1. Introduction

The **Business Process Management Initiative** (BPMI) has developed a standard **Business Process Modeling Notation** (BPMN). The primary goal of BPMN is to provide a notation that is readily understandable by all business users, from the business analysts that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes. Thus, BPMN creates a standardized bridge for the gap between the business process ~~analysis~~design and process implementation.

Another goal, but no less important, is to ensure that XML languages designed for the execution of business processes, such as **BPEL4WS** (Business Process Execution Language for Web Services) and **BPML** (Business Process Modeling Language), can be visualized with a common notation. We will consider that each of these execution languages is equally relevant to BPMN. In the interest of consistency, however, they will be listed in alphabetical order when both are being discussed.

This specification defines the notation and semantics of a **Business Process Diagram** (BPD) and represents the amalgamation of best practices within the business modeling community. BPMN is the standardization of many different modeling notations and viewpoints and provides a simple means of communicating process information to other business users, process implementers, customers, and suppliers.

The BPMN specification defines a mapping from BPMN to BPEL4WS and BPML, and is comprised of the following topics:

~~*BPMN Overview*~~*BPMN Overview* provides an introduction to BPMN, its requirements, and discusses the range of modeling purposes that BPMN can convey.

Business Process Diagram Concepts provides a summary of the BPMN graphical elements and their relationships.

Business Process Diagram Graphical Objects details the graphical representation and the semantics of the behavior of BPMN diagram elements.

Connecting Objects defines the graphical objects used to connect two objects together (i.e., the connecting lines of the diagram) and how flow progresses through a Process (i.e., through a straight sequence or through the creation of parallel or alternative paths).

BPMN by Example provides a walkthrough of a sample Process using BPMN.

Mapping to Execution Languages provides the formal mechanism for converting a BPMN diagram to a BPEL4WS or BPML document.

References provides a list of normative and non-normative references.

Open Issues provides a list of issues that will affect the future of the BPMN specification.

Appendix A: E-Mail Voting Process BPEL4WS provides a full sample of BPEL4WS code based on the example business process described in the "BPMN by Example" section.

Appendix B: E-Mail Voting Process BPML provides a full sample of BPML code based on the example business process described in the "BPMN by Example" section.

Appendix C: Glossary presents an alphabetical index of terms that are relevant to practitioners of BPMN.

1.1 Conventions

The section introduces the conventions used in this document. This includes (text) notational conventions and notations for schema components. Also included are designated namespace definitions.

1.1.1   Typographical and Linguistic Conventions and Style

This specification incorporates the following conventions:

- The keywords "MUST," "MUST NOT," "REQUIRED," "SHALL," "SHALL NOT," "SHOULD," "SHOULD NOT," "RECOMMENDED," "MAY," and "OPTIONAL" in this document are to be interpreted as described in RFC-2119.

- A **term** is a word or phrase that has a special meaning. When a term is defined, the term name is highlighted in **bold** typeface.

- A reference to another definition, section, or specification is highlighted with <u>underlined</u> typeface and provides a link to the relevant location in this specification.

- A reference to an element, attribute, or BPMN construct is highlighted with a capitalized word (e.g., Sub-Process).

- A reference to a BPEL4WS or BPML element, attribute, or construct is highlighted with an italic lower-case word, usually preceded by the word "BPEL4WS" (e.g., BPEL4WS *pick*) or "BPML" (e.g., BPML *choice*).

- Non-normative examples are set of in boxes and accompanied by a brief explanation.

- XML and pseudo text is highlighted with `mono-spaced` typeface.

- The cardinality of any content part is specified using the following operators:
  - (none) — exactly once
  - ? — 0 or 1
  - * — 0 or more
  - + — 1 or more
  - Properties separated by | and grouped within (and) — alternative values
  - : <value> — default value

1.2 Dependency on Other Specifications

The BPMN specification supports for the following specifications is a normative part of the BPMN specification: BPEL4WS and BPML.

The following abbreviations may be used throughout this document:

This abbreviation Refers to

BPEL4WS   Business Process Execution Language for Web Services (see BPEL4WS). This abbreviation refers specifically to version 1.~~0~~ 1 of the specification, but is intended to support future versions of the BPEL4WS specification.

