

## BPMN PATTERNS USED IN MANAGEMENT INFORMATION SYSTEMS

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**ABSTRACT:** *Business Process Modeling Notation (BPMN) is a graphical standard in which controls and activities can be connected almost arbitrary. A design pattern describes a general solution for a recurrent problem, within several business processes. In this article, the authors propose four BPMN patterns that can be used for modeling business processes in the accountancy field. The purpose of these patterns is to simplify diagrams and to ensure a high flexibility as well as a higher abstracting degree in the mentioned field of activity.*

**Keywords :** *BPMN, BPMN Patterns, Workflow Patterns, Management Information Systems*

**Jel Code :** *M15, M41*

### Introduction

A *business process* is an activity or a collection of activities whose purpose is to achieve a certain goal in an organization. Business processes “*represent a strategic and critical intellectual asset that needs to be understood and proactively managed*” (Schedlbauer M., 2010). According to its complexity, a business process can be divided into sub-processes. Any company aims at optimizing its own business processes so that they become more efficient, more adjusted to the ever changing business environment. The business process management (BPM) basically represents a methodology for optimizing the business processes in an organization.

Generally, for the representation of business processes in organizations, one can adopt either the UML standard, namely activity diagrams - to be more precise, or the BPMN standard (Business Process Modeling Notation). Nevertheless, UML was created and is mainly object-oriented in order to model software applications, while the BPMN has aimed since the very beginning to model processes specific to informational systems.

*BPMN* represents the graphic standard for describing and understanding the particular activities of a certain business, “*it is a core enabler for a new initiative in the Enterprise Architecture world*” (Martin O. and Jog R., 2003). Since 2005, BPMN has been managed by *Object Management Group* (OMG) due to the merger between this organization and BPMI. BPMI has developed three standards to enable the business process management (Martin O. and Jog R., 2003):

- BPMN, as a standard language for business processes modeling,
- Business Process Modeling Language (BPML), as standard business execution language,
- Business Process Query Language (BPQL), as a standard management interface for implementing and executing e-Business processes.

In January 2011, OMG published BPMN version 2.0 which extends the application field and the competences of the previous version, in several areas (OMG, 2011):

- Formalizes the semantic execution of all BPMN elements,
- Defines an extensibility mechanism both for the extensions of the Process Model, and for the graphic extensions,

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- Refines the composition and the correlation of events,
- Defines a Choreography Model.

The primary goal of BPMN is “to provide a notation that is readily understandable by all business users, from business analysts that create the initial draft of processes to technical developers responsible with their implementation and, in the end, for the business people who will manage and monitor those processes. Therefore, BPMN creates a standardized bridge for the difference between the design of the business process and its implementation” (OMG, 2011). In this sense, BPMN provides the Business Process Diagram which is designed to be used both by the designers and by the manager of business processes.

BPMN defines a mapping of its visual notations for the semantic execution of business processes by execution languages, such as Business Process Modeling Language (BPML), Business Process Execution Language for Web Services (BPEL4WS), Web Services Business Process Execution Language (WS-BPEL).

### **Literature review**

Over the years, many methodologies and/or graphic languages for business process representation have been developed. Nevertheless, only two of them became standards in the field, namely: the Business Process Languages Notation (BPMN) and the UML Activity Diagrams (UML AD). Based on these standards, different comparative studies have been made over the years. For many researches, comparative studies have been made from several perspectives, such as: “How easy can they be understood by the users, how well do the graphical elements of these two notation languages represent the real business processes of an organization and how easy these two business process modeling languages can be mapped to Business Process Execution Languages?” (Geambasu C.V., 2012).

As already shown, for the modeling of business processes within an organization, both the BPMN standard and the UML (UML AD) activity diagrams can be used. In this sense, the specialty literature published articles displaying the workflow patterns by using both the BPMN standard and the UML AD standard. This includes major researches containing BPMN and UML 2.0 AD evaluations based on workflow patterns, by analyzing the capacity of each modeling language (White S., 2004; Russell N. et al. 2004a; Russell N. et al. 2004b; Russell N. et al. 2006a; Russell N. et al. 2006b; Wohed P. et al., 2006).

