Using Goals to Identify Aspects in Business Process Models

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ABSTRACT

Modularization of business process models using aspects is a new line of research. Aspectual languages in this context have been proposed and are still under development. However, most of the guidelines for aspects identification in this domain is still dependent on the idea of process model elements repetition. In this paper, we explore a new way of identifying aspects, based on the ideas of the GPM (Generic Process Model) and process goals. We present a procedure for aspect identification and provide an example to illustrate its application.

Categories and Subject Descriptors

D.2.1 Requirements/Specifications; Methodologies (e.g., object oriented, structured).

General Terms

Management.

Keywords

Aspect-Oriented Business Process Modeling, Aspect identification, Goals, GPM.

1. INTRODUCTION

The marriage of the aspect-oriented (AO) paradigm and business process modeling brings benefits in terms of modularity to the process modeling. According to [2] conventional process modeling notations and languages have some functional decomposition principles and separation of concepts, but they are not enough to represent concepts repeated in the same process or in several different activities and in other processes.

Even if a process model is conventionally modularized, several concerns, the so-called *crosscutting concerns*, remain scattered throughout the process [1], generating models with reduced understandability and reusability and increased maintenance effort. This lack of crosscutting concerns modularization causes some drawbacks such as a little modification in part of a process will require changes in several parts of the process. Using AO-BPM techniques [2], crosscutting concerns are represented as aspects. This strategy divides the process into *core process* and *aspect process*, improving modularity, understandability and maintainability of the process model

The transformation of a process model into an aspectized process model involves three steps: (i) identifying crosscutting concerns in the source process model, (ii) transforming these concerns into aspects and iii) modularizing the process with an AO-BPM language.

For the first step some heuristics were proposed by Cappelli *et al*. [2]: "*(i) if the concept is repeated several times in different places, (ii) if it is used by different other concepts, (iii) if it reflects an integration of semantically distinct situations, (iv) if it represents a decision situation from which different options may be taken, (v) if its absence does not interfere with the global goals of the whole, (vi) if it can be reused in other domains and (vii) if it is very much independent of other concepts* ".

One of the heuristics, (v), is related to the process goal, which is the focus of our proposal. We propose a way to use the goal concept in business process modeling to help identify which elements or set of elements are dispensable in order to a process

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reach its goals. As pointed by the (v) heuristic these elements are considered *crosscutting concerns.*

We organized the presentation of our proposal as follows: Section 2 introduces the relationship between operational goal and process in a Business Process Modeling context, Section 3 gives an overall explanation on the GPM (Generic Process Model) framework, which is the basis for our proposal, Section 4 highlights a procedure for finding aspects based on the GPM framework, Section 5 gives an example of use of our proposal and Section 6 presents related works. We conclude in Section 7 with an overview and stressing future developments.

2. GOALS IN BUSINESS PROCESS MODELING

The idea of goals is associated with business process as they exist to satisfy a goal of an organization. According to Soffer and Wand [6] the association of business goals and business models has received little attention. As a consequence, goals are not integrated to the process modeling.

Some efforts in the representation of goals come from the requirements engineering, where goals are associated with the requirements.

Ghattas *et al*. [4] propose LPM (*Learning Process Model*), an evolutionary-based approach that establishes that a business process must be built with the minimum elements needed to launch the required services. During the process execution, it is possible to collect and analyze data resulting from the process. As a consequence, deviations from the defined process model and the actual business process can be identified and the process model can be modified to reflect the reality of the process. This is the basis for learning and adapting the process based on the experience. To support this approach, the process goals must be known. The proposal include the use of GPM to explicit represent the process goals.

3. THE GPM FRAMEWORK

The GPM framework is based on concepts of Bunge ontology, adapted for information systems modeling and for business processes modeling. Besides the basic ontological concepts, Soffer and Wand [6] defined others to represent processes concerns in ontological terms, they are: domain, state, sub-domain, stable state, unstable state, law, transition law, stability condition and process. Also some definitions are presented to relate the concept of operational goals[1] to process models.