BPML   Business Process Modeling Language (see BPML). This abbreviation refers specifically to version 1.0 of the specification, but is intended to support future versions of the BPML specification.

WSCI   Web Services Choreography Interface (see WSCI). This abbreviation refers specifically to version 1.0 of the specification, but is intended to support future versions of the WSCI specification.

WSDL   Web Service Description Language (see WSDL). This abbreviation refers specifically to the W3C Technical Note, 15 March 2001, but is intended to support future versions of the WSDL specification.

XPath   XML Path Language (see XPath). This abbreviation refers specifically to the W3C Recommendation, 16 November 1999, but is intended to support future versions of the XPath specification.

XQuery   XML Query Language (see XQuery). This abbreviation refers specifically to the W3C Working Draft, 20 December 2001, but is intended to support future versions of the XQuery specification.

XSDL   XML Schema structures and data types (see XML-Schema). This abbreviation refers specifically to the W3C Recommendation, 2 May 2001, but is intended to support future versions of the XML Schema specification.

1.3 Conformance

A ~~**BPMN processor**~~ is responsible to process XML documents that conform to the BPMN schema and the rules set forth in this specification, and any related specification that must be supported in order to fully conform to the requirements of the BPMN specification.

A **BPMN implementation** is responsible to perform one or more duties based on the semantics conveyed by BPMN definitions. A BPMN implementation must understand the semantics of BPMN definitions as set forth in this specification.

A **conformant implementation** is any BPMN implementation that can process BPMN documents and perform one or more duties based on the semantics conveyed in BPMN definitions, as set forth in this specification.

At the minimum, a fully conformant implementation of version 1.0 of the BPMN specification must support for the following features. There is no need to specify these features in a BPMN document.

Specification Feature

BPMN 1.0~~.9~~   http://www.bpmi.org/~~2002~~2003/~~11~~06/bpmn

A conformant implementation is not required to process any extension elements or attributes, or any BPMN document that contains them. ~~Extension elements and attributes are specified in a namespace that is other than the BPMN namespace and may only appear where allowed~~.

2. BPMN Overview

There has been much activity in the past two or three years in developing web service-based XML execution languages for BPM systems. Languages such as BPEL4WS and BPML provide a formal mechanism for BPM Systems to define and execute business processes and to interoperate with each other. The key element of these languages is that they are optimized for the operation and interoperation of BPM Systems. The optimization of these languages for software operations renders them less suited for direct use by humans to design and manage business processes. BPML is a block-structured language and BPEL4WS is a combination block- and graph-structured language. In addition, these languages define the behavior of a business process in a very compact and efficient manner. Given the nature of these languages, a complex business process will be organized in a potentially complex, disjointed, and unintuitive format that is handled very well by a software system (or a computer programmer), but would be hard to understand by the business analysts and managers tasked to develop and manage the ~~business~~ process. Thus, there is a human level of ~~interoperability~~ "interoperability" that is not addressed by these web service-based XML execution languages.

~~Humans~~ People tend to visualize business processes in a flow-chart format. There are thousands of business analysts studying the way companies work and defining business processes with simple flow charts. There is a technical gap between the format of the initial design of business processes and the format of the languages that will execute these business processes. This gap needs to be bridged with a formal mechanism that maps the appropriate visualization of the business processes (a notation) to the appropriate execution format (a BPM execution language) for these business processes.

Interoperation of business processes at the human level, rather than the software engine level, can be solved with standardization of the Business Process Modeling Notation (BPMN). BPMN provides a Business Process Diagram (BPD), which is a diagram designed for use by the people who design and manage business processes. BPMN also provides a formal mapping to execution languages of BPM Systems, such as BPEL4WS and BPML. Thus, BPMN would provide a standard visualization mechanism for business processes defined in an execution optimized business process language.

BPMN will provide businesses with the capability of understanding their internal business procedures in a graphical notation and will give organizations the ability to communicate these procedures in a standard manner. Furthermore, the graphical notation will facilitate the understanding of the performance collaborations and business transactions between the organizations. This will ensure that businesses will understand themselves and participants in their business and will enable organizations to adjust to new internal and B2B business circumstances quickly. To do this, BPMN will follow the tradition of flowcharting notations for readability; yet still provide the mapping to the executable constructs. BPMI is using the experience of the business process notations that have preceded BPMN to create the next generation notation that combines readability, flexibility, and expandability.

