

Additional Information in Business Processes: A Pattern-Based Integration of Natural Language Artefacts

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Abstract: Business process modelling initiatives frequently make use of semi-formal modelling languages for depicting the business processes and their control flows. While these representations are beneficial for the analysis, simulation and automatic execution of processes, they are not necessarily the best option to communicate process knowledge required by employees to execute the process. Hence, textual process representations and their transformation to semi-formal models gain importance. In this paper, a pattern-based modelling approach positioned in between the two extremes of informal text and semi-formal process models is derived. The patterns offer a basis for a seamless integration of natural language and business process models. In particular the business process modelling patterns, which have to rely on human interactions are focussed. For those patterns an integrated representation of information that support the manual execution is developed. The approach fosters the contribution by employees of the operative business, since it does not rely on classical modelling paradigms, but uses natural language for modelling business processes.

1 Introduction

At present, a multitude of different methods and languages exist for the purposeful specification of business processes in companies such as BPMN, UML-AD and EPC. Business process models gained such an importance that understanding them is relevant for a plethora of stakeholders, not just process experts. Regardless whether these stakeholders are considered with planning, execution or just auditing with respect to their own requirements, the representation given by a business process model has to be understood by diverse stakeholders. Unfortunately, although the (semi-)formal representation offered by current business process modelling languages is sufficient to be used as a basis for process execution in Workflow Management Systems (WfMS) [JNF⁺00], human stakeholders involved in the processes still seem to have ambiguous interpretations of these models [MAA10]. Information that is satisfactory for machines to interpret business process models may not be sufficient for the interpretation and act of learning driven by humans. Every socio-technological system has its special needs regarding information requirement for the purposeful execution of business processes, which is highly dependent on the interaction between the individuals and their collaboration. Therefore such processes of human inter-

action should be supported and fostered by collaborative methods that enable these human to define their own required representation of business process models.

In this paper, an approach will be discussed that reflects the previously described assumptions. More precisely, a relation between process knowledge captured in business process models and natural language representations of process relevant information will be revealed. Such information is called "Natural Language Artefact" (NLA). It will be shown how to enrich NLAs using annotated text to represent basic control flow patterns of business process modelling languages. The overall approach aims at the amalgamation of (semi-)formal process models with natural text representations in order to empower people from the operative business to contribute to purposefully described business process models.

The remainder of the paper is structured as follows. At first in section 2, the relationship between business process models and natural language artefacts will be discussed. Following, business process modelling patterns will be introduced in section 3 that act as a basis for our approach. Next in section 4 the mapping between these patterns and natural language text will be described. The mapping will be discussed in the following section 5 and the paper ends with a conclusion.

2 Business Process Modelling and the Relation Towards Unique Information Needs of Socio-Technological Systems

2.1 Relation Between Business Processes and Natural Language Artefacts

Business process models generally provide a holistic overview about the processes executed by an enterprise in order to satisfy its business related purpose [vdA04]. Unfortunately, such a holistic overview is less suited, when it comes to the actual execution of a business process [Swe13]. The inclusion of multiple paths for various alternatives, exceptions or situations requiring error-handling, which are important for analyses and simulative reasons, raises the complexity for a single individual to understand the procedures and further to filter its required information.

Moreover, execution instructions of business processes for humans are usually not stated by means of business process models [LA94]. So, it would not be sufficient to enrich a business process model with more details to capture all relevant information. Consequently, individuals are usually dependent on additional instructions. Regardless whether these instructions are transcribed in documents or only communicated orally, in the latter, they will be referenced as a Natural Language Artefact (NLA). There can be two reasons identified for the requirement of NLAs, next to a business process model. First, activities documented in business process model are usually depicted in an aggregated manner. Although an activity should use terms the individuals are familiar with, initial instructions are needed in order to build up an understanding for the used terms. Second, important and more enterprise-specific information can not always be captured through a business process model. For example, the use of a specialised information systems developed for specific purposes of a company, may require additional information.