A *Process-Aware Information System* (PAIS) is “a software system that manages and executes operational processes involving people, applications and/or information sources on the basis of process models” (van der Aalst W.M.P., 2009). As part of these systems, the following patterns have been proposed:

- *Control-Flow Patterns*: they refer to aspects related to the interconnection between flow controls among different activities. The initiative of workflow control patterns was created with a view to separating the fundamental requirements that appear during the modeling of business process in their basic form and are described as imperatives (Russell N. et al., 2006b).

- *Workflow Data Patterns*: they provide the patterns of data representation and use within the workflows (Russell N. et al., 2004a).

- *Workflow Resource Patterns*: they offer versions of resources representation and use within the workflows (Russell N. et al., 2004b).

- *Exception Handling Patterns*: they provide patterns for treating the exceptions that may appear in PAIS Systems (Russell N. et al., 2006a).

In the specialty literature, there are different researches made with a view to implementing business process patterns. In this sense, we need to mention Ouyang C. et al. (2007), who present in their research different solutions for turning the BPMN models that describe workflow patterns, *inter alia*, into BPEL code.

Moreover, there are significant researches on the issue of managing complex BPMN patterns (La Rosa M. et al., 2011a; La Rosa M. et al., 2011b). La Rosa M. et al. (2011b) identifies certain patterns with a view to simplifying the complexity degree of certain BPMN, in terms of abstract syntax, by introducing new patterns such as *Block-Structuring*, *Vertical Modularization* etc. In another article, La Rosa M. et al. (2011a) identifies patterns in order to simplify the complexity of certain BPMN models, without changing the abstract syntax, by introducing new patterns such as *Textual Annotation*, *Pictorial Annotation* etc., which bring further explanations to the model.

Zimmermann B. and Doehring M. (2011) present an approach based on a combination between models of workflows, rules, events and adjustment patterns for workflows. The latter offers certain adjustments within the workflows valid for specific situations.

Marco Brambilla et al. (2011) present a designing methodology, supported by certain specific instruments, destined to extending social-character business processes. In this sense, the scientific paper presents BPMN extensions and social design patterns destined to representing repeated scenarios existing in social software.

Niculae C.C. (2011) offers a list of time patterns used in the past 10 years in the specialty literature. Moreover, he offered symbols for each pattern and extended their already existing activity, within the conceptual modeling with time support.

From our analysis, we discovered that until now, much attention was paid especially to patterns destined to a representation of workflows within an enterprise. An important role in the information system of an organization is played by the accounting information flow, because *"the accounting information is maybe one of the most sensitive because we are speaking about information that express first of all money"* (Briciu Sorin et al., 2011).

In this article, we propose a set of patterns for modeling processes often discovered in informational systems. By applying them, models are simplified and the related activities and flows represented by BPMN are standardized.

### **Research methodology**

Our research started with an analysis on the already existing patterns and on the opportunity of using them when modeling business processes. The analysis showed us that many researchers have been particularly interested in using the workflow patterns when describing business processes. The workflow patterns can be described by BPMN and UML AD standards. There are two different subjects:

- The first one refers to the use of general workflow patterns, initially described in UML AD and then revised and transcribed in BPMN,
- The second one refers to the use of certain BPMN patterns, divided into fields and sub-fields of activity, used in the description of business processes.

From the studies made, we discovered that the subject of using BPMN patterns designed according to fields and sub-fields of activity, used in the description of business processes, is rather poorly analyzed. One of the reasons would be that in the description of business processes, by using the BPMN standard, one can also use the basic workflow patterns, initially described in DA UML and which are valid in any activity field. *In fact, any flow or association that can occur between two flow objects can be represented as a workflow pattern.*

*The raising issue is the possibility of creating specialized patterns classified according to fields and sub-fields of activity.* This is the purpose of this article, namely proposing certain BPMN patterns, as well as the corresponding symbols, necessary to describing the business processes specific to the accounting field.

**BPMN proposed patterns for management information systems**

We paid attention to the possibility of obtaining solutions for the representation of informational flows within the accountancy or management processes, generally valid, that might be reused in the description of several business processes.