The basis is related to the concept of things that make up the world and have their own properties or mutual properties to more than one thing. The properties of things can be understood as attributes that possess values over time. Things come together to form a composite thing that possess their own properties that things have not alone. The state of a thing is the current set of values of its attributes. Attributes modifications are caused by events or changes in the state of things. State changes occur due to internal modification of the thing or by interactions between things. The laws indicate the possible states of a thing and the transition laws govern the transition state changes [6].

[1] From [6] "Note that by "goal" we relate to an operational goal of the process only, as opposed to business goals of the organizations".

Concepts of processes, based on ontology, include the concept of domain, which is part of the world contains things whose interactions and modifications will be modeled. When defining a domain, understanding the process scope is facilitated. This allows the discovery of internal events (those governed by the process) and external events (those outside the process control). The domain state provides information about what will be modeled and is formed by the state of all things within the domain. A sub-domain is part of the domain defined by a subset of the set of state variables. A sub-domain also has a state. The state of the sub-domain indicates the scope of the sub-process.

A state can be stable or unstable. The state is stable when it can only be changed by an event outside the domain. Since the unstable state is a state that needs to be modified, Soffer and Wand [6] consider a process "as a sequence of unstable states which ends when the stable state is reached" [6]. The law is a function of the set of states into itself. The transitional law is a function of the set of possible unstable states in the set of states, therefore, to unstable states; the law is the transition law. The stability condition means that there is a stopping point for the entire sequence of unstable states.

To relate the concept of goals to processes, the following definitions are presented: goal is a set of stable states that are part of the proper subset of the set of stable states. Process goal is when every process execution allows the goal to be reached. To relate the goal to the process design that allows it to be achieved, the concept of goal is operationalized through the criterion function, which maps the values of state variables in the domain, allowing to conclude whether the process has reached its goal or not. The definitions and concepts presented do not clearly represent the information contained in process models, such as pre-conditions, post-conditions, resources, actors and ordered activities.

For this paper, it is important to clarify the concept of pre and post-conditions. Pre-conditions can be understood as triggering events; and they define the set of initial states of the process. Post-conditions define the set of process goals that means what the process should have realized when it is finished.

4. USING GPM FOR ASPECTS IDENTIFICATION IN PROCESS MODELS

The usual heuristics to identify elements that need to be modularized as aspects were presented at the introduction and most of them are centered on the concept of repetition. However, these heuristics are not enough to identify if an element or a set of elements could become modularized as an aspect. Another important strategy is to identify if the removal of an element does interfere with the global goal [2].

In order to identify elements or set of elements to be modularized as aspects we propose the use of GPM to explicitly represent the initial state and the goals for each process activity, it is related to the sub-domain state. From this explicit representation it is possible to verify if an element can be considered dispensable to the model, in which case it will be considered and modeled as an aspect.

To evaluate the importance of a process element with respect to a desired goal, we propose the following procedure:

1. Define the process goals (*);
2. List each activity of the process or set of activities (**);

3. Identify the goals of each item on the list produced in the previous step (they are associated to the output of each activity) (***);
4. For each element in the list and its associated goal, the following analysis must be done:
   4.1. Question: if this activity is removed or not executed the goal of the process is still reached?
   4.2. Indicate the result of the question (yes or no);
   4.3. Add comment related to the answer, this comment allow others to understand the reasons why the activity or set of activities were considered dispensable.
5. Consider all dispensable elements as aspects;
6. Modularize the process using AO-BPM [2].

(*) the process goal may not be specified, but according to Soffer and Wand [6], it is possible to understand the process goal through the analysis of the whole process states and activities.
(**) this proposed analysis can be done for single and composed elements, in the case of composed, the goal evaluation must be related to the goal of the entire composition, instead of using each goal of the elements part of the composition.
(***) This step is dependent on domain knowledge. The information could be more accurately obtained in the stage of gathering information for further elaboration of the model. It is also possible to get this information from those responsible for this process.