In conclusion, there are two points of criticism for using process models as instructions: First, it was argued that business process model include a certain amount of information, which is unrelated for the human actor. Second, additional information that is required by the human actor remains unconsidered by business process models and it is necessary to capture this knowledge by additional NLAs.

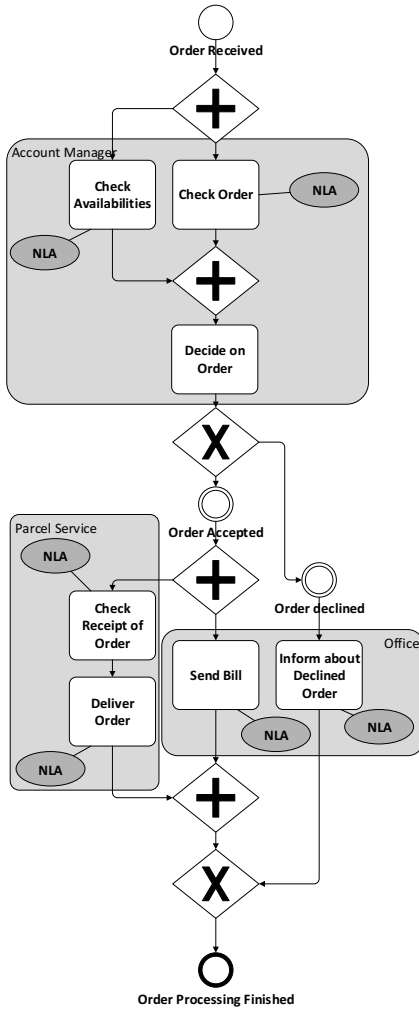


Figure 1: Exemplary Business Processes with Corresponding NLAs

the availability of experienced employees is not always given, transcribed NLAs should be preferred, but only if they are integrated with the respective business process model.

Through Figure 1 such a relation between a business process model and the relevant NLAs for its execution is exemplified. Within the business process model there are three different roles required for the execution of the business process. Each of these roles has to rely on different NLAs for the execution of its relevant part. However, the business process model is not sufficient to support the roles with the needed information. For example the business process model only states that the received order has to be checked by the account manager, but it does not state by means of which criteria the order has to be checked and when the order should be declined or accepted.

Hence, the account manager has to rely on further information, which specify what these criteria are, how they are mapped to the received order and when he should accept the order or decline it. Such information can be offered through NLAs, which are often either documented or communicated orally in seminars or through co-workers. It may be the case that the account manager does not have to rely on such NLAs, because he developed tacit knowledge about when to accept or decline an order, which can not be formalised [KPV03, KB02]. However, there should be at least a basis for learning such tacit knowledge for the case that new account managers have to be trained. One solution would be that experienced account managers instruct the new employees. In this case, information that goes beyond the business process model would be offered orally. Since

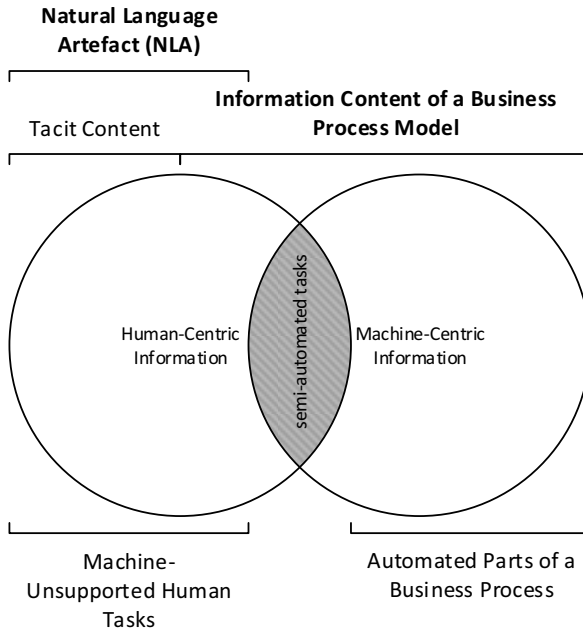


Figure 2: Shared Information Content of NLA and Business Process Models (Based on [BT13])