As all the activities in the management of an organization are recorded in documents and moreover, as the accounting operations are generated by primary (justifying) documents, we considered that the activities occasioned by documents can make the object of patterns with a broader applicability level. Due to this reason, we focused on analyzing and abstracting certain activities which are frequent in any company: receipt or release of a document, respectively, payment or cashing of the same.

**Pattern 1: Receive Document**

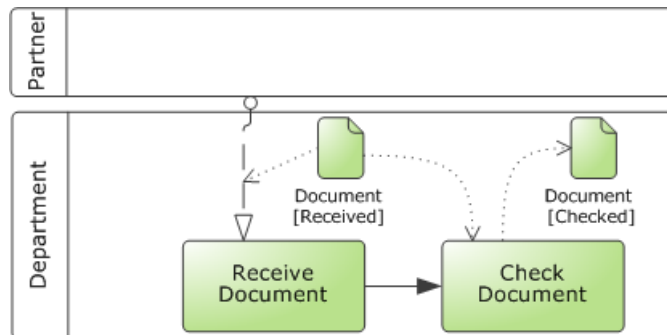
*Description:* the pattern can be used when a department from a certain organization receives a document from a business partner.

*Graphical representation:* it shall be represented similar to an activity, with a pictogram in the right corner up, as in the figure bellow (Figure no. 1):



**Figure no. 1 - Graphical representation of "Receive Document" pattern**

Figure no. 2 presents the content of the received document pattern from a partner of the organization. When a document is received from a partner, the activity "Receive Document" is initiated followed by verification (activity "Check Document").



**Figure no. 2 - Description of "Receive Document" pattern**

**Pattern 2: Send Document**

*Description:* the pattern can be used when the organization drafts a document that is to be sent to a partner afterwards.

*Graphical representation:* it shall be represented similar to an activity, with a pictogram in the right corner up, as in the figure bellow (Figure no. 3):



**Figure no. 3 - Graphical representation of "Send Document" pattern**

Figure no. 4 presents the content of the pattern for sending the document by the organization to a commercial partner. When a document is drafted by the organization, it is first of all checked and then sent to the commercial partner.

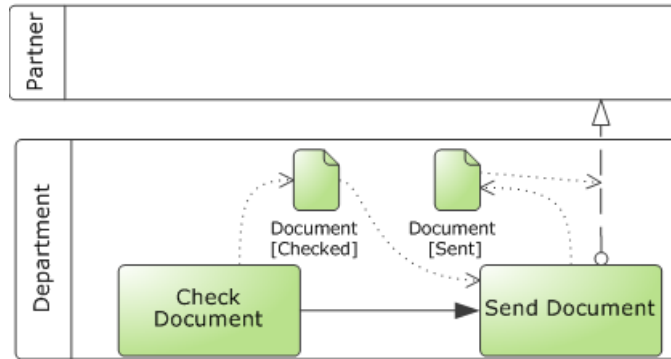


Figure no. 4 - Description of " Send Document " pattern

**Pattern 3: Pay Document**

*Description:* the pattern can be used when paying a document via bank transfer.

*Sub-patterns:* "Receive Document" pattern, "Send Document" pattern

*Graphical representation:* it shall be represented similar to an activity, with a pictogram in the right corner up, as in the figure bellow (Figure no. 5):



Figure no. 5 - Graphical representation of "Pay Document" pattern

Figure no. 6 presents the content of the "Pay Document" pattern. When one desires to make the payment of a document, he/she must first of all verify this pattern. This verification can be optional, because theoretically, it has been executed also when receiving the document from the issuing-partner. The payment of the document means crediting the account of the enterprise, operation based on which the bank will send the enterprise a proving document confirming the payment. After receipt of the proving document, the relevant department must verify it.

As this pattern also has sub-patterns, its content can be described by using the patterns "Receive Document" and "Send Document".

Figure no. 7 presents the content of the "Pay Document" pattern on a higher abstract level, by using the "Receive Document" and "Send Document" sub-patterns.

