Subject-Oriented Plural Method meets BPMN:
A Case Study

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ABSTRACT

Subject-oriented approach to business process management focuses on the subjects and their interactions with the aim to capture more accurate process information with increased fidelity. In a common setting, business processes are modeled by process engineers or modeling experts who often create their processes in a top-down fashion. However, this may pose risks to the acceptance and adoption of these models in practice, particularly in knowledge-centric environments. The Plural method follows a subject-oriented approach and allows process participants, rather than a centralized group of process engineers, to model and maintain their processes in a decentralized way. It guides process participants to focus on the roles and their interactions in terms of message exchanges. This study investigates the use of BPMN 2.0 for the Plural method. With the aim to show the applicability of the notation for a subject-oriented approach and report on the benefits and limitations of the new edition of the Plural method in general, we performed a case study in an industry company. Guided by a coordinator, 11 process participants modeled four processes that they participate by following the Plural method. These models were also compared with the classical models developed prior to the application of the Plural method to better understand the influence. Analyses showed that the application of the Plural resulted in more complete process models. However, there are concerns regarding the understandability of these models when compared with their classical counterparts. It has been shown that the Plural method is a powerful tool for process discovery and modeling, but an improvement on its models is needed to obtain full value of the framework.

Keywords
Subject-oriented, Plural, Business process modeling, Process model completeness, Process participant, Process ownership.

1. INTRODUCTION
Businesses constantly struggle to improve their competitive position through increasing effectiveness and maintaining internal

efficiency of operational processes. Hence, it is essential to maintain a clear overview of running processes. A frequently used paradigm for obtaining such oversight is Business Process Management. The value of applying BPM in a company has been shown frequently [8]. Process orientation has been linked to organizational performance indicators like increase customer satisfaction, cost reduction and speed improvement [10], [13], [11].

Modeling the processes, often referred to as process discovery, requires significant effort; there is a separation in know-how. People who are intimately known with the contents of a certain business process (i.e. the people who execute it) are rarely trained in modeling techniques. However, the people who are modeling experts might lack domain-specific knowledge. In BPM initiatives, process discovery is usually mentioned as the most time-consuming phase with about 40% of total time spent [26]. There are some ways to mitigate the separation of know-how. People who execute the process (process participants) can be trained in modeling techniques, which allows them to model their own process directly. This is a costly and time-consuming effort. Another option is to get the modeling expert familiar with the domain. This is a more common approach, as there are several techniques to achieve this. The modeling expert can perform interviews, workshops or document analysis [4]. A large body of knowledge is attributed to performing process discovery through automated techniques, such as process mining [1].

However, apart from the domain-knowledge, there are several other factors that play a significant role for a successful BPM initiative. These matters, known as critical success factors have been widely discussed in BPM literature [16], [14]. The most frequently cited factors often concern informing and including end-users in the BPM Initiative. This shows that these end-users take a crucial role in the progress of a BPM initiative.

In a classical setup, modeling business processes is often performed by an external consultant, or by an internal process modeling experts [24], [5]. These people might observe the processes and perform workshops and/or interviews with the employees to find out how a process is actually enacted. They are often skilled in process modeling, but have limited domain knowledge about the processes. The result is a set of process models, as perceived by the external process modeling experts. This situation poses some risks particularly when the modeled process entails knowledge work. Knowledge workers have a high level of curiosity and creativity [20]. This is among the reasons why they may resent particular work structures as they are

prescribed in process models [6]. This leads us to a situation where the full value of a process model is not utilized. This might be attributed to the way these models come about.

To cater for the active involvement of the process participants, the *Plural method* was developed by Turetken et al. [23, 24]. The Plural method offers a disciplined guideline for organizations to perform process modeling in a decentralized way, allowing process owners and participants to take responsibility for describing and improving their own processes, and collectively building and maintaining the organization's process-base.

In conventional modeling, interactions between participants often are implicit, or simply omitted. The Plural method requires and facilitates the identification and definition of all interactions between process participants explicitly and accurately.