Based on the discussed example, it can be inferred that both the NLAs and the business process model share commonalities (as shown in Figure 2). These commonalities are mainly identifiable by means of the business process modelling language. For example, the NLAs should describe activities, which have to be executed by the employees and such activities are designated by means of the business process model. Hence, integrating between the NLAs and business process model is possible through the described commonalities. However, such an integrated view is necessary because it decreases the maintenance effort and reduces false interpretation. For example, if an activity that is described by a business process model becomes automated, respectively completely executed by machines, then the respective NLAs become obsolete. With the complete automation of the activity, human actions have become unnecessary for the execution of the respective process. So in order to support such an initially felt dichotomous relationship between informally described NLAs and semi-formal specified business process models, an integration is required that lasts longer than one instance.

For that purposes it is necessary to integrate these two representations of a business process, the business process model and the necessary NLAs for the execution of it. From that integration, both types of information would come available, which is the additional informal information required by individual employees and the information for machine

interpretations. The previous described adaptation of the NLAs that occur after changes within the business process model is just one benefit from an integration. Further it would be possible to adapt the business process model after changes within the NLAs occurred. Such changes could then relate to alternative solutions, which would result in a more efficient execution of the business process.

2.2 Individual Learning and Individual Information Requirements

Business process models form a basis for the configuration of WfMS [vdAT03]. Next to such information, business process models offer information regarding manual steps executed by individuals. For such type of information a formalised approach is just one way to guide the execution of manual activities of a business process [Gia01, LA94]. However, a formalised approach must not be the most efficient solution for humans, because it requires understanding the respective, sometimes unfamiliar modelling language [MS08, Swe13]. More importantly the required degree of information might vary with respect to the experience of the employee or the culture of the company [IRRG09]. An experienced employee might be able to take decision based on his knowledge and experience. Furthermore in a company, where it is usual to communicate with each other and to help new employees, precise information might inhibit the communication within a company.

The use of language should consider the enterprise culture, which influences the used terms and is at least in parts difficult to influence [Gib87]. The dynamics within one company mainly depends on its individuals and furthermore the necessary information for executing tasks depends on the ability to learn and to cooperate with each other. So the given NLAs should evolve with the respective socio-technological system. With respect to the different requirements individuals might have [BDJ⁺11], it is necessary to provide them with a platform where they are able to retrieve information as well as where they can contribute their information. The latter aspect is required because of the necessity for capturing knowledge.

Such a process of capturing knowledge regarding the executions of the business processes would ensure that once an individual has built up an understanding for the execution of his individual tasks, it is able to share these experiences and related information. Such a process of knowledge management would ensure the depiction of distinct specialities existing in a company. Furthermore, the depiction would be suitable for being shared with others, because it was collected from individuals situated in the same domain.

However, to ensure that the collected information is purposeful, it is necessary to provide a structure for capturing the information. Although the captured knowledge is strictly individual, the relation to the business process model has to be established. The relation then should ensure the alignment between the executions of the business processes with the executions of the individual tasks. Hence, there is the necessity for proposing a structure to which the NLAs can be aligned and which is coherent to the business process models. Such a structure can be derived from business process modelling language by relating the given NLAs towards the respective concepts of a business process modelling language.

Moreover, the relation between the NLAs and the business process modelling concepts should include a further tier, which are business process modelling patterns. This further tier is motivated by the required coherency of a description regarding the achievement of a certain goal, which requires the execution of multiple, succeeding activities. So the coherency of the respective activities should be transposed to the NLAs. Additionally, only those patterns that are human-centric invoke the necessity for including additional instructions by means of NLAs. Human-centric relates to the necessity of the participation of humans in order to execute the part of the processes that is captured by a pattern.