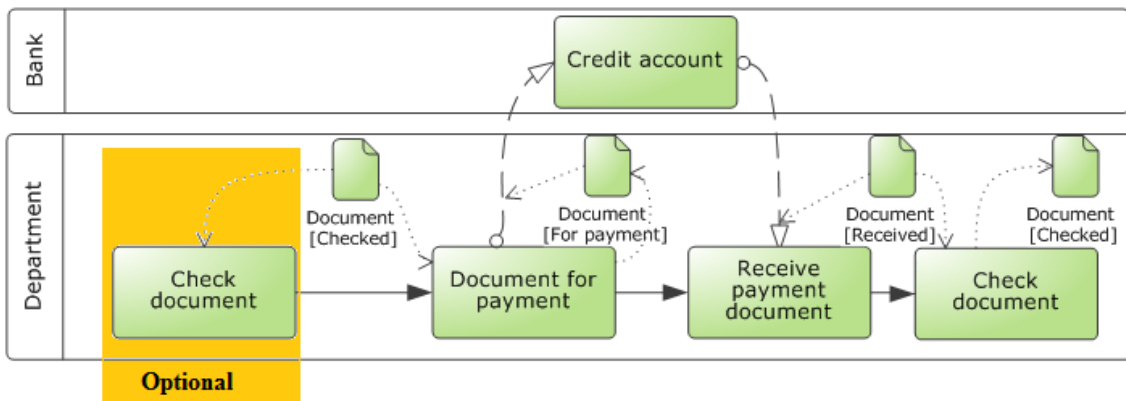


Figure no. 6 - Description of "Pay Document " pattern



**Figure no. 7 - Abstract description of "Pay Document" pattern**

**Pattern 4: Cash a Document**

*Description:* the pattern can be used for a cashing operation via bank transfer.

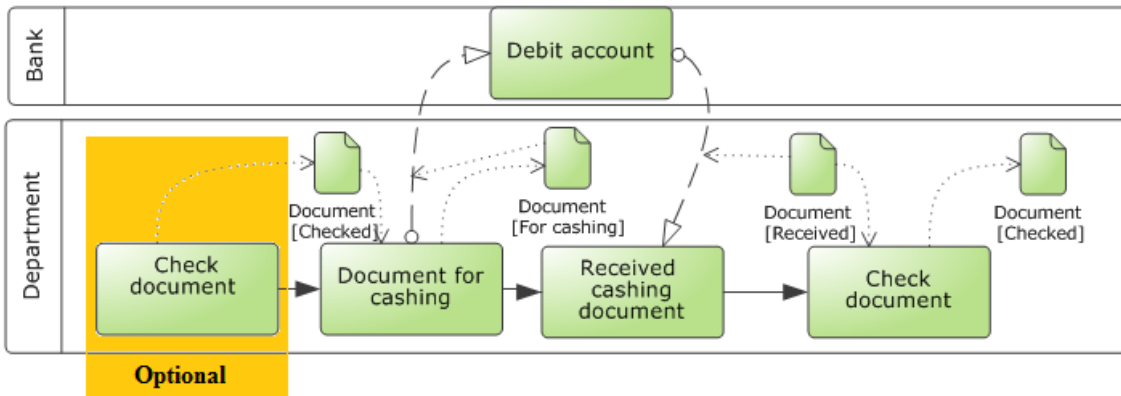
*Sub-patterns:* "Receive Document" pattern, "Send Document" pattern.

*Graphical representation:* it shall be represented similar to an activity, with a pictogram in the right corner up, as in the figure bellow (Figure no. 8):



**Figure no. 8 - Graphical representation of "Cash a Document" pattern**

Figure no. 9 presents the content of the document cashing pattern. When cashing a document, the bank is submitted the document based on which the cashing is made, the company's account is debited, then a justifying document is received from the bank, confirming the cashing process. After receipt of the document from the bank, the justifying document is verified.



**Figure no. 9 - Description of "Cash a Document" pattern**

As for the payment activity, the activity of verifying the document based on which the cashing is to be made can be omitted, because this activity is likely to have been made in advance as well.

As the "Pay Document" pattern, the "Cash a Document" pattern also has sub-patterns and thus it can be represented on a higher abstract level. Figure no. 10 presents the content of the "Cash a Document" pattern on a high abstract level, by using the sub-patterns "Receive Document" pattern, "Send Document" pattern.



**Figure no. 10 - Abstract description of "Cash a Document" pattern**

In order to demonstrate the efficiency of the patterns proposed, let's take an example which aims at modeling business process for an information system regarding the supply and reception of products and their payment.