A process owner is someone who is intimately known with a business process and feels accountable for it [7]. Even though not every participant of a business process is appointed to be the process owner, these participants can still have the feeling of ownership. If people feel a degree of ownership, they are also more likely to adopt technology regarding this process [9]. End user ownership is established through the responsibility people have and display [3]. The Plural Method provides the process participant with a large amount of responsibility, as they are expected to model their own processes.

Employees who have the feeling of being empowered feel they have some influence over their job. It has been shown that employees who indicate they feel empowered are more satisfied with their jobs [18]. Employee empowerment can be achieved by giving people control over their jobs. This results more in a higher level of motivation among employees [2].

The previous research on the benefits of involving process participants in the modeling process also confirms that such process models (created through a subject-oriented approach) are more accurate and possess a higher level of detail [12].

The process description in the original Plural method is supported by the event-driven process chain (EPC) notation [23], which has limitations particularly in relation to the process execution. This work presents (i) how the Business Process Model and Notation (BPMN) [15] can be adapted to the Plural method as the primary means for process description, and (ii) reports on the application of this new approach on the modeling of four real-life processes of a large company. The case study that was conducted for the second goal employs a quasi-experimental setup (i.e. without a control group) to show the applicability of the method with its new notation, as well as its benefits from the process participants' point of view.

The remainder of the paper is organized as follows: Section 2 presents a brief overview of the Plural method and shows the adaption of the BPMN as the modeling notation. Section 3 presents the case study design and the conduct. In Section 4, we present and discuss the case study findings. We finally conclude in Section 5.

2. PLURAL METHOD
The Plural method is grounded on the idea of allowing process participants to model their processes and maintain these definitions. Process participants, first, define the *operations* they perform (serve) with respect to the roles they act for within a specific process. In addition, they define their interface to their operations in terms of the *messages* they exchange with other

participants, stakeholders, and entities in the business environment. In cases of inconsistencies between the definitions of different process participants, they communicate to solve the issue. The definitions (for *operations*) can be integrated where necessary to visualize process information in various ways, and give insight into the way the organization works. The models that can be generated include end-to-end process diagrams, process dependency and role-dependency diagrams depicting dependencies based on the messages exchanged [23].

Plural is an iterative approach for process definition with three main phases as depicted in Figure 1. We summarize the phases below (as also available in [23]) and refer the reader to [24] for an elaborate description of the phases and the roles that are involved.
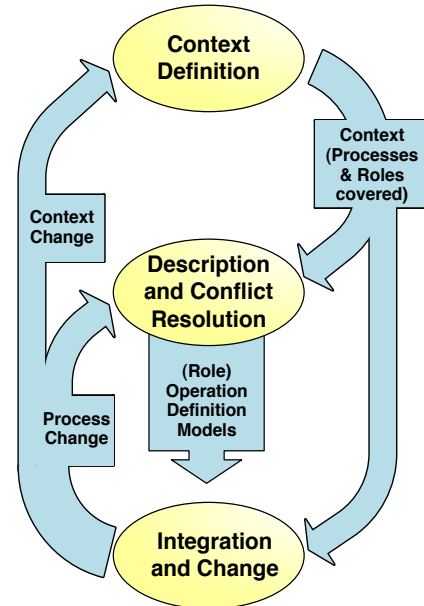
Figure 1. Plural phases [24]

The *Context Definition* phase initiates with the identification of the scope, which consists mainly a high-level process network, participating roles and agents, and their structural relationships. Process participants and other stakeholders (sponsors, etc.) (i) determine the purpose of the modeling initiative, (ii) identify the processes to be covered and the roles that take part in each process, and (iii) select the *coordinator*(s) that will facilitate the modeling throughout the iterations. They finally (iv) assign participants to roles and plan the first iteration for the modeling.

Coordinator role is key to ensuring that Plural method is appropriately applied. A coordinator guides participants in modeling and maintaining the process network, remove the roadblocks, and makes sure that Plural principles are properly followed. However, he has no authority over participants. He envisages the top view of processes as a whole, verify individual operation definition models, identify problems and capture high-level improvements.