3 Human-Centric Business Process Modelling Patterns

Business process models provide information for two different kinds of recipients. First, they provide information for an automatic execution. Such information are then interpreted by WfMS, which are in charge for the distribution of relevant documents and the execution of respective tasks. Second, and more important for the presented approach, business process models provide information, which guide the execution performed by humans. Hence, they provide information for decision-making, task accomplishment, collaboration with others and more. Therefore a distinction between those parts that require a human interpretation from those that can be interpreted by machines is needed. Unfortunately, such a distinction is not possible on the level of the modelling language. The concepts of a modelling language are important to both, humans and machines. For example, the concept of an activity is relevant to both, because activities exist that are executed by humans and machines. Thus a separation regarding the human and non-human recipient is needed to be sought on a more aggregated level. An appropriate level of distinction can be achieved through the use of business process modelling patterns.

In [Aal03] the authors define several control flow patterns from which business process models are constructed. With respect to these patterns, a distinctive selection of those patterns that are more relevant for a human interpretation can be made. Thereby, those patterns that might require an additional instructions through NLAs were identified through an expert group. Patterns used to represent processes with manual work or to represent decisions requiring human judgement were considered more likely to require additional documentation. Hence these patterns are more important for the presented approach than patterns used to represent machine-executable parts of process models. This is due to the fact that our approach aims at combining structured process knowledge (control flow) with additional textual information for humans (incorporated in NLAs).

For example, a multi-choice pattern (see Table 1 No. 6) in a process can require a list of regulations and applicable laws described in natural language to decide which options should be executed. In contrast, a pattern that merges different branches (see Table 1 No. 5) of a logical control flow without any synchronisation or blocking such as a simple merge may seem like an execution of a sequence after a decision. It does hence not require additional documentation.

Table 1: Relevance of Natural Language Text Instructions for the Execution of Specific Business Process Patterns

No.	Pattern	Abbreviation	Relevant for NLAs
1.	Sequence	SEQ	Yes, in order to provide instructions for manual or partly-manual executed activities.
2.	Parallel Split		No, because the execution of parallel activities either requires the activities to be executed by multiple individuals or in a sequence.
3.	Synchronisation	Sync	Yes, when the manual decision for succeeding is required.
4.	Exclusive Choice	XOR	Yes, if the decision making process can not be formalised.
5.	Simple Merge		No, because this merge is rather technical and the succeeding activity can only be triggered once.
6.	Multi Choice	OR	Yes, if the decision making process can not be formalised.
7.	Synchronising Merge	SyMe	Yes, when the manual decision for succeeding is required.
8.	Multi Merge		No, because the multi merge refers to multiple execution without a synchronisation of these.
9.	Discriminator		No, as the succession is automatically conducted on arrival.
10.	Arbitrary Cycles		No, because multiple iterations can rely on the same instructions.
11.	Implicit Termination		No, because a signalling a termination will be done through other mediums than the textual instructions.
12.- 15.	Multiple Instances (Several Patterns)		No, because multiple executions can rely on the same set of instructions.
16.	Deferred Choice		No, because no extra construct is necessarily needed to depict deferred choices (see [Aal03, p. 30]).
17.	Interleaved Parallel Routing	IPR	Yes, because the actor must be instructed about his freedom of choice in executing.
18.	Milestone		No, milestones are necessary for managerial aspects, not for the actual execution.
19.	Cancel Activity		No, because after the cancellation no more instructions are necessary that relate to the initial business process.
20.	Cancel Case		No, same reason as above (cf. No. 19).

Numbers correspond to [Aal03]

Overall six patterns have been selected for being relevant for additional information embedded in NLAs. All of the twenty patterns are summarized in Table 1. This table further gives an overview of the pattern selection and the reasons for choosing patterns appropriate for being represented by means of NLA. It further includes the reasons for rejecting patterns that do not require additional instructions. Those patterns become relevant for being represented through NLAs, if they include human actions and hence the business process model requires additional information for the employees of the operative business. The following examples for the particular patterns are part of Figure 1.

One of these patterns that may require additional documentation is the execution of a sequence of manual or partly manual activities (sequence, SEQ). The execution requires an awareness of the different steps, which constitute the different activities. Furthermore information about the handling of relevant information systems is required. Regarding Figure 3 the activities associated with the "Parcel Service" is an example for such a sequence. The sequence describes a set of tasks performed by a single individual. Whether those tasks rely on the support by additional information systems or not, additional information may needed in order to enable the human to execute those tasks.

