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https://www.omg.org/spec/BKPMN/20211101/BKPMN-Semantic.xsd

https://www.omg.org/spec/BKPMN/20211101/BKPMNDI.xsd

https://www.omg.org/spec/BKPMN/20211101/BKPMN-Libary.xml

This OMG document replaces the submission document (bmi/21-12-15). It is an OMG Adopted Beta Specification and is currently in the finalization phase. Comments on the content of this document are welcome and should be directed to issues@omg.org by June 24, 2022.

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Preface

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1 Scope

The focus of this specification is to specify the content and structure of a BPM-Plus (BPM+) Knowledge Package. A BPM+ Knowledge Package is considered a “box” or “wrapper” model that contains models developed through the other BPM+ standards (**BPMN**, **CMMN**, and **DMN**), and other artifacts.

Based on recent experience with the use of the current set of BPM+ standards the need of a packaging mechanism for groups of related BPM+ models was identified (see the use case described in Clause 16.1 for a use case example. For example, using BPM+ models to define a large topic, such as the behaviors of a healthcare clinical guideline (e.g., a hypertension) may result in dozens of individual Process, Case, and Decision models. But there is currently a lack of a mechanism to package the related models with relevant metadata to aid in understanding the content and to aid in the discovery of appropriate BPM+ Knowledge Packages.

A key expectation is that BPM+ Knowledge Packages will be readily distributed to interested parties (i.e., spreading the knowledge). However, unlike a physical package that contains unique physical elements and can be shipped to different locations, a BPM+ Knowledge Package references BPM+ models and other artifacts. These models and artifacts can be re-used by multiple BPM+ Knowledge Packages and, technically, don’t exist “inside” the package. Thus, the “shipping” of a BPM+ Knowledge Package consists of the distribution of a set of model files (either XMI or XML). The file for the BPM+ Knowledge Package will include a manifest that identifies the files that contain the BPM+ models or other artifacts. All the files identified in the manifest will be distributed along with the BPM+ Knowledge Package file. **BKPMN** is currently focused on the BMI behavioral standards, but supports the inclusion of additional models and documents.

A BPM+ Knowledge Package will also contain metadata that describes the purpose and contents of the Knowledge Package and to help organizations discover the Knowledge Package that is appropriate for their circumstances.

2 Conformance

Software can claim compliance or conformance with **BKPMN 1.0** if and only if the software fully matches the applicable compliance points as stated in the specification. In addition, the structural elements provided by Specification Common Elements (**SCE 1.0**) are also required in a compliant or conformant software solution. Software developed only partially matching the applicable compliance points can claim only that the software was based on this specification but cannot claim compliance or conformance with this specification.

2.1 BPM+ Knowledge Package Modeling Conformance

The implementation claiming conformance to the BPM+ Knowledge Package Modeling Conformance SHALL comply with all of the requirements set forth in Clauses 9 through 13, and it should be conformant with the Visual Notation Conformance in Clause 16 Conformant implementations SHALL fully support and interpret the exchange format specified in Clause 15.

This compliance point is intended to be used by **BKPMN** modeling tools.

2.2 Visual Conformance

An implementation that creates and displays **BKPMN** models SHALL conform to the specifications and restrictions with respect to diagrammatic relationships between graphical elements, as described in Clause **Error! Reference source not found.**. A key element of **BKPMN** is the choice of shapes and icons used for the graphical elements identified in this specification. The intent is to create a standard visual language that all BPM+ Knowledge Package Data modelers will recognize and understand. An implementation that creates and displays **BKPMN** models SHALL use the graphical elements, shapes, markers and decorators illustrated in this specification.

There is flexibility in the size, color, line style, and text positions of the defined graphical elements, except where

otherwise specified. In particular:

- **BKPMN** elements MAY have labels (e.g., its name and/or other attributes) placed inside the shape, or above or below the shape, in any direction or location, depending on the preference of the modeler or modeling tool vendor.
- The fills that are used for the graphical elements MAY be white or clear. The notation MAY be extended to use other fill colors to suit the purpose of the modeler or tool (e.g., to highlight the value of an object attribute).
- Graphical elements, shapes, and decorators MAY be of any size that suits the purposes of the modeler or modeling tool with the condition that the additional graphical elements SHALL NOT conflict with any current BPM+ Standard defined graphical element.
- The lines that are used to draw the graphical elements MAY be black.
    - The notation MAY be extended to use other line colors to suit the purpose of the modeler or tool (e.g., to highlight the value of an object attribute).
    - The notation MAY be extended to use other line styles to suit the purpose of the modeler or tool (e.g., to highlight the value of an object attribute) with the condition that the line style SHALL NOT conflict with any current BPM+ Standard defined line style.

The following extensions to a **BKPMN** model are permitted:

- New decorators or indicators MAY be added to the specified graphical elements. These decorators or indicators could be used to highlight a specific attribute of a **BKPMN** element or to represent a new subtype of the corresponding concept with the condition that the additional graphical elements SHALL NOT conflict with any current BPM+ Standard defined decorator or indicator.
- A new shape representing a kind of knowledge element MAY be added to a model with the condition that the shape SHALL NOT conflict with the shape specified for any other BPM+ Standard element or decorator.
- Graphical elements MAY be colored, and the coloring MAY have specified semantics that extend the information conveyed by the element as specified in this standard.
- The line style of a graphical element MAY be changed, but that change SHALL NOT conflict with any other line style REQUIRED by this specification or the other BPM+ Standards.
- An extension SHALL NOT change the specified shape of a defined graphical element or decorator. (e.g., changing a square into a triangle, or changing rounded corners into squared corners, etc.).

This compliance point is intended to be used by entry-level **BKPMN** tools.