5. EXAMPLE

In order to illustrate the effectiveness of our proposed procedure we use the Close Daily Production process represented in Figure 1. This process model is concerned to the domain of oil production, and was adapted from a real business process model executed on a Brazilian oil and gas company.

This process is responsible for the assessment of the production focusing on deviations related to production operation, ensuring the integrity of daily production, performing the division of daily production, generating the summary of daily production and disseminating this summary.

Every day after the production is registered, the Production Control area informs the daily production data to the CORP-PE area and fire daily division of the production, this may result in success or failure. If data is incorrect, the Operation area is informed about the error and corrects the data. After correction, the division is performed again by the Production Control area. If the division is successfully consolidated, the oil composition data is registered, the daily production summary is generated and this information is sent via email. So the daily closing is consolidated.

Following, we instantiated the procedure of Section 4 with the data in the EPC (Event-driven Process Chain) [5] of Figure 1 using the numbers to show which step of the procedure we are instantiating.

1. Process Goals: Daily production closed and Data of the daily production correct.
2. Process activities:
   (a) Inform daily production to CORP-PE;
   (b) Fire daily division;
   (c) Inform Operation area about incorrect daily production data;
   (d) Correct daily production data;
   (e) Register oil composition data;
   (f) Generate daily production summary;
   (g) Inform daily production summary in email;

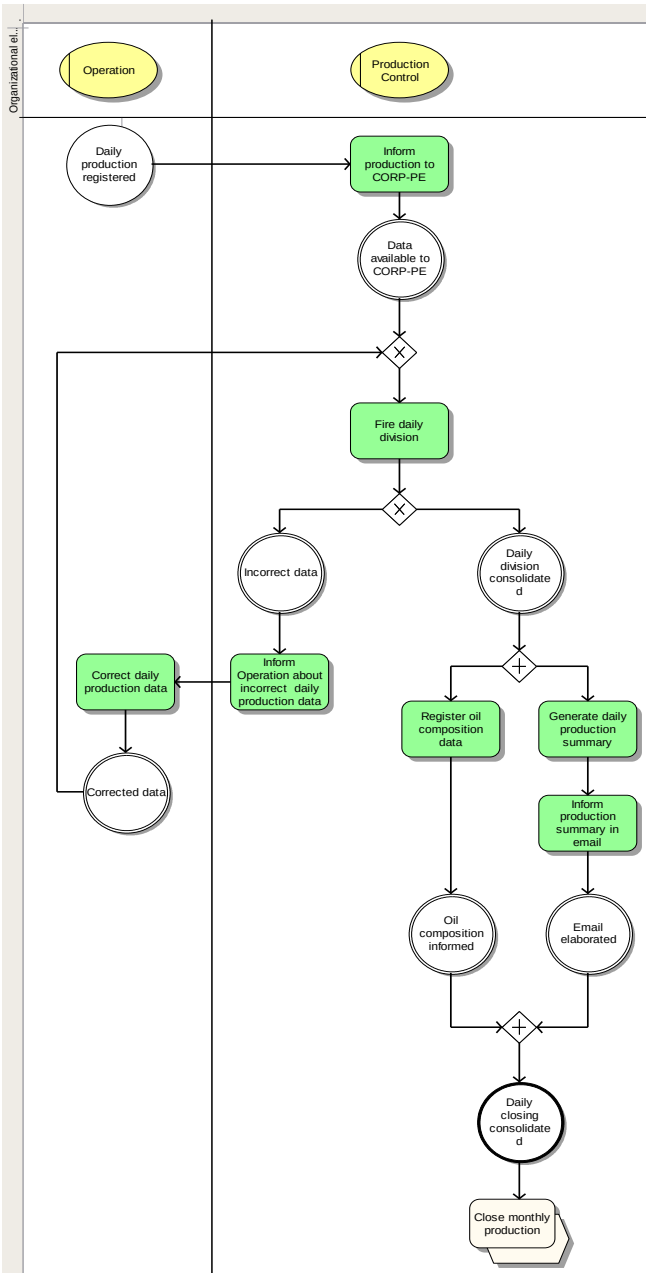

Figure 1. Close daily production process.