BPMN will also advance the capabilities of traditional business process notations by inherently handling B2B business process concepts, such as public and private processes and choreographies, as well as advanced modeling concepts, such as exception handling and transaction compensation.

2.1 BPMN Scope

BPMN will be constrained to support only the concepts of modeling that are applicable to business processes. This means that other types of modeling done by organizations for business purposes will be out of scope for BPMN. For example, the modeling of the following will not be a part of BPMN:

- Organizational structures

- Functional breakdowns

- Data models

In addition, while BPMN will show the flow of ~~data~~data (messages), it is not a data flow diagram.

2.1.1   Uses of BPMN

Business process modeling is used to communicate a wide variety of information to a wide variety of audiences. BPMN is designed to cover this wide range of usage and allows modeling of end-to-end business processes to allow the viewer of the diagram to be able to easily differentiate between the sub-model sections of a BPMN diagram.

There are three basic types of sub-models within an end-to-end BPMN model:

- Private (internal) business processes

- Interface (public/abstract) processes

- Collaboration Processes

Some BPMN specification terms regarding the use of swimlanes (e.g., Pools and Lanes) are used in the descriptions below. ~~Refer to the section entitled "Pools and Lanes" on page 64~~Refer to the section entitled "Pools and Lanes" on page 73 for more details on how these elements are used in a BPD.

Private Business Processes

Private business processes are those internal to a specific organization and are the types of processes that have been generally called workflow or BPM processes. A single private business process will map to a single BPEL4WS or BPML document.

If swimlanes are used then a private business process will be contained within a single Pool. The Sequence Flow of the Process is therefore contained within the Pool and cannot cross the boundaries of the Pool. Message Flow can cross the Pool boundary to show the interactions that exist between separate private business processes. Thus, a single BPMN diagram may show multiple private business processes, each mapping to a separate BPEL4WS or BPML document.

Interface Processes

This is also called an abstract process and this represents the interactions between a private business process and another process or participant. Only those activities that are used to communicate outside the private business process are included in the interface process. All other "internal" activities of the private business process are not shown in the interface process. Thus, the interface process shows to the outside world the sequence of

messages that are required to interact with that business process. A single interface process may be mapped to a single WSCI document (however, this mapping will not be done in this specification).

Interface processes are contained within a Pool and can be modeled separately or within a larger BPMN diagram to show the Message Flow between the interface process activities and other entities. If the interface process is in the same diagram as its corresponding private business process, then the activities that are common to both processes can be linked together.

> **Note**: The mechanisms for defining how the activities can be linked has not been defined and is an open issue. Refer to the section entitled "Open Issues" on page 137 for a complete list of the issues open for BPMN.

Collaboration Processes

A collaboration process depicts the interactions between two or more business entities. These interactions are defined as a sequence of activities that represent the messages being sent between the entities involved. A single collaboration process may be mapped to an ebXML various collaboration languages, such as ebXML BPSS, RosettaNet, or WSCI global model process the resultant specification from the W3C Choreography Working Group (however, these mappings are outside the scope of this specification considered as future directions for BPMN).

Collaboration processes are may be contained within a Pool and the different participant business roles are shown as Lanes within the Pool. They may also be shown as two or more Interface Processes interacting through Message Flow. These processes can be modeled separately or within a larger BPMN diagram to show the Message Flow Associations between the collaboration process activities and other entities. If the collaboration process is in the same diagram as one of its corresponding private business process, then the activities that are common to both processes can be linked together.

> **Note**: The mechanisms for defining how the activities can be linked has not been defined and is an open issue. Refer to the section entitled "Open Issues" on page 137 for a complete list of the issues open for BPMN.

