On the Capabilities of BPMN for Workflow Activity Patterns Representation

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Abstract. This paper provides a complete version of the Workflow Activity Patterns (WAP) in the Business Process Modeling Notation (BPMN) as well as an extended evaluation of the capabilities of BPMN and their strengths and weaknesses when being utilizing for representing WAPs. When implementing the activity patterns in existing Business Process Modeling tools, it is fundamental to represent them in BPMN. This representation may facilitate the adoption of the WAPs by BPMN tools as well as the use of the WAPs in process design.

Key words: Workflow activity patterns, BPMN, process design

1 Introduction

Process models can be assembled out of a set of recurrent business functions (e.g., task execution request, approval) of which each has a specific semantics. In an earlier work we related such business functions to a set of well-defined workflow activity patterns (WAPs): request for activity execution with/without answer, approval, notification, decision-making, and information request [1]. This pattern set is closer to the vocabulary and abstraction level at which business processes are usually described by domain experts. This fosters pattern reuse when modeling business processes and therefore contributes to more standardized and better comparable business process models. Generally, multiple WAPs can be composed in a process model using workflow patterns like Sequence, AND-Split, AND-Join or XOR-Split [5].

In order to facilitate the adoption of the WAPs by BPMN design tools as well as their use in new approaches it is fundamental to represent them in BPMN. If we have the patterns in BPMN and the tool supports BPEL output from BPMN diagrams, we already have BPEL output implemented for the pattern designed processes.

The remainder of this paper presents the WAPs in BPMN and a discussion on the strengths and weaknesses of BPMN when being utilizing for representing them.

2 Representing Workflow Activity Patterns in BPMN

A WAP refers to the description of a recurrent business function as it can be frequently found in business processes [1]. We had developed an empirical study, in which we analyzed more than 200 real-world process models in order to confirm the existence of the seven WAPs [2]. The study showed that the analyzed process models can be designed based on the investigated patterns; i.e., the set of identified WAPs is necessary as well as sufficient to design the 200 process models, at least at a certain level of granularity.

2.1 WAP1: Approval Pattern

An approval shall be done by a single role or by multiple roles either concurrently or iteratively (see Fig. 1).

- **Single approval**: a requestor sends an approval request to exactly one reviewer. This reviewer performs the revision either resulting in approval or rejection.
- **Iterative approval**: based on a list of reviewers (BPMN collection data object) a requestor sends an approval request for the first reviewer from the list. This reviewer performs the approval resulting either in approval or rejection. If approved the next reviewer from the list will receive a request for approval, and so on; if one reviewer rejects, all previous approvals (in case they exist) will be cancelled and the overall approval procedure will be aborted. At the end, a final decision approval or rejection is made concerning the object under revision.
- **Concurrent approval**: given a list of reviewers a requestor sends an approval request to all reviewers simultaneously. After all reviewers have performed their approvals the final decision is made. To represent the parallelism we used the collection data object and the multi-instance marker for parallel instances.

2.2 WAP2: Question-Answer

Major design choice regarding the question-answer pattern is whether the question will be send to one or multiple roles and actors, respectively (see Fig. 2).

- **Single-Question-Answer**: Based on a question description an organizational role with expertise in the respective domain is chosen to answer the question. The sender waits until the response arrives and then continues process execution.
- **Multi-Question-Answer**: Based on a question description multiple organizational roles with expertise in the respective domain are chosen to answer the question. The sender waits until all responses arrive and then continues process execution.

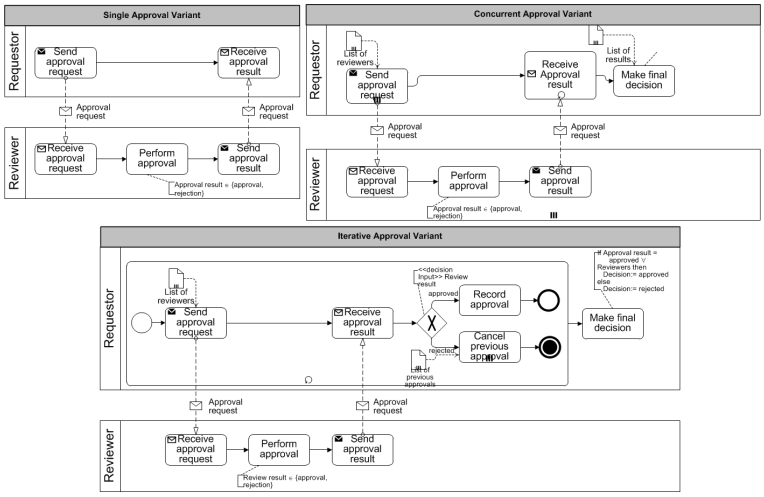

Fig. 1. Approval Pattern Variants.

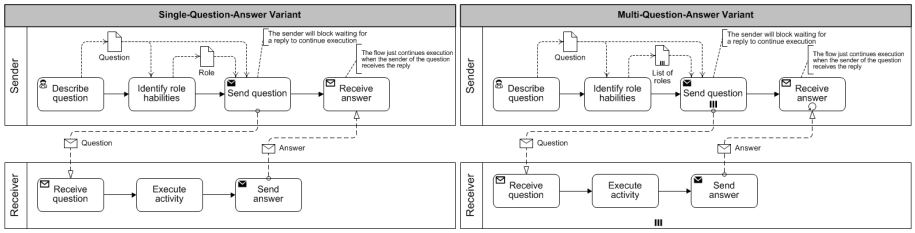

Fig. 2. Question-answer Pattern Variants.

2.3 WAP3: Unidirectional Performative

Major design choice is whether the activity execution request shall be sent to one or multiple actors (see Fig. 3).