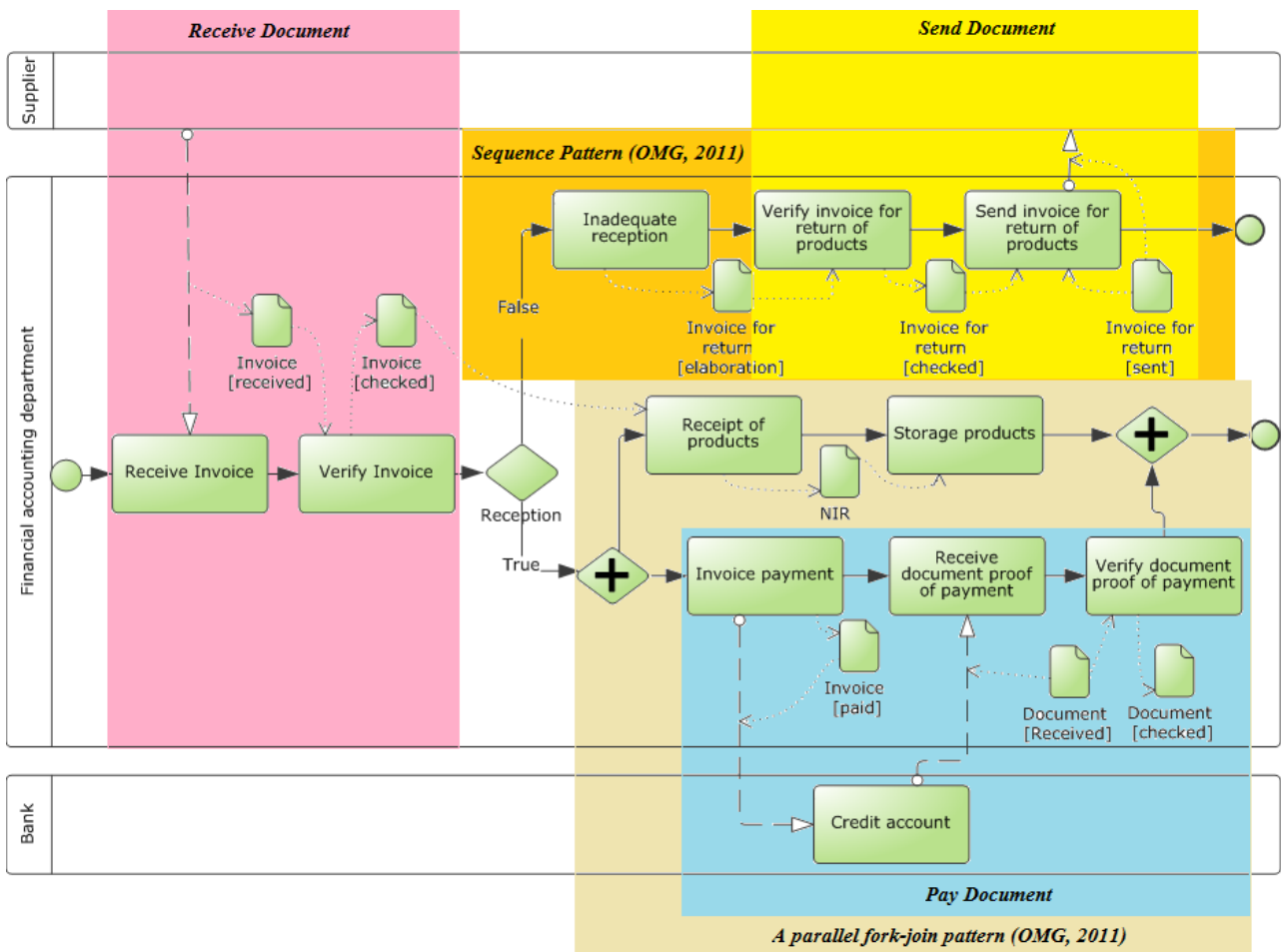
The informational flow within the business processes, described in Figure no. 11, is the following:

1. The financial-accounting department receives an invoice issued by the supplier. As it happens with any document received by the enterprise, the document is verified.