Having been assigned to a set of roles, in the *Description and Conflict Resolution Phase* the process participants first identify the *operations* that they perform with respect to the processes they participate. Each operation is "a cohesive set of activities performed by a specific role". Next, participants define the behavior for each role-operation. This consists the activities they perform, the information items they require as inputs and those

that they produce as outputs. In addition (and as a key concept in Plural), participants provide the sources of the inputs and destinations of the outputs, if any. The sources might be other roles or entities, such as project repositories, folders, software tools, or other operations of the same role. Participants also represent the activities their roles perform with other roles. This representation of the interactions forms the expectations of that role from other roles or business entities.

A role's expectations are satisfied (and thus the models are consistent) if, in the models of the other roles, the expectations are acknowledged and shown at the expected interface. For example: suppose in a simplified loan processing scenario, the loan manager defines that he needs loan information from the loan processing clerk as input to his 'approve loan' operation. This expectation is considered 'satisfied' if the clerk, in any of her operation model, declares that she provides this information item to the manager. Otherwise, we consider that there is an inconsistency between the expectations of these two roles.

Inconsistency resolution is participants' responsibility. Inconsistencies with respect to unsatisfied expectations may originate due to a range of reasons; from a simple typo or –more seriously- a misunderstanding or a concealed assumption regarding how the process executes (or will execute). In the later case, the resolution typically incurs an interaction between participants to share a common understanding.

The inconsistencies between operation definition models can be automatically identified and presented to the involved participants. In [10], we present an add-on developed on top of a commercial BP modeling and analysis tool, which allows participants to analyze the expectations and possible inconsistencies during process definition.

Once the role-operation models are correct, complete and consistent, i.e., all expectations of roles are satisfied within and all individual models are verified and validated, the organization has a set of models that implicitly or explicitly convey a great amount of information regarding how the organization operates. Based mainly on the operation definition diagrams, during the *Integration and Change* phase, a variety of models can be generated, each presenting the process information from different perspectives and in different abstraction levels. Each model is a query to the process-base that visualizes a portion of the processes from a specific perspective. A generated model is valid until a change is performed to the models that form the base for its generation.

The changes regarding the behavior depicted in operation definitions are made by process participants. With respect to the principle of encapsulation, if a change does not affect the interface of the role, it is an alteration in role's context and does not affect the interaction between the roles and the way they perform their tasks. If an update modifies the role's interface (and thus its expectations), the change should either be incorporated in all related models or it should be revoked after negotiation between parties. Such cases manifest themselves as inconsistencies between expectations and resolved in the relevant models.

As an output, the Plural method generates a set of models that depict process relevant information in different forms. The Plural is developed to facilitate the modeling and visualization of processes as well as help validating and maintaining them. Currently, however, it does not incorporate mechanisms to support the enactment of the defined processes based on executable definitions generated from these models.

2.1 Adapting BPMN for the Plural Method

The possibilities of using BPMN for subject-oriented approaches have also been investigated before (e.g. [22]). The original version of the Plural method employs primarily the refined EPC notation for representing the behavioral aspect of processes - in particular, for the "Operation Definition Diagram" and the "Process Models (operation or activity level)" [23]. However, due to the limited support of EPCs for process execution, and the growing importance of OMG's Business Process Model and Notation (BPMN) [15], which has been dominating the process standards space [27], we explored the possibility of adopting the BPMN for representing behavioral aspects of processes in the Plural method. Another powerful advantage of using BPMN is the availability of a wide range of modeling tools.

