extractable from process stories? Business process context cannot be fully understood by analysing prescribed procedure alone. Part of that context stems from varying circumstances across process instances. As they are dealt with, workers become more experienced but this knowledge remains tacit in their minds and it is difficult if at all possible to articulate (Polanyi 1967; Baddeley 1992). Although we cannot assert that this tacit knowledge is being externalized in process stories, they do contain elements showing that context information is being preserved as a form of situated recall, from which tacit knowledge can be more easily primed and shared (Brown and Duguid 1998; Bennet and Bennet 2008). They are (1) the presence of emotional elements within the narrative in eight of the stories, signalling an emotional engagement of the author and transmitting information often untapped by traditional elicitation techniques, such as the role of emotion (e.g. irritation, empathy) on making decisions impacting process flow; (2) the depiction of unexpected situations in almost all of the stories; with (3) corresponding contextualized descriptions explaining the actors' reasoning and detailing their responses towards resolving those situations. The occurrence of

the latter two items in the stories constituted a documented contextualized account on the behaviour of experienced workers when facing real-world situations in their daily routines. These behaviours, grounded on implicit knowledge stemming from years of experience, often deviated from approved practices and at times went as far as contradicting them, although preserving the intended outcome of the prescribed procedure.

How do process stories improve the modelling of business processes? Our results indicate that stakeholder-centred storytelling is a valuable technique towards improving process elicitation and modelling. In this particular study, the creation of individual process stories by staff unveiled numerous *de facto* practices that were not captured by traditional process elicitation and modelling. These practices, while not featured in the standard process, are common in the work routine, and appeared in multiple stories with small variations and adaptations according to context. By analysing the different process stories we could observe that the operatives' activities were supported on a mental model of the process (versus an opaque rigid set of operating rules) and were driven by intention. For instance, the several stories that workers chose to externalise suggest workers understand the particular reasons behind the students' unusual requirements when requesting diplomas. By collaborating with various units within the organization and exerting contextualized reasoning, they seem to be in some circumstances able to tackle situations where prerequisites are not met, and still provide the service to the student. The fact that these operational practices were captured in the process stories shows that our method was

successful in modelling the actual process versus an idealized version based on an abstract rule-based workflow.

By combining different process scenarios detailed in individual stakeholder accounts, we were able to compose a highly detailed process model based on actual procedure, which constitutes a valuable artefact for evaluating and enriching the reference model. Finally, we note the converged model was presented to the Chief of Division, who apart from minor discrepancies validated it as satisfying the standard process. The reference model had already been validated at the end of phase 2.b. The organization is currently undergoing steps to document its processes with the aim of meeting quality requirements and automating procedures for increased control and efficiency.

6 Conclusions and future work

This paper presented a new approach for process modelling centred on the elicitation and analysis of process stories composed by stakeholders. A benefit of this approach relies with how it balances descriptive, creative aspects of storytelling with constrained, activity-oriented aspects of process modelling. The storytelling environment steers the stakeholders into creating concrete, event-based process stories, while at the same time granting space for them to supply stories with contextual explanations and subjective remarks. The results from our case study have confirmed that stakeholders without IT backgrounds and modelling expertise are able to create process stories using our method. Moreover, they show that the storytelling method applied to process modelling is an effective technique for eliciting process stories containing detailed

contextualized accounts of use case scenarios that have actually taken place in the work routine and that can deviate or even contradict prescribed procedures. These process stories are descriptive but grounded on the sequencing of process activities, and thus can be translated and integrated into traditional process models. This approach can play a complementing role to traditional modelling techniques by capturing process knowledge that is often implicit and difficult to transmit by other means. Process stories constitute an asset for retaining organizational knowledge and sparkling discussion in modelling and reengineering teams.

These research results open up some interesting avenues for future research. A promising research line concerns theory building, which may depart from the positive indications provided by the adoption of storytelling and sensemaking theories to further develop a theory about business process contextualisation, process richness, flexibility, and human behaviour. In turn, such theory could lead towards the development of process modelling languages more centred on human and organisational needs rather than technical needs.

Another research line to consider brings back the various criteria and specific measures we adopted in this study to analyse process stories, assessing in particular the structural complexity, expression of personal views, depiction of unexpected situations, and number of decision steps, among others. Further research could explore the value of these criteria to assess model quality.

The very positive signs brought by this study suggesting that stakeholders can generate process models, even though some participants in the study expressed

initial concerns that they would be unable to do it, advise further research on how to increase the usability of existing process modelling languages and tools, and also how to increase collaboration in process elicitation and modelling. In a wider perspective, we note an interesting trend moving process modelling from modelling experts to stakeholders. Another interesting possibility would be crowdsourcing process modelling, which would allow large organisations to reduce the costs of BPM initiatives while increasing agility and maintainability.

7 Appendix: Characterization of synthesized stories

In Table 4 we provide raw collected data from user stories and details on the corresponding synthesized BPMN models. The process story labelled PP in the table corresponds to the prescribed procedure elicited in phase 2.b. Models were not created from stories 4, 15, and 20, as they did not describe the diploma process. As an example, Figure 9 shows the process model elicited from story #3.