3 References

3.1 Normative References

The following normative documents contain provisions which, through reference in this text, constitute provisions of this specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply.

- Key words for use in RFCs to Indicate Requirement Levels, S. Bradner, IETF RFC 2119, March 1997 http://www.ietf.org/rfc/rfc2119.txt
- [BPMN] OMG Business Process and Model Notation (BPMN™): https://www.omg.org/bpmn/
- [CMMN] OMG Case Management Model and Model Notation (CMMN™): https://www.omg.org/spec/CMMN/
- [DD] Diagram Definition (DD™)
- [DMN] OMG Decision Model and Model Notation (DMN™): https://www.omg.org/spec/DMN/
- [MDMI] OMG Model Driven Message Interoperability (MDMI), Version 1.0: https://www.omg.org/spec/MDMI/

- [SCE] Specification Core Elements (SCE): https://www.omg.org/spec/SDMN/
- [UML] Unified Modeling Language ™ (UML®): http://www.omg.org/spec/UML
- [XMI] XML Metadata Interchange (XMI®) http://www.omg.org/spec/XMI

3.2 Non-normative References

The following normative documents contain provisions which, through reference in this text, constitute exemplars or influencers of this specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply.

- [SysML] OMG Systems Modeling Language (SysML®): http://www.omg.org/spec/SysML/

4 Terms and Definitions

The table below presents a glossary for this specification:

Table 1. Glossary

Termm	Definition
Applicability	Applicability describes the conditions for which the Knowledge Package is intended. A **DMN** Decision Service can be defined to express the formal logic of the applicability conditions.
Association	A type of Artifact that is a connecting object that is used to indicate there is some relationship between two **BKPMN** graphical elements. There are no semantics defined by the connector.
BPM+ Knowledge Model	A diagram that provides a visual representation of the breadth and scope of a Knowledge Package in terms of the BPM+ models it contains.
BPM+ Knowledge Package	A Knowledge Package is mechanism for packaging and distributing a set of BPM+ models (i.e., the knowledge).
Case	A **CMMN** element that involves actions taken regarding a subject in a particular situation to achieve a desired outcome.
Choreography	A **BPMN** Element that is an ordered sequence of B2B message exchanges between two or more Participants. In a Choreography there is no central controller, responsible entity, or observer of the Process. The ChoreographyRef element provides a link to a Choreography in a **BPMN** document.
Collaboration	A **BPMN** Element that is a collection of Participants shown as Pools, their interactions as shown by Message Flows, and MAY include Processes within the Pools and/or Choreographies between the Pools.The CollaborationRef element provides a link to a Collaboration in a **BPMN** document.
Contributor	A Contributor is a person that assisted in the development of the Knowledge Package. There are different types of Contributors, such as editors, reviewers, etc.
DataItem	An **SDMN** element that represents a common definition and structure for the data handling elements of the other BPM+ models.
Decision	A **DMN** element that is the act of determining an output value (the chosen option), from a number of input values, using logic defining how the output is determined from the inputs.
Decision Service	A **DMN** element that defines reusable logic within a decision model. A decision service exposes one or more decisions from a decision model, a reusable element, a service, which might be consumed (for example)

	internally by another decision in the decision model, or externally by a task in a **BPMN** process model. When the service is called with the necessary input data and decision results, it returns the outputs of the exposed decisions.
DecisionServiceRef	A **BKPMN** element that provides a link to a Decision Service in a **DMN** document. The DecisionServiceRef is a graphical object in a “”BPM+ Knowledge Model.
Development Method	A "mini" KnowledgePackage that is specifically designed for the people, activities, data, and decisions that are required as part of the development of a KnowledgePackage.
Effect	An expected response to the application of a KnowledgePackage element. In Medicine, for example, a reduction in blood pressure would be an expected response to the application of a medication.
Event History	The Event History lists the significant events that have occurred during the development of the Knowledge Package.
Expression	A **BKPMN** element that uses natural-language text to extract information from the different elements, normally data elements. These Expressions are not executable and are considered underspecified. Expressions are contained (aggregated) within the **BKPMN** elements that use them.
Input	An Input represents a key Data Item that is necessary to be present at the start of a performance of a Knowledge Package.
Manifest	The Manifest is a list of files that contain the components of the Knowledge Package. This will usually include multiple BPM+ documents (e.g., bpmn files). Other files, such as narratives, will also be in the Manifest.
Model Artifact	A graphical object that provides supporting information about the BPM+ Knowledge Model. However, it does not have any behavioral semantics.
Order Set	An order set is a group of related orders which a physician can place with a few keystrokes or mouse clicks. An order set allows users to issue prepack“ged ”roups of orders that apply to a specified diagnosis or a particular period of time (Clinfowiki)
Order Set Handler	A "mini" KnowledgePackage that is specifically designed for the activities, data, and decisions that are required when a Order Set is used in another Knowledge Package.
ParticipantRef	A Participant is distinguished from a Performer. Performers are those resources, often Human, that are responsible for performing activities within a Process or a Case.
Process	A **BPMN** element that d“scri”es a sequence or flow of Activities in an organization with the objective of carrying out work. The ProcessRef element provides a link to a Process in a **BPMN** document.
Questionnaire Handler	A "mini" KnowledgePackage that is specifically designed for the activities, data, and decisions that are required when a Order Set is used in another KnowledgePackage.
QuestionnaireHandlerRef	A **BKPMN** element that provides a link to a QuestionnaireHandler in a **BKPMN** document, which is a specialized type of Knowledge Package. The QuestionnaireHandlerRef is a graphical object in a BPM+ Knowledge Model.
Risk Factor	Indicates the impact and probability of loss.
Semantic Reference	The SemanticReference element allows model elements to be linked to External Sources of Truth, such as ontologies or data models.
Side Effect	A potential Effect created by an element of the Knowledge Package. A Side Effect is an Effect that is not intended and is often adverse.
Text Annotation	A type of Model Artifact that are a mechanism for a modeler to provide additional information for the reader of a **BKPMN** model. The TextAnnotation object can be connected to a specific object on the Model with an Association.