Types of BPD Diagrams

Within and between these three BPMN sub-models, many types of diagrams can be created. The following are the types of business processes that can be modeled with BPMN (those with asterisks will may not map to an executable language):

- High-level private process activities (not functional breakdown)*
- Detailed private business process
  - As-is or old business process*
  - To-be or new business process

- Detailed private business process with interactions to one or more external entities (or "Black Box" processes)

- Two or more detailed private business processes interacting

- Detailed private business process relationship to Interface Process

- Detailed private business process relationship to Collaboration Process

- Two or more Interface Processes ~~— not executable~~*

- Interface Process relationship to Collaboration Process*

- Collaboration Process only (e.g., ebXML BPSS or RosettaNet)*

- Two or more detailed private business processes interacting through their Interface Processes

- Two or more detailed private business processes interacting through a Collaboration Process

- Two or more detailed private business processes interacting through their Interface Processes and a Collaboration Process

BPMN is designed to allow all the above types of diagrams. However, it should be cautioned that if too many types of sub-models are combined, such as three or more private processes with message flow between each of them, then the diagram may become too hard for someone to understand. Thus, we recommend that the modeler pick a focused purpose for the BPD, such as a private process, or a collaboration process.

BPMN mappings

Since BPMN covers such a wide range of usage, it will map to more than one lower-level specification language:

- BPEL4WS and BPML are the primary languages that BPMN will map to, but they only cover a single executable private business process. If a BPMN diagram depicts more than one internal business process, then there will a separate mapping for each on the internal business processes.

- The interface sections of a BPMN diagram will be mapped to Web service interfaces specifications, such as the abstract processes of BPEL4WS and WSCI.

- ~~The Collaboration model sections of a BPMN will be mapped Collaboration models such as ebXML BPSS and RosettaNet.~~

- The Collaboration model sections of a BPMN will be mapped Collaboration models such as ebXML BPSS, RosettaNet, and the W3C Choreography Working Group Specification (when it is completed).

This specification will only cover the mappings to BPEL4WS and BPML. Mappings to other specifications will have to be a separate effort, or perhaps a future direction of BPMN (beyond Version 1.0 of the BPMN specification). It is hard to predict which mappings will be applied to BPMN at this point, since process language specifications is a volatile area of work, with many new offerings and mergings.

A BPD is not designed to graphically convey all the information required to execute a business process. Thus, the graphic elements of BPMN will be supported by properties that will supply the additional information required to enable a mapping to BPEL4WS and BPML.

2.1.2   Diagram Point of View

Since a BPMN diagram may depict the Processes of different Participants, each Participant may view the diagram differently. That is, the Participants have different points of view regarding how the Processes will behave. Some of the activities will be internal to the Participant (meaning performed by or under control of the Participant) and other activities will be external to the Participant. Each Participant will have a different perspective as to which are internal and external. At runtime, the difference between internal and external activities is important in how a Participant can view the status of the activities or trouble-shoot any problems. However, the diagram itself remains the same.

Although the diagram point of view is important for a viewer of the diagram to understand how the behavior of the Process will relate to that viewer, BPMN will not currently specify any graphical mechanisms to highlight the point of view. It is open to the modeler or modeling tool vendor to provide any visual cues to emphasize this characteristic of a diagram.

2.1.3   Extensibility of BPMN and Vertical Domains

BPMN is intended to be extensible by modelers and modeling tools. This extensibility allows modelers to add non-standard elements or artifacts to satisfy a specific need, such as the unique requirements of a vertical domain. While extensible, BPMN diagrams should still have the basic look-and-feel so that a diagram by any modeler should be easily understood by any viewer of the diagram. Thus the footprint of the basic flow elements (Events, activities, and Gateways) should not be altered. Nor should any now flow elements be added to a BPD, since there is no specification as to how Sequence and Message Flow will connect to any new flow object. In addition, mappings to execution languages may be affected if new flow elements are added. To satisfy additional modeling concepts that are not part of the basic set of flow elements, BPMN provides the concept of Artifacts that can be linked to the existing flow objects through Associations. Thus, Artifacts do not affect the basic Sequence or Message Flow, nor do they affect mappings to other languages.

The graphical elements of BPMN are designed to be open to allow specialized markers to convey specialized information. For example, the three types of Events all have open centers for the markers that BPMN standardizes as well as user-defined markers.