In Plural, the use of *operations* allows people to focus on the parts they are responsible for rather than being mentally overloaded with the entire process. The concept of shielding users from irrelevant information is known as 'information hiding'. This concept is well-known in the BPM and computer science field [17, 19]. Information hiding is applied in Plural through the use of *operations*, as mentioned earlier. Each operation is modeled as a *BPMN sub-process*, in which the agent can define his/her activities. To facilitate information hiding, the roles of others are shown as a 'black box' as collapsed BPMN pool. Something comes out of the black box (input needed for the current operation), activities are executed with this information and consequently output is sent to another black box (collapsed BPMN pool). Both in computer science and BPM, information hiding has been linked to increased understanding.

For clarification of this concept, please review Figure 2. It shows a top-level process of defining and executing a project, modeled in the Plural method using BPMN. On the top-level, only roles, their operations (collapsed BPMN sub-processes) and the interface are shown. The complete internal behavior is modeled in sub-processes using BPMN constructs that are used in BPMN Collaboration Diagrams [15]. This allows for quick understanding of the responsibilities and interface of each role. If the model reader is interested in the exact workings of an operation, it can be expanded to show its behavior.

Figure 3, for instance, shows the operation 'Review Project Plan' when expanded. As can be seen, the actual behavior of the role 'Project Team Member' is not shown in Figure 3. When the agent who performs the role 'Manager' starts modeling this operation, he/she is presented with these two empty pools. The agent can model the behavior of 'Review Project Plan' and state what input is needed from other roles and what output is presented. Once the agent has indicated what exchange of information is necessary to perform his task, this is presented on the top level.

However, from Figure 3 one can observe that a pool element is being used in a sub-process. There have been ongoing debates on whether BPMN 2.0 standard allows for pools and lanes in sub-processes [15]. Yet, a quick workaround is to use the 'reusable sub-processes' (call activity) that, according to the BPMN standard, can include pools and lanes.

As the developed processes were meant to communicate the process information with existing and future process participants (as opposed to the automated execution of the processes), the

BPMN core constructs were sufficient to represent the operation and the overall process model.
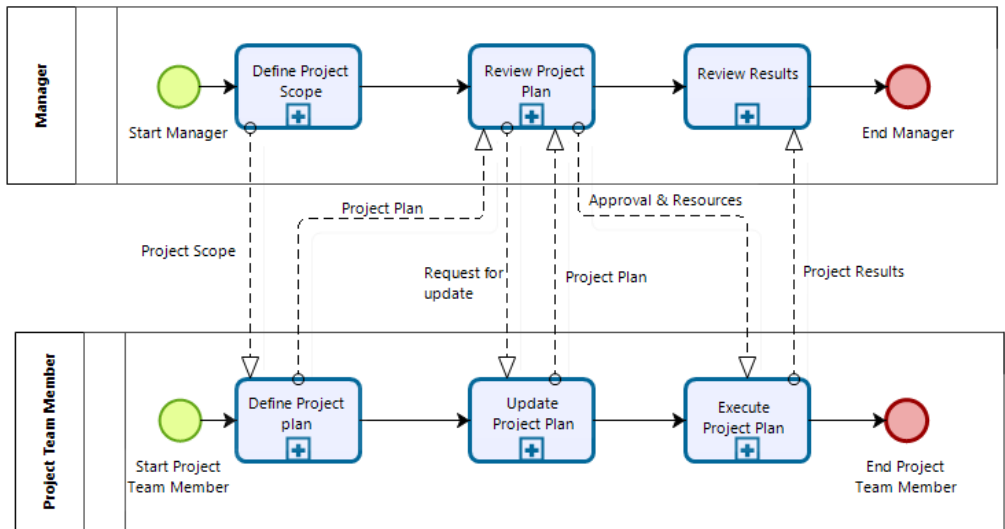
Figure 2. An Example Process Model representing the Plural approach
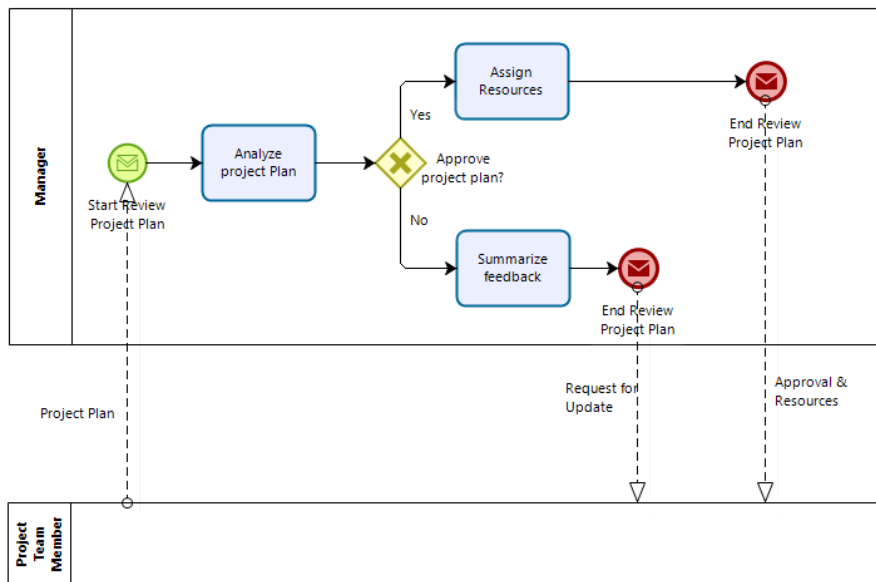
Figure 3. An Example Operation Definition Diagram (the operation "Review Project Plan" expanded)