3. Goals of each activity:
   (a) Daily production data available to CORP-PE;
   (b) Daily division fired;
   (c) Incorrect daily operation data informed to Operation area;
   (d) Daily production data corrected;

(e) Daily division consolidated and Oil composition data registered;
(f) Daily division consolidated and Daily production summary generated;
(g) Daily division consolidated and Daily production summary informed by email.

4. For each activity and corresponding goal answer the question and add a comment:
   (a) Yes. Purely informative activity;
   (b) No. Main process activity;
   (c) No. Informative activity, but related to the process goals. If the Operation area is not informed about incorrect data, may compromise the entire process goal.
   (d) No. Activity indispensable in the case of wrong daily production data.
   (e) Yes. Purely informative activity, consists of inform oil composition on the ERP.
   (f) Yes. Purely informative activity, consists in generate daily production summary;
   (g) Yes. Purely informative activity, consists in send an email with daily production summary.

The answers of step 4 and its justification were based on more detailed information on each activity and may be supported by the available expertise at hand.

5. All elements of step 4, which has a **Yes** answer will be considered as aspects.
6. Using AO-BPM notation, in this case AOARIS [3], the Close daily production process is modularized. Note that the core process is separated from the aspects by a double vertical red line in Figure 2.

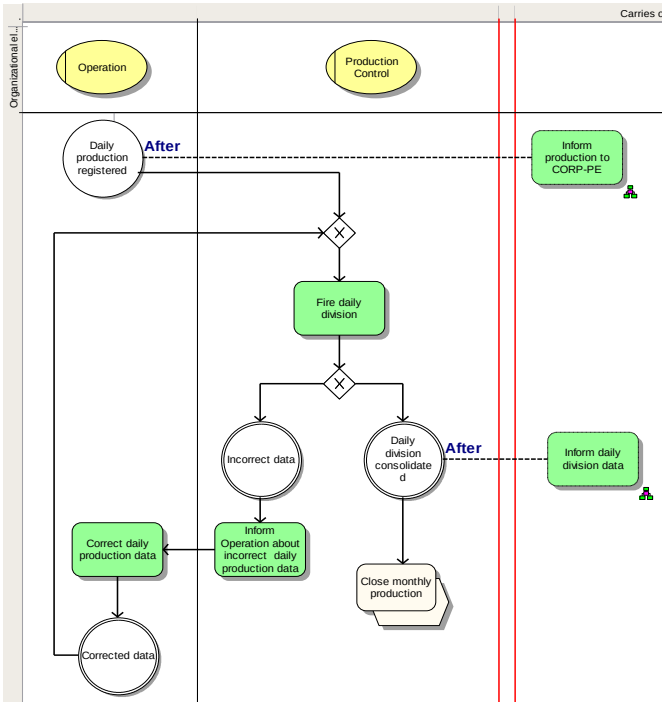

Figure 2. Close daily production aspectized process.

The aspectized activities Inform production to CORP-PE and Inform daily division data represent accessories activities in the process as they can be removed without affecting the main goal of the process. These activities are used to represent all activities removed from the core process. This is possible because of ARIS assignment feature [3]. These two aspectized activities are detailed in Figure 3 and Figure 4.

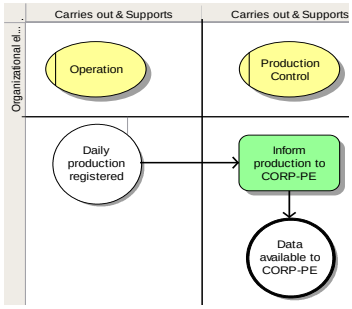

Figure 3. Inform production to CORP-PE.