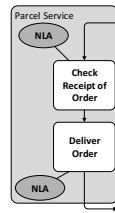


Figure 3: SEQ Pattern

A related pattern to the sequence, is the interleaved parallel routing (IPR). Within this particular pattern, the activities does not have to be executed in a rigid line, but the actor can choose the sequence of their execution. Similar to the SEQ pattern, this pattern requires additional instructions beyond the process model, if it includes manual or partly manual activities. An example is illustrated in Figure 4 in the activities of the "Account Manager".

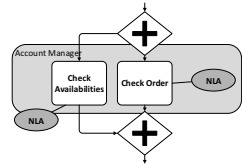


Figure 4: IPR Pattern

Next to the execution of activities, another important kind of patterns is considered with decisions. More specifically, the relevant human-centric decision patterns are those that do not allow a complete formalisation of the decision-making process and hence require the interaction of a human. The given alternatives are needed to be evaluated regarding specific requirements by a human, any time the requirement for such a decision occurs. Further, it is required to understand on which facts the choice has to be made and how these facts have to be interpret. However, such an understanding mostly builds on tacit knowledge [KPV03] and hence, the automation of the decision process is not possible.

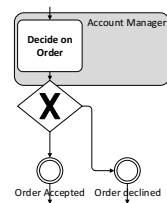


Figure 5: XOR Pattern

Within the given patterns two alternatives are considered with human decision: First, decisions including multiple choices (multi-choice, OR); Second, decisions considered with excluding choices (exclusive choice, XOR). As depicted by Figure 5, the account manager has to decide whether to accept or decline an order. Although the decision-making process

can not be formalised, the account manager should be at least provided with some general rules and references for basing his choice.

The last important group of pattern is concerned with the coordinated invocation of activities after multiple branches within a business process are completed. For the presented approach, these patterns are only relevant when the judgement for proceeding with an activity can not be formalised and therefore has to rely on human judgement. These patterns are specifically the synchronisation (Sync) and the synchronising merge (SyMe). Within Figure 6 the synchronisation of the activities "Check Availabilities" and "Check Order" of the "Account Manager" is shown as both activities have to be finished before the following decision on the order can take place.

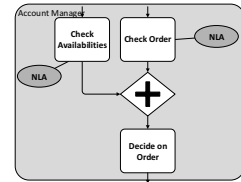


Figure 6: Sync Pattern

In the next section, an alternative but coherent way of presenting information through natural language next to a business process model will be discussed.

4 A Reliable Interpretation of Natural Language Text Through Pattern Modelling

4.1 The Mapping of Natural Language Artefacts to Business Process Information

Although the use of business process modelling is disseminated widely, employees of the operative business are sometimes unfamiliar with their use. Business process models provide a holistic view on the dynamics in business regarding multiple departments, teams and individuals. However, sometimes for individuals, who operate isolated task, an understanding about the whole business process is not necessary. Hence, providing them a holistic view as offered by business process models, may not be appropriate for employees from the operative business and further may not include sufficient information for executing a single activity due to the aggregated level of business process models.

Providing additional informal descriptions, e.g. through NLAs, is not sufficient either. Because those descriptions have to be evaluated regarding their correctness with reference to the related business processes. Instructions proposed through NLAs are human specific, since they have to relate to the knowledge respective individuals have. Hence, those instructions have to be created with respect to the recipients. Unfortunately, the produced NLAs are created in a manual and informal manner. Thereby the validation of the NLAs towards the business process model requires a huge effort. The integration of NLAs and business process models is crucial. Therefore well-formalised and annotated NLA are capable of bridging the gap between the NLAs and the business process model.