3. CASE STUDY

3.1 Objectives

The objective of the case study was two folds: First; to investigate the *applicability* of the BPMN incorporated Plural method in real-life business settings, second; to observe the *perceived usefulness* and benefits of the method from process participants' point of view.

The applicability and potential benefits of the original Plural method has been shown in the modeling of real-life processes in diverse business settings [21, 23–25]. However, the adoption of the BPMN requires Plural method to be re-applied as this has major impact on the 'description and conflict resolution' and 'integration' phase of the method. Moreover, we expected that the application of the method in the real-life settings would also shed light on the usefulness of the method with further insights.

3.2 Case Company

To achieve the research objectives outlined above, we applied the Plural method for modeling four processes in a business unit of a large-corporation. In applying the method, process participants of

these processes were actively involved in the modeling of the activities they perform in the scope of these processes.

The company that was chosen for the case study is one of the largest divisions of a corporation operating in several countries worldwide, which is headquartered in Europe. The division employs over 3000 people, many of which work as knowledge workers. This makes the company a suitable business environment to test the applicability and usefulness of the method, since Plural is designed to promote the involvement of the knowledge workers in the management of their processes.

We targeted on four business processes that are performed in a particular business unit of the division, which has already defined majority of their core processes using conventional flowcharts with texts, called procedures and work instructions. These definitions are driven by the policies originating from high-level management.

3.3 Case Study Conduct

As for the first phase of the Plural method, the work started with the "*definition of the context*". This involves the identification of the scope in terms of the set of processes to be covered. Together with several process participants including those from the Quality department, the following four processes were included in the scope with respect to their significance and criticality for the business unit[1]:

- *Process A* involves the actions to be performed in order to adequately respond to crucial problems in a product or process. Performing a single instance of this process requires significant effort and resources. It is often regarded as a large and time consuming process, and one of the most important points of investigation for an internal and external audits or assessments.

- *Process B* entails identifying, classifying, investigating and if necessary, resolving customer complaints. This process is also regarded by process participants as fairly large and complex.

- *Process C* entails an update of systems that are deployed in the field (customer sites).

- *Process D* is about risk management, which involves the continuing cycle of identifying, classifying, analyzing, and monitoring risk and, if need be, mitigating them. This is regarded as one of the most important processes in the Quality Management System (QMS) as it is connected to all other business functions of the unit.