Undefined Behavior	A **BKPMN** element that is used as a placeholder for one of the other behavioral elements. It is mainly used early in the development of a Knowledge Package. A specific behavior is known to be part of the package, but it is not clear at that point whether the behavior is a Process or a Case. This allows the inclusion of the behavior in the overall context before the modeler is ready to set its type.

5 Symbols

There are no symbols defined in this specification.

6 Additional Information

6.1 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.

6.2 Typographical and Linguistic Conventions and Style

This document incorporates the following conventions:

This document 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 underlined typeface and provides a link to the relevant location in this specification.
- A reference to a graphical element is highlighted with a bold, capitalized word (e.g., **ProcessRef**).
- A reference to a non-graphical element or **BKPMN** concept is highlighted by being italicized and will be presented with the Times New Roman font (e.g., *Manifest*).
- A reference to an attribute or model association will be presented with the `Courier New` font (e.g., `Expression`).
- Non-normative examples are set off in boxes and accompanied by a brief explanation.
- XML and pseudo code is highlighted with `mono-spaced` typeface. Different font colors MAY be used to highlight the different components of the XML code.
- The cardinality of any content part is specified using the following operators:
  - [ ] — exactly once
  - [0..1] — 0 or 1
  - [0..*] — 0 or more
  - [1..*] — 1 or more
- Attributes separated by | and grouped within { and } — alternative values
  - <value> — default value
  - <type> — the type of the attribute

6.3 Display of Metamodel Diagrams

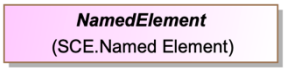
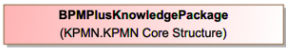
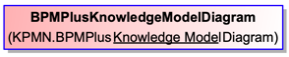
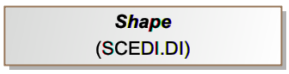
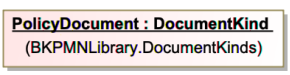
The metamodel presented in these sections utilizes the patterns and mechanisms that are used for the current BPM+ specifications. OMG specifications rarely display the entire metamodel of a technical specification in a single diagram. The entire metamodel would be very large, complicated, and hard to follow. Typically, a specification will present sub-sets of the overall metamodel as they apply to specific topics. For example, in the Business Process Model and Notation 2.0 (**BPMN**) specification there are metamodel diagrams that show the elements relating to activities or data elements. This document will follow that pattern and present sub-sets of a larger metamodel.

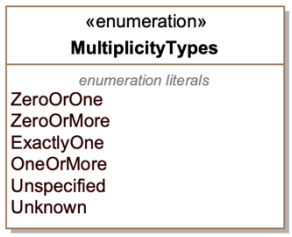
The metamodel diagrams are Unified Modeling Language (UML) structure diagrams. In addition to the metamodel, OMG specifications provide XML schemas which map to the metamodels. In general, it is through XML documents that BPM+ models are stored and exchanged.

Further, some of the metamodel elements are references to elements from other specifications. To clarify the owner of the metamodel element, there is a parenthesized text that identifies the model owner of that element. In addition, colors are used to support the text identification of the owner-language of that element. The colors are used as an aid to distinguish the languages but does not represent a normative aspect of the metamodels nor do they add any semantic information about the metamodels.

The table below presents examples of elements used throughout the metamodel diagrams within this specification:

Table 1: BKPMN Metamodel Color-Coding

Element	Description	Example Color
SCE Structural Class	Metamodel elements from the **SCE 1.0** specification are shown in **BKPMN** metamodel diagrams when **BKPMN** elements are dependent on an **SCE** element [OMG doc number bmi-2021-12-09]. These elements include the ower of the language (**SCE**) in parenthases below the element name and these elements are color-coded lavender (see figure to the right).	
BKPMN General Class	These elements include the owner of the language (**BKPMN**) in parenthases below the element name and these elements are color-coded pink and the border line color is light pink (see figure to the right). These make up the majority of metamodel elements shown in this specification.	
BKPMN General Class (focus of diagram)	These elements have the same naming and color, but the border line color is dark blue instead of light brown (see figure to the right). They are highlighted as the focus of the particular metamodel diagram. This is an informative depiction that does not add any semantic information about the particular metamodel diagram.	
External Class	Classes from specifications that are not specifically part of the BPM+ stack of standards can be included in metamodel diagrams and display the owner of the language in parenthases below the element name and these elements are color-coded light-gray. (see figure to the right).	
BKPMN Class Instance	These elements include the owner of the language (BKPMN) in parenthases below the element name and these elements are color-coded light-pink to identify **BKPMN** class instances from the **BKPMN** Library (see figure to the right).	

SCE Class Instance	These elements include the owner of the language (SCE) in parenthases below the element name and these elements are color-coded light-violet to identify **SCE** class instances from the **SCE** Library (see figure to the right).	
Enumerations	(see figure to the right).	

6.4 Use of Text, Color, Size, and Lines in a Diagram

Text Annotation objects can be used by the modeler to display additional information about a *BKPMNDiagram* or attributes of the objects within the diagram.