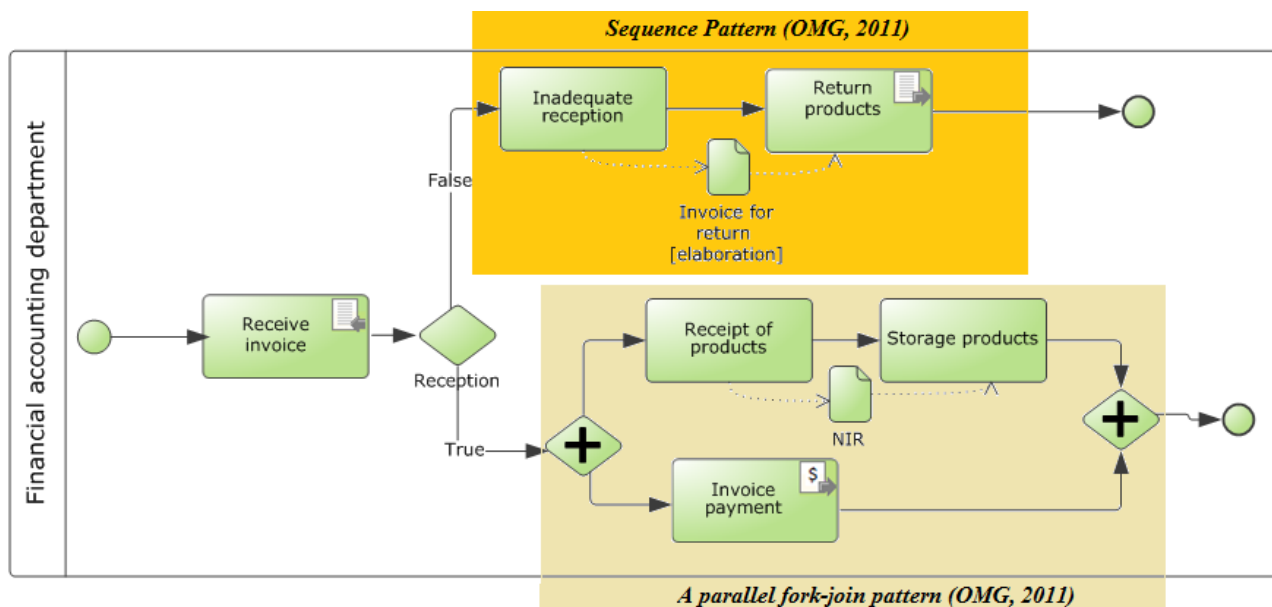
2. Based on the invoice received from the supplier, the products are subject to a reception operation. If the products are accepted (namely the products meet the quality and quantity requirements), then the acceptance report is drafted, based on which the products are recorded in the stock inventory.

3. The payment of the invoice received from the supplier is usually made via bank transfer. After this operation, the bank releases a justifying document confirming the payment and then the document is verified.

4. In case of discovering qualitative differences during the acceptance formalities, then the products are returned to the supplier, based on a return invoice. First of all, the return invoice is drafted, then it is verified and in the end, it is sent to the supplier together with the invoiced products.



**Figure no. 11 - Model the processes of purchasing, receiving and paying products without using the proposed patterns**



**Figure no. 12 - Model the processes of purchasing, receiving and paying products using the proposed patterns**

In BPD described under Figure no. 12, it can be seen a simplification and a refining of the BPD described in Figure no. 11, due to the use of BPMN patterns proposed in this article – namely “Receive Document”, “Send Document” and “Pay Document”. Besides these patterns, one can also use general workflow patterns, such as: *A parallel fork-join pattern* (OMG, 2011) or *Sequence Pattern* (OMG, 2011).

### Conclusions

The use of patterns specific to certain fields or sub-fields of activity results in obtaining simplified business models in terms of graphic structure and semantics, but with a high abstracting level.

The patterns proposed in this article enable the drafting of BPMN diagrams for the accounting field and confers upon them a high degree of generalization and reuse. As the description of a business process means a combination between the general workflow patterns and the BPMN patterns proposed, it is conferred a description of business process diagrams at a high abstracting level.

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