First, based on the existing definitions and other related material (guidelines, policy documents, work instructions, etc.) these four processes were modeled by an external business process modeling expert using BPMN 2.0 and through a conventional BP modeling approach (we call them as the classical models)[2]. These models were then reviewed by a second BPM expert and subsequently validated by a subject matter expert (SME) that typically acts as the owner of the process that he/she validated. This activity was (certainly) not part of the Plural method, but was performed to provide a basis for the benchmarking regarding the comparison of

these models with the Plural models that were developed in the next stage.

Second, taking the same sources as the basis, these processes were modeled using the BPMN incorporated Plural method. Before the actual modeling started, the external BPM expert, who had not applied or experienced the application of the Plural method before, went through a short orientation and document reading session regarding the use of the Plural method. This was necessary as he acted as the *coordinator* for the Plural sessions. As the coordinator, he helped process participants in modeling the parts of the processes (operations) that they are responsible for. The extent of the help included the use of the BPMN and the modeling tool[2] to provide better reflection of the individual parts (this can be compared to the typical settings where the responsibilities are in the reverse direction; i.e., process participants *help* process experts by providing process knowledge).

Figure 4 presents the process models as a result of applying classical modeling practice and the Plural method. Only highest-level models are presented and without legible labels, just to provide a sense of the size, structure and the representation of the processes[3].

In total, 11 process participants were involved in the Plural sessions; all with university bachelor or higher degrees (2 with PhD and 1 with masters). However, their process modeling knowledge and experience varied significantly. While 3 participants indicated daily encountering of process models, majority stated that they encounter process models less than once a month. Similarly, only few recently encountered a process model, while over half of the participants met with such models more than three years ago.

During the modeling sessions, comments and feedback regarding the use of the method were noted by the coordinator. Finally, participants were asked to fill out a questionnaire that also includes open-ended questions to investigate further on the benefits and difficulties they faced in the application of the method and to elicit further feedback on the use of it.

4. FINDINGS AND DISCUSSIONS

Table 1 presents the extent of the work involved in the Plural modeling sessions for each process. In total, the Plural modeling sessions took 7.8 hours and entailed 49.5 man-hour of effort. With respect to the number of operations, 0.9 man-hour was spent on the average in modeling each role-operation. This value - regarding the efficiency of the modeling effort- is closely inline with the values reported in the literature on the past applications of the method (where the average role operation modeling efficiency is reported as 1.03 man-hour [23]).

Although investigating the influence of the Plural method on the efficiency of the modeling is not within the scope of this research work, the total duration of one day with less than 7 man-days of effort to model (and consequently improve) 4 key processes of a company is a significant outcome and worth underlining. The application of the Plural method once again showed that it is possible to decrease the process improvement cycles in the order of days.

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[1] For the reasons of confidentiality, we do not disclose the name of the case company (or its division & business unit).

[2] In modeling both classical and Plural processes, Bizagi BPM Suite was used (www.bizagi.com).

[3] The process models shown in Figure 4 are available in legible forms at: https://drive.google.com/folderview?id=0B0i4ZY_RKOZ0dmxfTmNXb1pwWmM
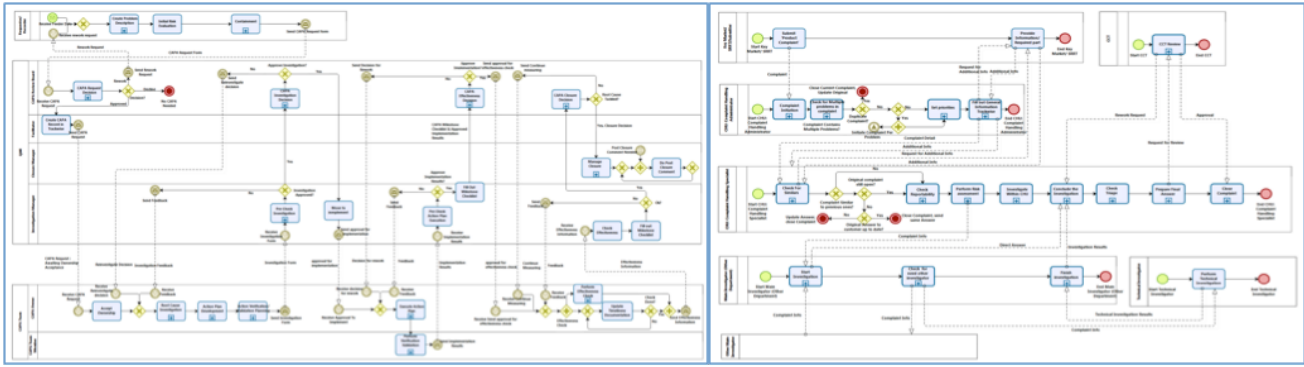
Figure 4. Process B represented as a classical (left) and Plural (right) process model