- Diagram elements MAY have labels (e.g., its name and/or other attributes) placed inside the shape, or above or below the shape, in any direction or location, depending on the preference of the modeler or modeling tool vendor.
- The fills that are used for the graphical elements MAY be white or clear.
  - The notation MAY be extended to use other fill colors to suit the purpose of the modeler or tool (e.g., to highlight the value of an object attribute).
- Diagram elements and markers MAY be of any size that suits the purposes of the modeler or modeling tool.
- The lines that are used to draw the graphical elements MAY be black.
  - The notation MAY be extended to use other line colors to suit the purpose of the modeler or tool (e.g., to highlight the value of an object attribute).
  - The notation MAY be extended to use other line styles to suit the purpose of the modeler or tool (e.g., to highlight the value of an object attribute) with the condition that the line style SHALL NOT conflict with any current defined line style of the diagram.

6.5 Abbreviations

The table below presents a list of acronyms, and their defintion, that are used in this specification:

Table 2. Acronyms

Acronym	Definition
BHMN	BPM+ Harmonization Model and Notation
BKPMN	BPM+ Knowledge Package Model and Notation
BKPMNDI	BPM+ Knowledge Package Model and Notation Diagram Interchange
BPMN	Business Process Model and Notation
BPM+	Business Process Management Plus
CMMN	Case Management Model and Notation
DC	Diagram Commons
DD	Diagram Definition
DI	Diagram Interchange

DMN	Decision Model and Notation
MDMI	Model Driven Message Interoperability
MOF	Meta Object Facility
PPML	Predictive Model Markup Language
OMG	Object Management Group
PPMN	Provenance and Pedigree Model and Notation
RFC	Remote Function Call
SCE	Specification Common Elements
SDMN	Shared Data Model and Notation
SysML	Systems Modeling Language
URI	Uniform Resource Identifier
XML	Extensible Markup Language
XMI	XML Metadata Interchange

6.6 Structure of this Document

This document provides a brief introduction to **BKPMN** and its purpose (see the section entitled "**Error! Reference source not found.**"). The introduction is followed by normative clausea that define the elements of the specification and their properties and associations (see the sections entitled "BKPMN Metamodel" (Clause 9); "Knowledge Elements" (Clause 10); "Package Elements" (Clause 11); "Manifest Documents" (Clause 12); "BPM+ Knowledge Model" (Clause 13); "BKPMN Library" (Clause 14); "BPM+ Models Harmonization: (Clause 15); and "BKPMN Diagram Interchange" (Clause 18)).

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- Auxilium Technology Group, LLC
- BPM Advantage Consulting, Inc.

Supporting Organizations (RFP Process)

The following organizations support this specification but are not formal submitters:

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- BookZurman, Inc.
- Camunda Services GmbH
- Department of Veterans Affairs
- FICO
- KnowProcess Limited
- Mayo Clinic
- Red Hat
- Thematix Partners, LLC
- Trisotech
- Xzyos, LLC

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7 Overview

The focus of this specification is to define the content and structure of a BPM-Plus (BPM+) Knowledge Package. A BPM+ Knowledge Package is considered a "box" or "wrapper" model that contains models developed through the other BPM+ standards (and other artifacts).

7.1 Motivation

The motivation for defining the current specification for a *BPM+ Knowledge Package* was derived from work being done for the development healthcare clinical guidelines using the current BPM+ standards. The current set of BPM+ standards are: **BPMN**; Case Management Model and Notation (**CMMN**); and Decision Model and Notation (**DMN**). The BPM+ Health organization has published the "Field Guide to Shareable Clinical Pathways". The Field Guide provides the methods and style of modeling with **BPMN**, **CMMN**, and **DMN** for a more formal definition of healthcare clinical guidelines. A Shareable Clinical Pathway is a healthcare domain-specific *BPM+ Knowledge Package* Model.

During the development of the Field Guide and supporting BPM+ Use Cases, it became apparent that there is no concrete model or structure that is available that would allow developers of Shareable Clinical Pathways to create, discover, and distribute a coherent package that is a Shareable Clinical Pathway.

7.2 What is a BPM+ Knowledge Package?

A BPM+ Knowledge Package has five major components: Processes, Cases, Decisions, Data – the four pillars – and a wrapper that combines them within a package. The wrapper is called a *BPM+ Knowledge Package*. Together, these five components will make up the next iteration of the set of BPM+ standards. This document specifies a fourth BPM+ standard named **BKPMN**. The fifth BPM+ standard for the data pillar is the proposed Shared Data Model and Notation (**SDMN**). An optional component for a *BPM+ Knowledge Package* is another specification that is currently in development: Pedigree and Provenance Model and Notation (**PPMN**). In addition to these three new BPM+ standards, there is a sixth standard, Specification Core Elements (**SCE**), that provides a set of common modeling language elements, such as root element and basic packing capabilities. Instead of defining these basic, non-language specific elements within each of the new languages, **BKPMN**, **PPMN**, and **SDMN** are built upon the structures provided by **SCE**.

The figure below shows the relationships between the six standards that are key to a *BPM+ Knowledge Package*.