In Figure 3 are represented the event before its main activity Inform production to CORP-PE, the main activity and the event after this activity. The assignment feature was used because besides one activity, one event should also be aspectized and the events were included in this EPC to turn explicit the place in the core process where the activity was removed from.

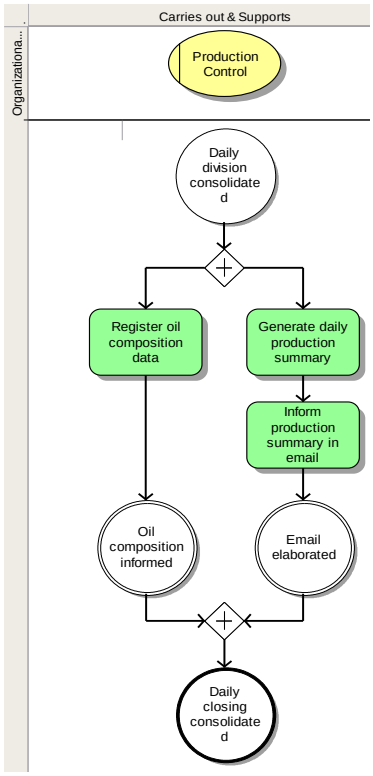

Figure 4. Inform daily division data.

In Figure 4 are represented all activities must occur after the Daily division consolidated event and consequently before the process interface Close monthly production.

6. RELATED WORK

In [5] is presented a general business process architecture, based on ARIS and formed by the following levels: process planning, process control, workflow control and application systems. As ARIS architecture address the entire process management life-cycle, it makes possible to create process-oriented software, where software developed will be aligned to business processes allow an organization to reach its goals. In this paper authors do not consider separation of concerns, so this entire architecture which should generate process-oriented software still generated software with concerns scattered and tangled.

In [3], the AOARIS approach is proposed, exploring the ways ARIS could support aspect-oriented concepts in business process models. In this paper, the approach used in section 5 to generate Close daily production aspectized model is detailed. The AOARIS approach uses repetition heuristics, different from our approach, which uses a new heuristic considering process goal to discover aspects.

In the example, Section 5, we used the architecture proposed in [5], which is the leader in this market. As such, we understand that we are helping AO-BPM tech transfer. Our approach contributes to discover aspects at early stages, still in the business process model.

In [6] authors present the formal GPM framework to evaluate process model validity (possibility of a process to achieve its goals). The GPM concepts and validity criteria are applied to a process from the SCOR (Supply-Chain Operations Reference-model) using the notation in which SCOR is specified (neither EPC nor BPMN). Besides the paper demonstrate causes for process invalidity and how to avoid them. Different from our approach, in this paper the authors do not consider modularity or separation of concerns issues.

In [2] is pointed the fact that few researchers are considering aspect-oriented concepts and business process modeling techniques. For the best of our knowledge and as can be seen in the sample of works mentioned above, there is no work similar to our approach regarding business process goals analysis to verify if an activity or set of elements could be considered dispensable to the model and then aspectized.

7. FINAL REMARKS

This paper proposes the use of the GPM model as a basis for identifying operational goals as well as the structure of stable and unstable states to determine the usefulness of certain elements (activities) with regard to the processes goals. Usefulness is understood as if the activity is essential or non essential in meeting the given goal. Results of this analysis point out to elements (activities) which can be modularized as aspects in a given process description.

We believe that this approach is a solid contribution to the task of aspect identification in a given process model. As we have shown in our demonstration example, the objective of modularization is achieved as a more clean description of the process is produced.

As future research we aim to use the entire GPM formalism, improving this approach. Other front is the use of our approach in business process models with goals already identified combined with goal oriented aspect elicitation [7].

8. ACKNOWLEDGMENTS

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