Different to previous approaches that included natural language, e.g. [Sch06, zMI10], such NLAs are not additional annotations of the process model, but are a further repre-

sentation of the respective part of the process model. Both the business process model and the respective NLAs should be regarded as two different, but integrated perspectives on a single business process. Through the use of human-centric patterns the NLAs dismiss any information that is irrelevant for the execution by the employees. Furthermore it includes required information for humans in order to succeed the relevant activities and do the respective decisions. The business process model, however, omits such additional information.

The sophisticated support for the execution of business processes requires the NLAs and business process model to be integrated at any time. Regardless any changes of the business processes, the NLAs have to fit the business process model and the other way around. In order to enable such integration, it is not sufficient enough for the NLAs to only consist out of natural language text. Every part of the given language artefact can be annotated, whereby the order of all annotations within a NLA has to conform to the annotation schema. The annotation schema is determined by the control flow pattern. Both categories and annotations have to be selected out from a given set, which was predefined and correlates to business process modelling semantics. The annotation schema consists of the names of the activities related to it. They could be furthermore predecessor or successor.

Table 2: Mapping Between Business Process Patterns and Annotations in Natural Language Artefacts

Pattern	Associated Annotation Schema (Strict Order)
SEQ	name*, successor
Sync	predecessor*, name, successor
XOR	name, successor*
OR	name, successor*
SyMe	predecessor*, name, successor
IPR	name*, successor

Table 2 illustrates the mapping from the business process modelling patterns and the annotated NLAs annotation schema. For representing a specific human-centric pattern, an annotations in the NLA have to be assigned to one or more activities in the business process model. The order of the annotations is prescribed by the annotation schema. While there is the possibility for multiple annotations (represented by an asterisk), the occurrence of the annotations have to follow the order as given in column 2 of Table 2.

This leads to a structured way a NLA can be integrated with the business process model. In Figure 7 an example NLA is given with a specific set of instructions relevant for the Sequence pattern of the parcel service in Figure 1. It includes the sequential instructions for executing the parcel deliverance tasks. It is completely integrated with the previous stated process model and includes the relevant information for the role "Parcel Service". Next to the already available information, the NLA is customised to the needed information of that particular role. Additionally it includes further information, which can not be depicted by the business process model. In this example further information about the delivery address is given: "The respective address can be found on the receipt."

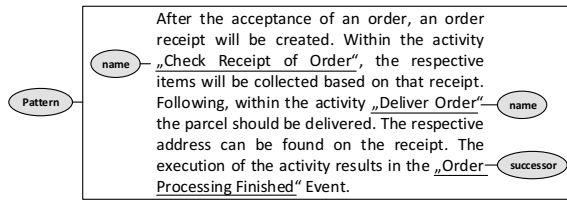


Figure 7: Exemplary Natural Language Artefact with Annotations

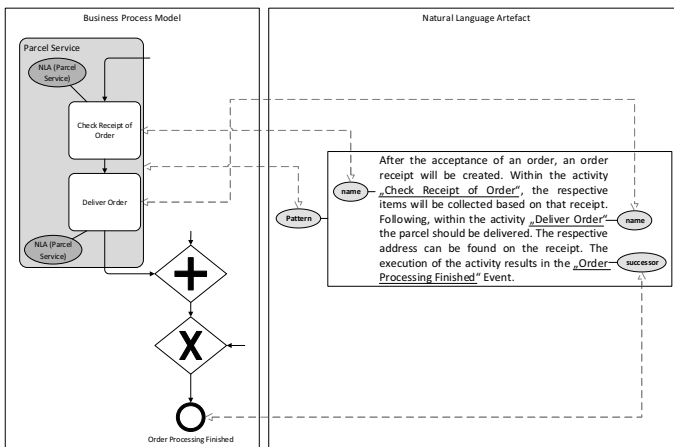


Figure 8: Exemplary Integration Between the Natural Language Artefact with Annotations and the Business Process Model

The given NLA with the annotations is completely integrated with the business process model. The overall relation is exemplary illustrated in the following Figure 8. Therefore the sequence pattern of the example process in Figure 1 for the "Parcel Service" is used. This pattern is associated with the NLA itself whereas the different activities within the pattern are associated with the annotations in the NLA. Consequently, the successor of the pattern which is the concluding "Order Processing Finished" event is also associated with the annotation in the NLA.