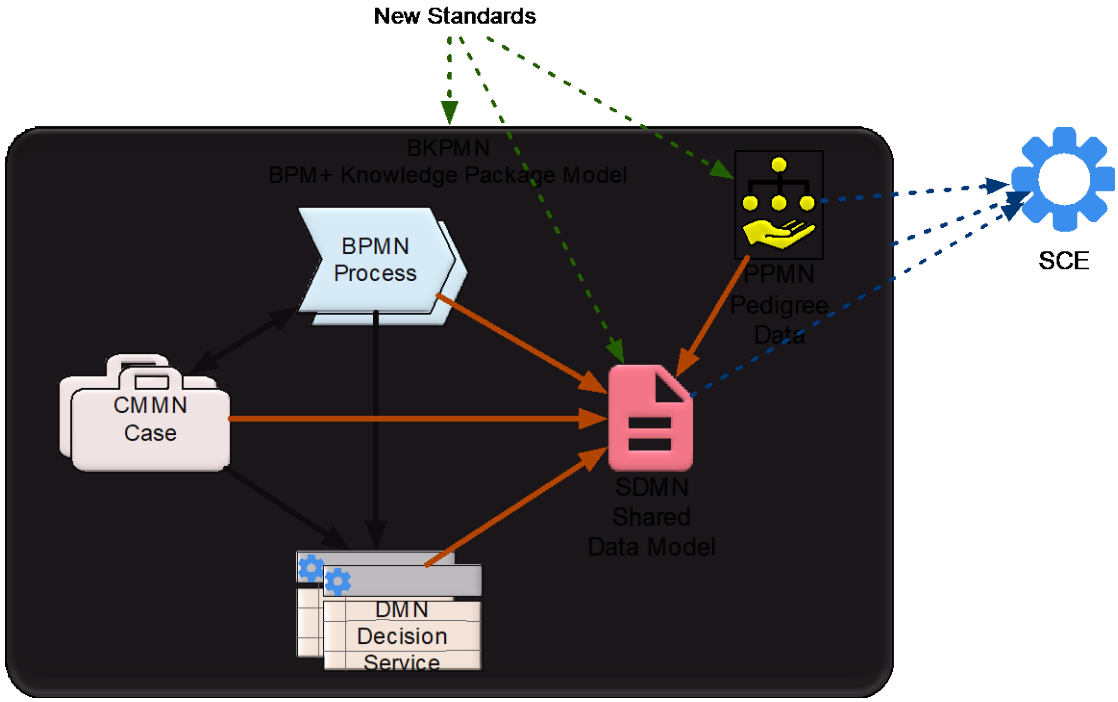


Figure 1: Overview of a BPM+ Knowledge Package

7.3 BPM+ Knowledge Package Model Diagram

The BPM+ Health organization has been defining Shareable Clinical Pathways. In the generic sense, they have been defining a type of *Knowledge Package*. To support the production of consistent *Knowledge Packages* and their distribution, this specification defines a new modeling standard named BPM+ Knowledge Package Model and Notation (**BKPMN**). This standard would follow the structure of other OMG standards and would become a member of the BPM+ list of standards.

Further, a diagram that was similar to Example of a BPKMNDiagram, below, was included for each Shareable Clinical Pathway. At that time, the diagram was called an Architectural Scope diagram.

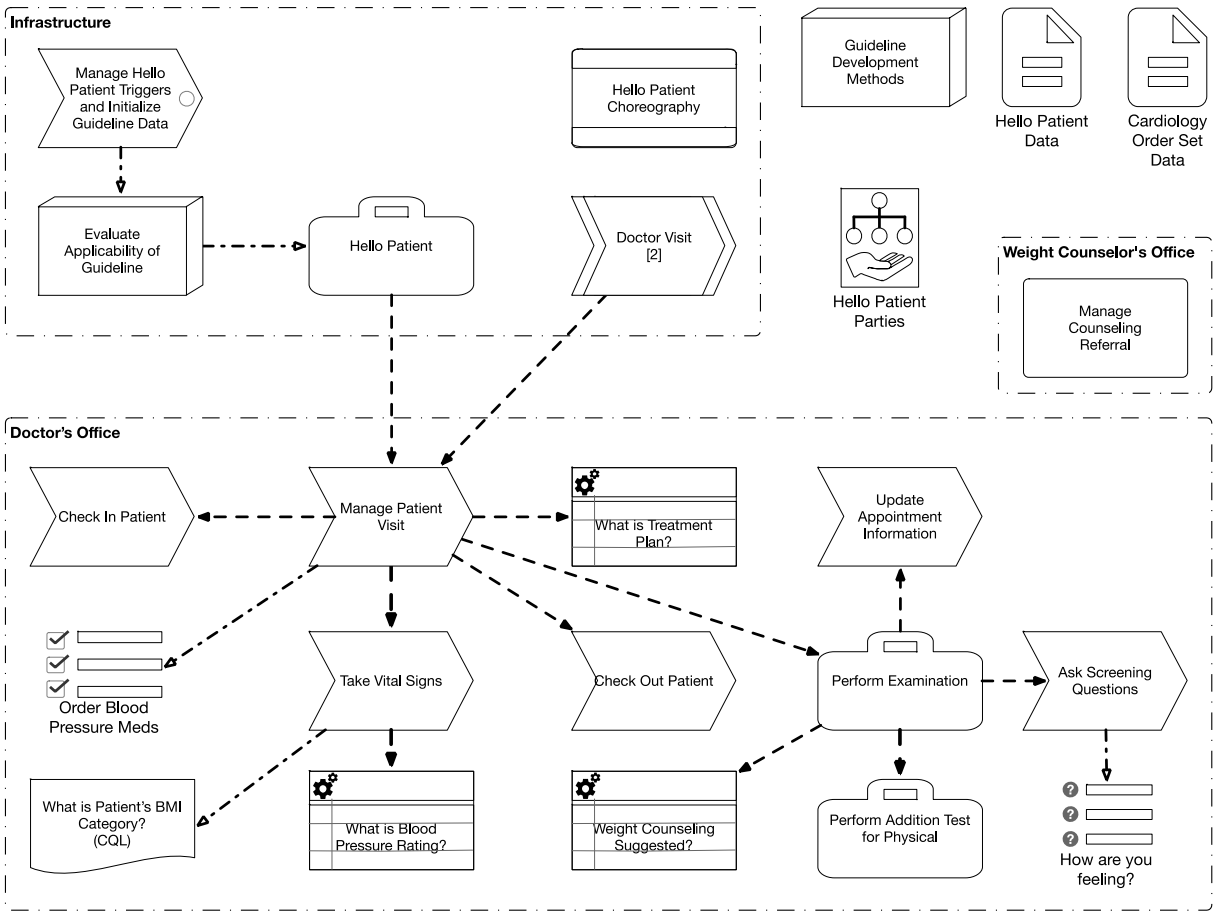


Figure 2: Example of a BPKMNDiagram

In **BKPMN**, this diagram is a representation of a **KnowledgeModel**. The intent of this diagram is to provide a visual depiction of the breadth and scope of a *BPM+ Knowledge Packages* – in terms of the BPM+ models it contains. The diagram is not intended to represent the entire set of contents of the *BPM+ Knowledge Package*, but only those elements that represent the behavioral aspects of the *BPM+ Knowledge Package*, particularly the BPM+ models.