Table 1. Extent of the Plural modeling effort

Process	Num. of Roles identified	Num. of Process Participants	Num. of Operations identified	Total duration of the Plural modeling sessions	Total effort spent for the Plural modeling sessions
Process A	7	4	19	3 hr 28 mins. (4 sessions)	27.7 man-hr
Process B	4	3	16	2 hr 11 mins. (3 sessions)	13.1 man-hr
Process C	3	2	13	1 hr 42 mins. (2 sessions)	6.8 man-hr
Process D	2	2	3	29 mins. (2 sessions)	1.9 man-hr

4.1 Feedback received during the modeling sessions and post-modeling questionnaire

Most feedback comments from the process participants included positive claims towards the intuitive nature of the BPMN notation (when compared with the flowcharts used in existing models) and the general usefulness of the method. During one session, a previously unknown feedback loop was found in the behavior of the process. One participant stated it as: "*It is remarkable that we found such an issue in just under 30 minutes. The existing models [created in a previous BPM initiative by external experts] were expensively made with a lot of man-hours, where we found new issues in a few hours. Remarkable!*"

During most modeling sessions, process participants identified additional operations/activities that they are responsible for but not available in the existing process descriptions, or those activities/operations that were defined in the existing descriptions but essentially found to be superfluous and should be ignored for the Plural models. There was frequent occurrence of 'venting' regarding the problems with the process or the way the work is done. In all sessions, the participants told valuable information regarding inefficiencies or lack of quality in the workflow. Emphasizing on the interactions between subjects (roles) that take part in the processes helped significantly in understanding their part in the overall process and uncovering what is effectively necessary and what is not. We believe that following this line of thinking in the modeling of their activities helped participants in identifying several instances of unclear behavior in the existing definitions.

There were also situations where conflicts occurred between process participants, for instance, on the place of a certain task in the workflow. Although in some cases, these conflicts caused duplicate efforts, they are essentially critical in uncovering such issues, which otherwise could stay hidden and potentially cause process related problems in the future. Making such issues and conflicts explicit is one of the fundamental design principles of the Plural method. As a subject oriented method, the Plural focuses on roles and their interactions, which are often considered as fragile points in processes performed by knowledge workers and are potential locations in identifying implicit assumptions of process participants.

The questionnaire filled out by 11 participants joined in the Plural modeling sessions also indicates a positive feedback towards BPMN and the Plural method itself. One of the participants had this to say about the notation: "*It gave a good and detailed insight in the actual process and work flow. Graphs were almost self-explaining.*" The same participant said this about the Plural method: "*I think this kind of business process modeling is really helpful to get the process well described, but also as an interactive tool during the operation of the work or during training of new employees.*" This notion was rather interesting, as the possibility of using the Plural method for employee training purposes has not been coined before. Another participant provided the following feedback about the modeling session: "*It showed me how complex we are working ;-)*". Though the smiley at the end of the quote indicates a light-hearted nature, the comment does point towards a powerful notion of the Plural method: it helps employees obtain oversight of the process they are a part of.