As illustrated through the previous example, it can be inferred that an NLA can be extended by means of natural language without losing the integration to the business process model. So additional information could be included, as long as the annotations and associated categories of the NLA are consistent. The natural language text can be extended, adapted or replaced regarding the specific requirements the respective employees might have, without jeopardising the integration with the associated business process model.

The following section will generalize the associations between the elements of the business process model and the annotations, the patterns and the NLA in a integrated meta model.

4.2 The Meta Model

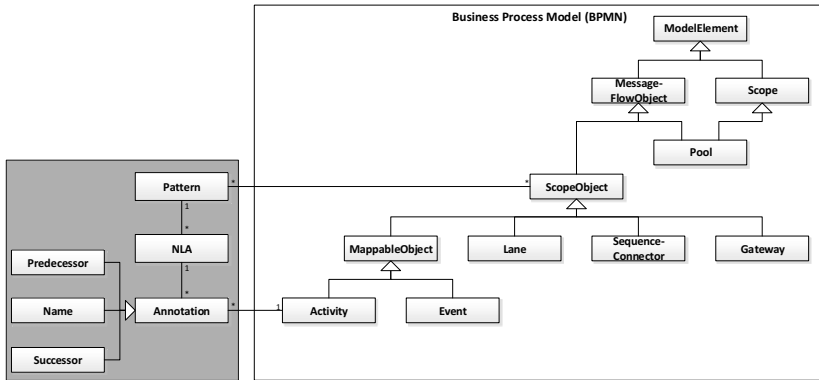


Figure 9: Integrated Meta Model Based on [Mül11]

A more generalized view of the presented approach will be given through a meta model. This consists of the meta model of BPMN as the widely used and in this paper applied modelling language for business process models and a meta model of the NLA annotations. The BPMN meta model is based on [Mül11]. As previously presented the annotations are subdivided in three types: the predecessor, the name and the successor. The given annotation generally is then associated with the activity as used in the BPMN business process model as well as with the NLA itself. In Addition, the NLA is associated with the different Pattern which consists of one or more ScopeObjects such as Activities, Events, Gateways or Connectors. The Figure 9 shows a slightly adapted part of the BPMN meta model of Mueller and the added elements with the association between them.

Altogether the presented association between formalized written Natural Language Artefacts (NLAs) and business process models demonstrate an sophisticated way of dealing with the lack of tacit knowledge in business process models for the manual execution.

5 Discussion

Other approaches such as [zMI10] integrated two different semi formal languages (SRML and BPMN) to gain advantages. However, the need for teaching employees another language downgrades this approach for the presented idea. Regarding the idea of having different information for different user groups is as well considered by [BDD⁺04]. They propose to integrate different information into the business process model and show only the needed information for the particular user group. This approach might be a solution for the presented problem though the use of elements of the specific modeling language limit the possible expressions. Furthermore approaches like [LMP12] and [FMP11] aim at the

transformation of business process models to natural language or the other way around but miss the integration of information that is not represented in business process models as stated in Figure 2. In Addition, a more general approach for wikis and the integration with conceptual modeling languages has been made by [GRS12]. However, their presented idea links the additional information (the wiki pages) based on an ontology instead of based on patterns. Another idea for linking wikis with ontologies was presented by [Sch06].

Using the presented approach it becomes possible to structure language artefacts according to annotations, which are derivable from respective modelling language. The structure of the natural language text enables some valuable advantages for business process modelling. First, by the structure of a NLA, the relation towards a business process model can be identified and revealed. Therefore the structure of an annotated NLA is coherent to a business process modelling language. Second, although coherent to a modelling language, the annotated NLAs can be enriched with further information. Adding further information towards a NLA does not jeopardise its formal semantics. Bridging logical gaps, adding more detailed instructions and including preferences as well as experiences is completely harmless to the structure of the NLA. The structure fully relies on the annotation.