8 Specification Core Elements

The **BKPMN** metamodel elements are built upon (directly reference) the elements of the Specification Core Elements (**SCE**) metamodel. The **SCE** metamodel is defined in a separate specification [OMG doc number bmi-2021-12-09] and contains a set of basic metamodel classes that are common to **BKPMN**, **PPMN**, and **SDMN** – and potentially other OMG specifications.

As can be seen the figure below, **SCE** defines elements that can be used by BPM+ modeling specifications – that is, the elements are not specific to any particular area of concern, such a data, process, decision, etc. For example, the **SCE** *Documentation* element can be used (and is used) in current BPM+ modeling specifications since it is important to allow modelers to provide documentation about a model element.

Because **SCE** defines these elements, **BKPMN** does not have to duplicate them in this specification. **BKPMN** can just create metamodel bindings to the elements in **SCE**. Thus, throughout this specification, **SCE** elements may be seen in metamodel diagrams and **BKPMN** elements will be shown as being specializations of those **SCE** elements. The **SCE** and **BKPMN** metamodel elements will be identified as described in Section 7.3.

The figure below presents a **SCE** high-level metamodel view of many of the **SCE** elements that are used in

BKPMN.

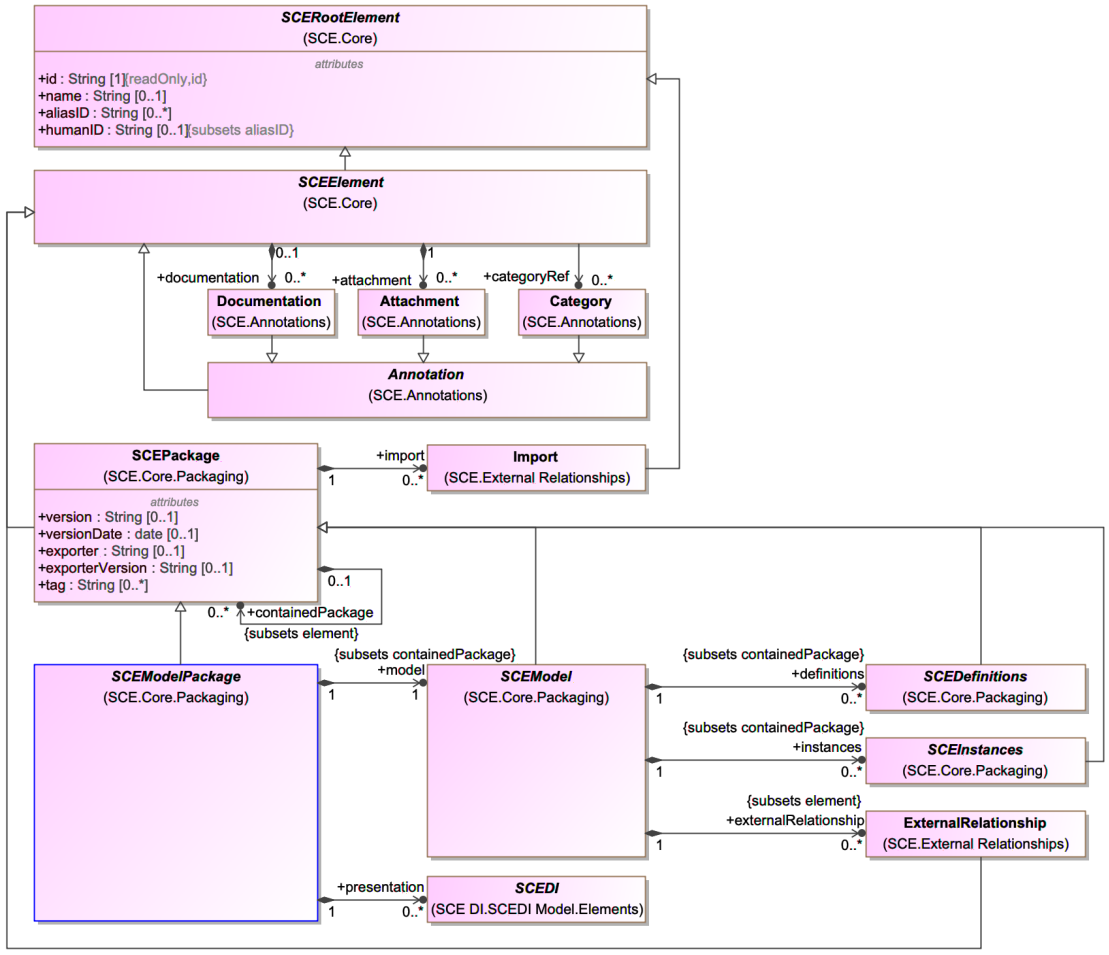


Figure 3: The Specification Core Elements (SCE) High-Level Metamodel

9 BKPMN Metamodel

The figure below displays the organization of the main packages of the BPM+ Knowledge Package Model and Notation (**BKPMN**) metamodel.