Table 4 – Collected data from user stories and synthesized BPMN models.

| Process story #	Scene Count	Word count (narrative)	Word count (dialogue)	Structural complexity	Unexpected situations	Personal views	Nodes per segment ATT	Nodes per segment PAY	Nodes per segment PRO	Nodes per segment Total	Decision steps	Adds to procedure	Contradicts procedure
1	2	55	2	Low			0	0	7	7	1	•	
2	5	90	28	Med	•		6	5	0	11	4	•	
3	6	68	160	Med			7	8	0	15	2	•	
4	3	204	3	Med	•	•	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	7	274	319	Med			5	9	0	14	1	•	
6	12	158	80	Hi	•		0	0	27	27	2	•	
7	8	112	55	Hi	•		0	0	25	25	2	•	•
8	7	83	25	Hi	•		0	0	17	17	1	•	
9	7	144	133	Med	•	•	13	0	0	13	2	•	•
10	1	160	112	Med	•	•	11	0	0	11	2	•	
11	4	81	94	Low		•	0	7	0	7	0	•	•
12	7	118	74	Med	•	•	2	0	15	17	0	•	
13	3	105	78	Low	•	•	5	0	0	5	0	•	
14	3	29	45	Low	•	•	0	6	0	6	0	•	
15	2	7	8	Low	•	•	n/a	n/a	n/a	n/a	n/a	n/a	n/a
16	7	105	126	Hi	•		14	0	0	14	1	•	•
17	8	164	102	Hi	•		13	2	9	24	1	•	•
18	12	141	241	Hi	•	•	25	2	0	27	1	•	•
19	4	126	16	Hi	•		13	0	0	13	2	•	
20	5	141	52	Med	•		n/a	n/a	n/a	n/a	n/a	n/a	n/a
PP	n/a	n/a	n/a	n/a	n/a	n/a	13	3	22	38	6	n/a	n/a
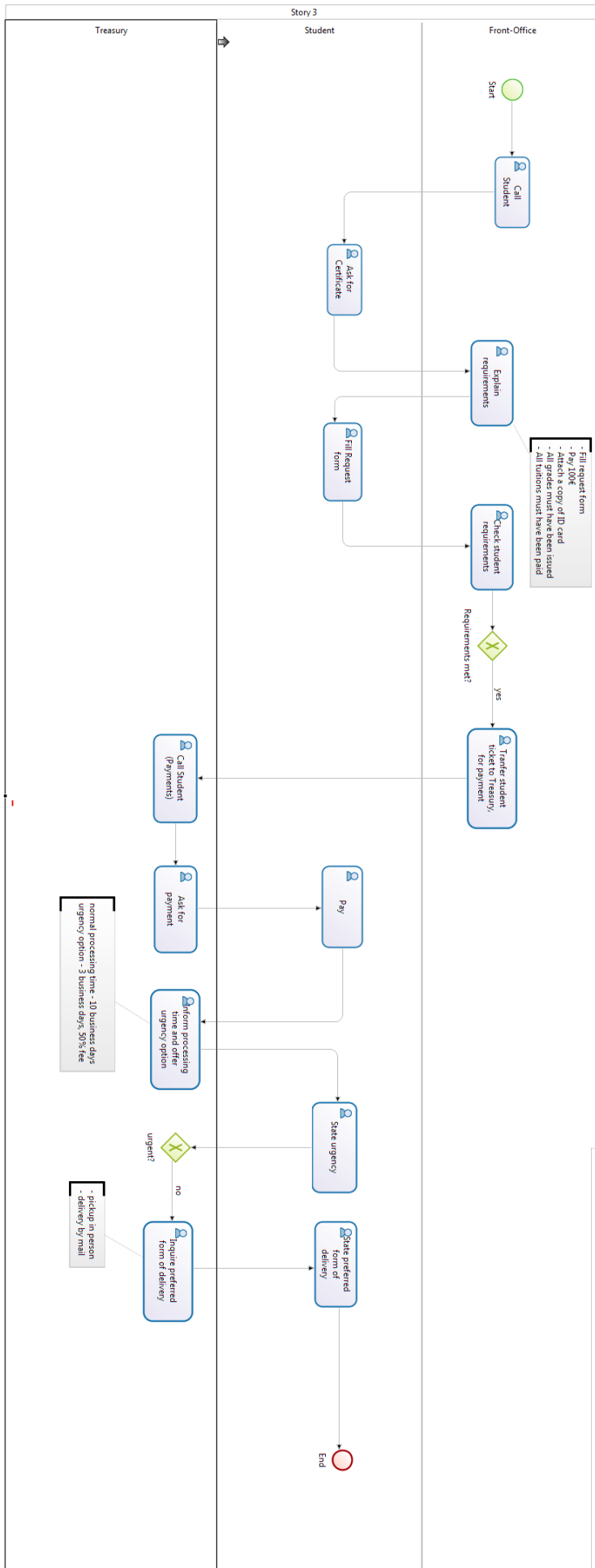
Figure 9 - Process model for story #3.

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