4.2 Findings regarding the completeness of the resulting models

One of the most important findings of the case study was the difference between the completeness of the obtained classical models and Plural models. In all cases, the Plural models contained more details, more feedback loops and more business related exceptions (while in some cases participants removed some of the high-level activities in the existing models that were deemed unnecessary). In some cases additional roles were identified during the creation of the Plural models. The Plural modeling sessions, where process participants were appointed as the people that are responsible for modeling their parts of the processes, resulted more details, which in turn contributed to the completeness and accuracy of the processes. The emergence of

this behavior seems to provide additional support for the qualitative value of the Plural method as a process discovery tool.

Table 2 shows the values for some of the process related metrics, such as the total number of nodes, and sub-processes, etc. Although the Plural models are slightly smaller in size than classical models for Process A and D, the difference in size between the Plural and classical models for Process B is significant (Plural models are considerably larger).

Table 2. Some metrics regarding researched process models

Process	# nodes		# sequence arcs		# message arcs		# gateways		# sub-processes	
	Classical	Plural	Classical	Plural	Classical	Plural	Classical	Plural	Classical	Plural
Process A	186	180	179	164	14	76	45	38	14	19
Process B	97	183	104	181	7	41	33	54	5	16
Process D	64	42	69	41	5	14	29	13	1	3

* Process C was not included in the list due to the reasons discussed in Section 4.3.

Though it cannot be concluded that the Plural method is the only method that would accomplish this behavior, it has been shown that this specific method allows for the detection of more inconsistencies and deviations than classical processes, which were validated by process owners. Though similar results could have emerged from using other subject-oriented process modeling techniques, the notion of using an operation -which is exclusive to the Plural method as of yet- was referred to as "intuitive" and "useful" by plural agents.

4.3 Limitation of the Method

Application of the method in the case study also revealed a key limitation of the method. As also reported in the previous studies that applied Plural [24], the method does not perform well when the process being defined by the participants are not effectively performed in the organization. This was the case, for instance, for process C where some process participants had utterly different viewpoints in regard to the overall goal of the process and its outcome. The case study made it clear that it is vital for key process participants and stakeholder to define and agree on the overall objectives of the process and expectations regarding its outcome before putting any effort on its modeling.

The case study also hinted some issues regarding the understandability of the Plural models. The results of the questionnaire showed that the complete modularity of the Plural models through the operations might pose difficulties on the comprehension of the models. The results indicate that there exists some preferred balance between showing control flow and modularity on the top level of a process model as well as a trade-off between modularity and total process model size.

5. CONCLUSIONS

This study presents how BPMN can be adopted as the process modeling notation for the subject oriented Plural method, and what implications can be observed when the method is applied in modeling business processes in real-life settings. It shows the findings resulted from a case study that involved the participants of four processes of a large size company modeling their own tasks in the processes that they take part in.

In order to compare the resulting Plural models with the classical BPMN models, the processes that were included in the case study were first modeled using a traditional modeling approach by an external modeling expert. Afterwards, the same processes were modeled by the process participants that actually perform these processes.

The case study showed that the BPMN can be successfully applied as a means to capture process information in a subject-oriented way. The process participants have indicated positive opinions about the use of the language when compared with the conventional flowchart notation and models. This is also given that the majority of the process participants have only limited experience with process modeling and related notations. This indicates that -for the settings where process modeling is steered by a coordinator-, skilled and experienced process participants (on process modeling and notation) are not prerequisites for BPMN integrated Plural method to be applied in practice.

The resulting Plural models contained more information and found some faults not identified by the classical models. As such, Plural models are found to be more complete and accurate than the classical models. However, process participants also indicated that the classical models were easier to understand than their Plural counterparts. This implies that the Plural method provides a powerful tool for process discovery and modeling, but there is a need to investigate ways to improve the representation of Plural models. The overstressed modularity of the Plural models seems to have a negative influence on their understandability. Future research will focus on this particular concern.

On the other hand, while we observed improvements in process models in several directions, -as an inherent limitation of the quasi-experiment design- it is difficult to argue that these improvements originate merely from the implementation of the Plural method and may not surface if another redesign or improvement approach was applied. This constitutes a major threat to the internal validity of the findings and asks for future research with carefully designed experiments on the completeness and understandability of Plural models.

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