- **Single-Request**: A requestor sends an activity execution request to a receiver and continues process execution without waiting for response.
- **Multi-Response**: A requestor sends an activity execution request to multiple receivers simultaneously and continues process execution afterwards, i.e., without waiting for any response.

2.4 WAP4: Bi-directional Performative

Major design choice is whether the activity execution request is sent to one or multiple actors (see Fig. 4).

- **Single-Request-Response**: A requestor sends an activity execution request to one receiver. He waits with continuation of his part of the process until the receiver notifies him about the performance of the requested activity.

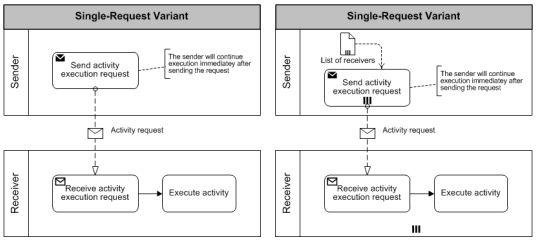

Fig. 3. Unidirectional Performative Pattern Variants.

– **Multi-Request-Response**: A sender sends an activity execution request to multiple receivers simultaneously and continues execution only after having received respective notifications from all performers (cf. Fig. 4).

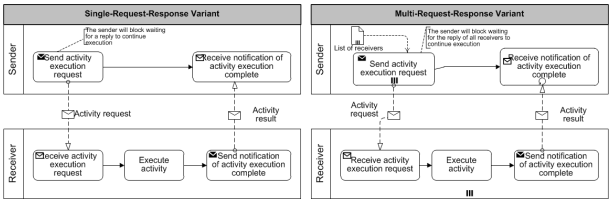

Fig. 4. Bi-directional Performative Pattern Variants.

2.5 WAP5: Notification

Major design choice is whether the notification is to be sent to one or multiple actors (see Fig. 5).

– **Single-Notification**: A sender sends a notification to a single receiver.
– **Multi-Notification**: A sender sends a notification to multiple receivers simultaneously.

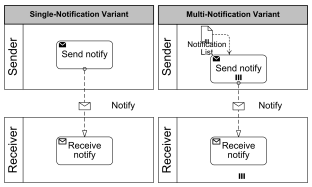

Fig. 5. Notification Pattern Variants.

2.6 WAP6: Informative Request

Major design choice is whether the information request is sent to one or multiple actors (see Fig. 6).

- **Single-Information Request**: A sender sends an information request to a receiver and does not continue process execution before having received the requested information.
- **Multi-Information Request**: A sender sends an information request to multiple receivers simultaneously and does not continue process execution before having received responses from all receivers.

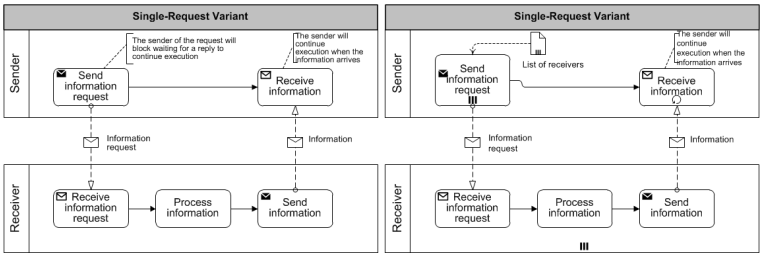

Fig. 6. Informative Pattern Variants.

2.7 WAP7: Decision

Major design choice is whether the final decision is based on the results of one single activity or a set of activities.

- **Single-Decision**: Based on the execution result of an activity one or several succeeding branches are executed.
- **Multi-Decision**: An activity execution request is sent to multiple performers. Based on the results of the activities one or several succeeding branches are executed.

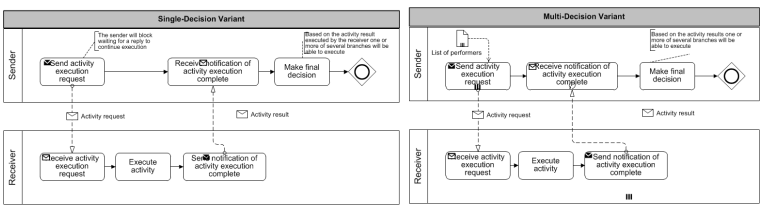

Fig. 7. Decision Pattern Variants.

3 Discussion and Conclusions

Basic advantages of the representation of the WAPs in BPMN are: (a) BPMN is becoming a well-known standard notation for business process modeling. When comparing with UML 2.0 some aspects look clearer like the message exchange between process participants. Having the patterns in BPMN makes possible to perform experiments to compare process design with and without the support of WAPs; (b) BPMN showed suitable for modeling most of the WAPs. We observed that some structures (e.g., participants related to a multiple instance activity) can be represented in different ways in BPMN. We believe that not always the proposed WAPs will be directly identified.

We have experienced that the use of WAPs for designing integration business process models brings several advantages: automate and facilitate the design of process models, reduce process modeling time and cost, improve process model quality, and enable the reuse of the process knowledge captured in them to generate the public and private activities [3]. Also, the use of WAPs ensures the interoperability in the message exchange between integration business processes by providing synchronization among the sending and receiving tasks generated in the processes. As drawbacks we can mention that the WAPs do not express how to generate the business document to be sent in each business message.

The WAPs in BPMN are very important for designing process models executed in virtual organizations [4]. The WAPs showed to be very effective for representing single/multi participants either requesting the execution of activities or being notified about executed activities. In addition they help to add more semantics and details for the activities description.

As future work we are going to use the WAPs in BPMN for designing processes from different application domains and organizations. Our goal is to verify how effective the patterns are for process design when comparing with the same design using only BPMN elements.

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