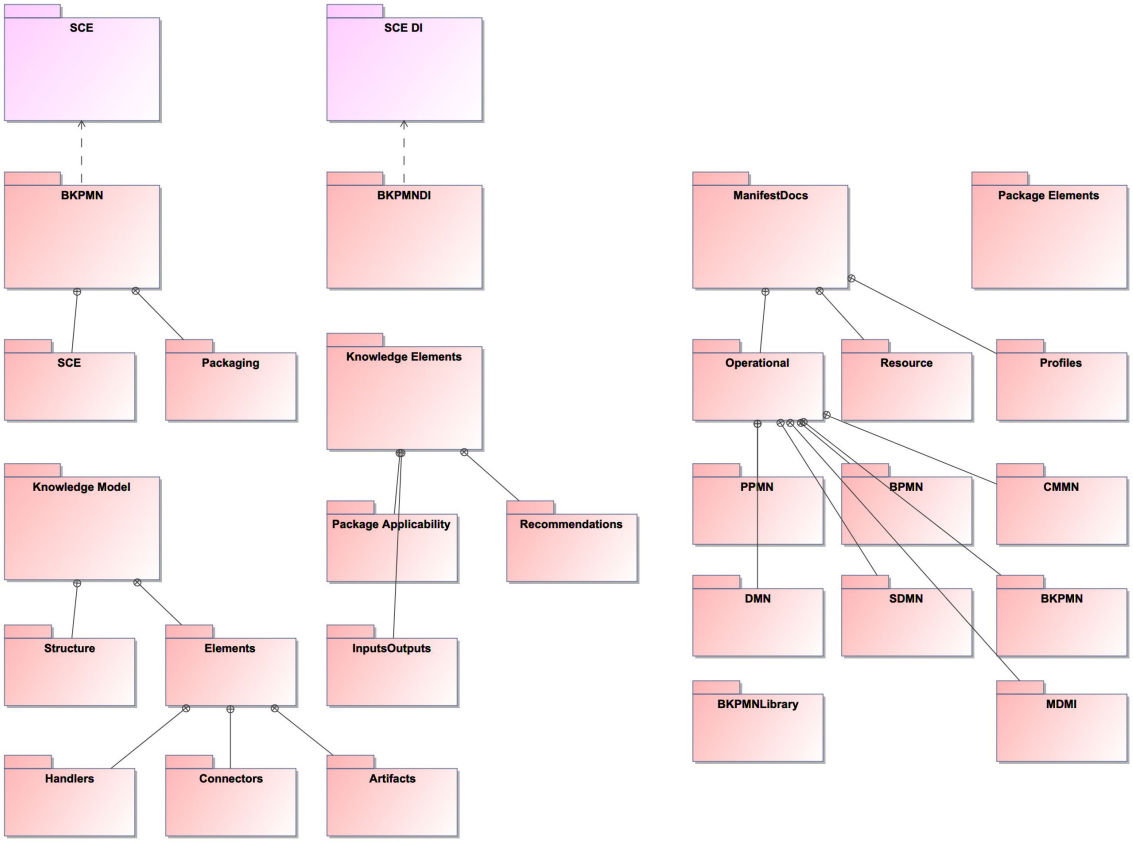


Figure 4: BKPMN Main Packages

The high-level view of the overall **BKPMN** Metamodel displays the key elements of a *BKPMNDefinitions* (for more details see *BKPMNDefinitions*, below).

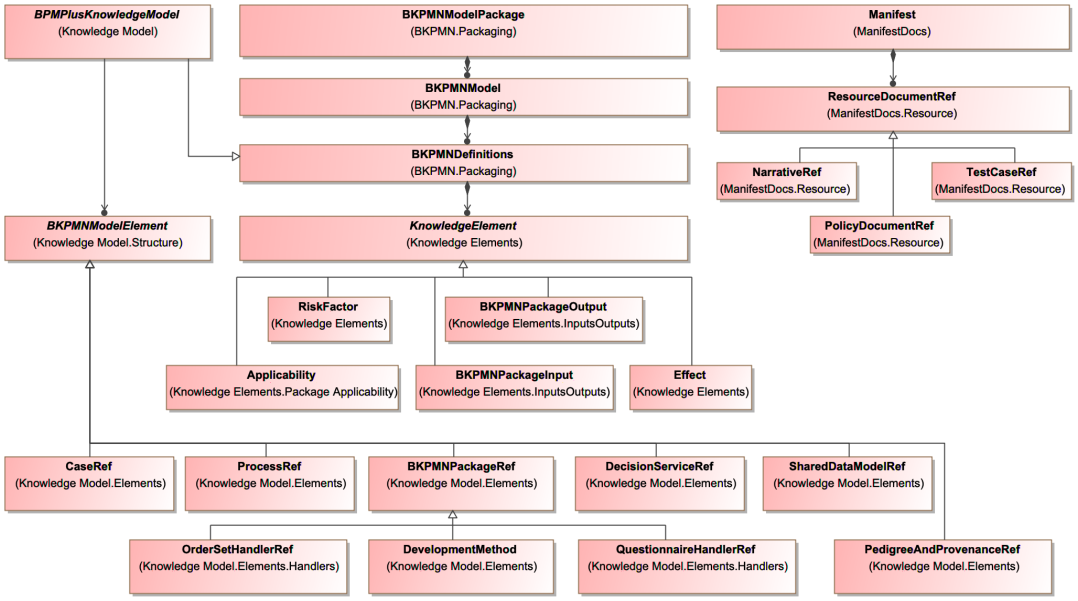


Figure 5: The BKPMN Package High Level Metamodel

The Core Element Model high-level metamodel, including the *BKPMNModelPackage*, which is like the "Definitions" element in the metamodels that are defined in by the current BPM+ specifications, defines the basic infrastructure elements of a *BKPMNModelPackage* document.