Furthermore, next to other approaches, the presented approach does not include natural text to a model description, but it integrates two different perspectives. The process model and the NLA are coherently integrated, so that changes towards the model has implications to the NLA and the other way around. Hence an NLA, or a set of NLAs, is a further representation of a business process, which is more specific to operative business, since they enable to provide specific instructions for different individuals.

Changes regarding the business process model do have consequences regarding the NLAs. Reconsidering Figure 1, the automatic processing of order and availability checking and judging for its acceptance, would result in an disassociation of the account manager with the "Check Order" and "Check Availabilities" activities. This would implicitly cause the irrelevance of the respective NLA, which previously have instructed the account manager in checking incoming orders. So if constructs are removed from the business process model, then the NLAs that are in relation to these constructs could be either shortened or removed completely.

Further, if a business process model is enriched with further constructs, then this enables the creation of new NLAs. These new NLAs then relate to the new constructs of a business process model, which form one of the specific patterns. Such a relation between the two perspectives supports the operative execution of business processes, since unrelated instructions are removed and the business process model will be automatically enriched with the occurrence of new NLA that follow a specific structure.

Such benefits have been achieved through the use of a further tier, which is represented through the human-centric business process modelling patterns. In the presented approach any NLA has to be associated to a specific human-centric process pattern (cf. Section 3). Hence, on the one hand an automatic derivations based on the patterns of the required NLAs for a process model as well as the need for alter NLAs after changes within the process model are possible. On the other hand, due to the integration, adaptations of process models can be derived by means of the related NLAs.

6 Conclusion and Future Work

In this paper it was shown, how to establish a purposeful integration between business process models and semi-structured natural language text, respective annotated NLAs. The relation identified was based on the assumption that natural language text is required when humans have to interact and that different NLAs are useful for different actors of a business process. Therefore an integrated relation between multiple annotated NLAs, which uniquely concentrate on a set of task executed by a specific actor and the respective business process model was established.

In conclusion, with the presented approach it becomes possible to execute business processes with WfMS and whenever necessary, provide the human actors with NLAs that are coherent to the business process model as well as tailored to the specific informational needs. The coherency enables the NLA and the process model to exist in a synchronised manner. Whenever changes occur on one side, the other side can be adapted automatically. Furthermore, the adaptiveness of NLAs enables the provision of a unique set of comprehensive information specific to a socio-technological system. Additionally, the use of NLAs enables the employee of the operative business to contribute to such specifications, because of the possibility to contribute information and experience by means of natural language.

Future research directions will concentrate on different paths. First, the contribution towards NLAs by actors of the operative business requires the purposeful guidance and support. Although such a consideration of actors might contain an innovation potential, methods should be developed which guide the extraction of the respective knowledge. The use of social media techniques, e.g. rating systems, could improve this extraction. Second, with an increasing relevance of enterprise wikis, e.g. [BMNS11], the presented approach could be generally applicable for collaborative enterprise modelling through the use of enterprise wikis. The presented approach could be used for structuring enterprise wikis and further gain information, namely conceptual models, from those wikis. Within such a conceptualisation, every annotated NLA corresponds to exactly one wiki page from an enterprise wiki. Furthermore it would be possible to describe an excerpt of an enterprise model that is constituted by multiple constructs with one wiki page, which corresponds to a specific pattern. Recently proposed semantic wikis, e.g. [KVV06, BGS⁺11, Sch06], could support this form of enterprise wikis through enabling semantically enriched annotations and categories for wiki pages. Third, by enabling the use of annotated NLAs through semantic enterprise wikis, integrating between WfMS and those wikis could enrich the execution of business processes. Semantic enterprise wiki could provide their already contained and annotated NLAs to a WfMS, whenever the necessity occurs for executing a specific human-centric task. Fourth, empirical investigation will be undertaken, which try to evaluate the benefits of collaborative enterprise modelling through annotated NLAs. These empirical investigations could be both, experiments and case studies with partners in practice. In general, the investigation would try to find out the efficiency gain the approach offers, both in execution as well as innovating the business processes.

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