The figure below displays the core elements of **BKPMN**.

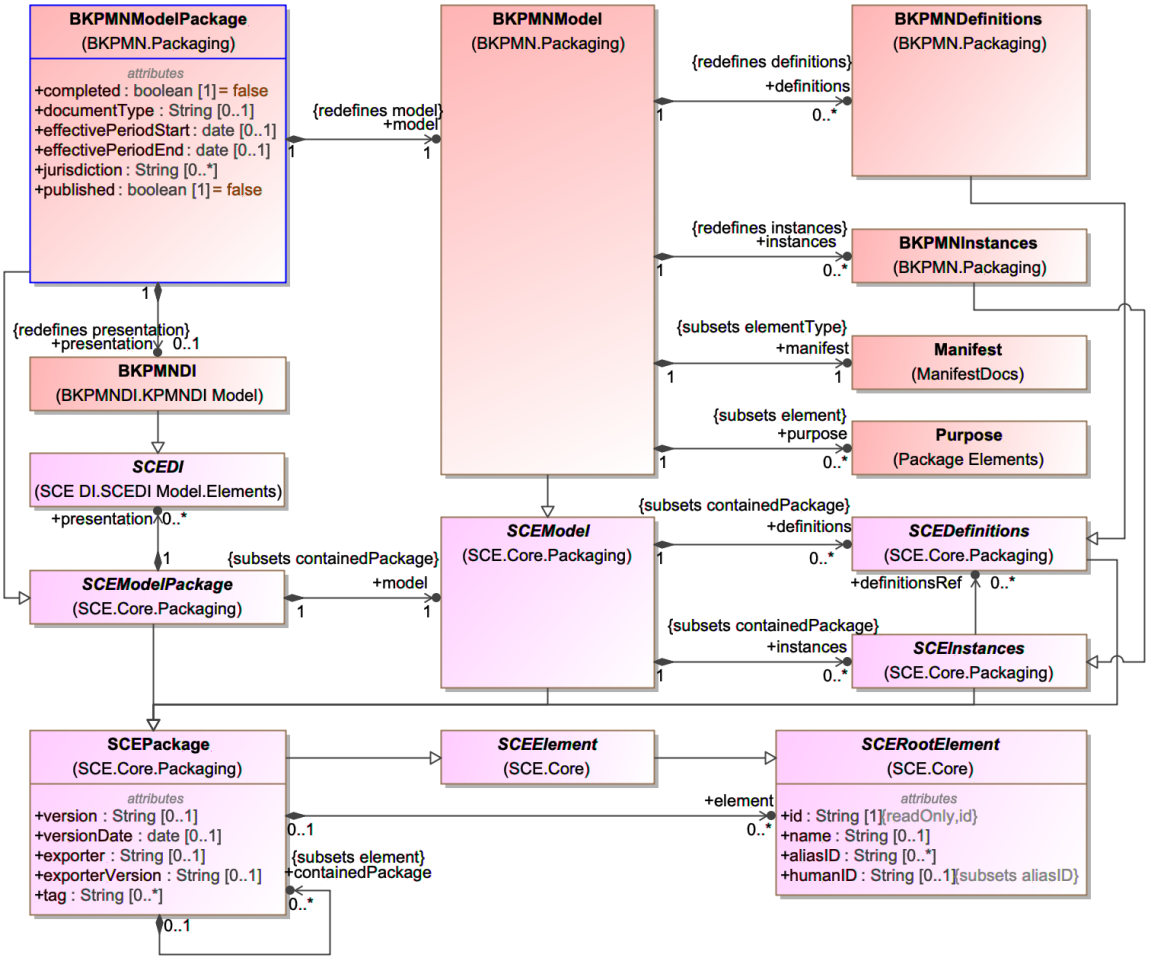


Figure 6: The BKPMN Core Element Metamodel

9.1 Packaging

A **BKPMN** provides mechanisms for packaging and distributing the content of a BPM+ Knowledge Package, which includes a set of BPM+ models (i.e., the knowledge). A *BKPMNPackage* references separate but connected BPM+ models (**BPMN** Processes, **CMMN** Cases, and **DMN** Decision Services). It should be noted that **BKPMN** is designed to support the BMI behavioral standards, but other kinds of models can be included in a *BKPMNPackage*. A *BKPMNPackage* also references a Data Item library for the data that will be used by the BPM+ models (the proposed standard **SDMN** defines the elements of the Data Item library). The *Manifest* contains the references to the documents that contain the various BPM+ Models that are required for the *BKPMNPackage*.

There are 3 elements that are used for packaging **BKPMN** content: *BKPMNModelPackage*, *BKPMNModel*, and *BKPMNDefinitions* (see the next three sections).

9.1.1 BKPMNModelPackage

The *BKPMNModelPackage* class is the outermost containing object for all **BKPMN** elements. It defines the scope of visibility and the namespace for all contained elements. The interchange of **BKPMN** files will always be through a *BKPMNModelPackage*. Specifically, an XML file for a **BPM+ Knowledge Model** usually would be appended with a ".bkpmn" label.

A *BKPMNModelPackage* contains two sub-packages: The *BKPMNModel*, which contains all the semantic content

of the Knowledge Package; and *BKPMDI*, which contains all the diagram interchange information for any BKPMN models that are represented through diagrams.

A *BKPMNModelPackage* also contains metadata about the topic of the package to aid in understanding the content and to find appropriate *BKPMNModelPackages*.

The following figure shows the *BKPMNModelPackage* metamodel.

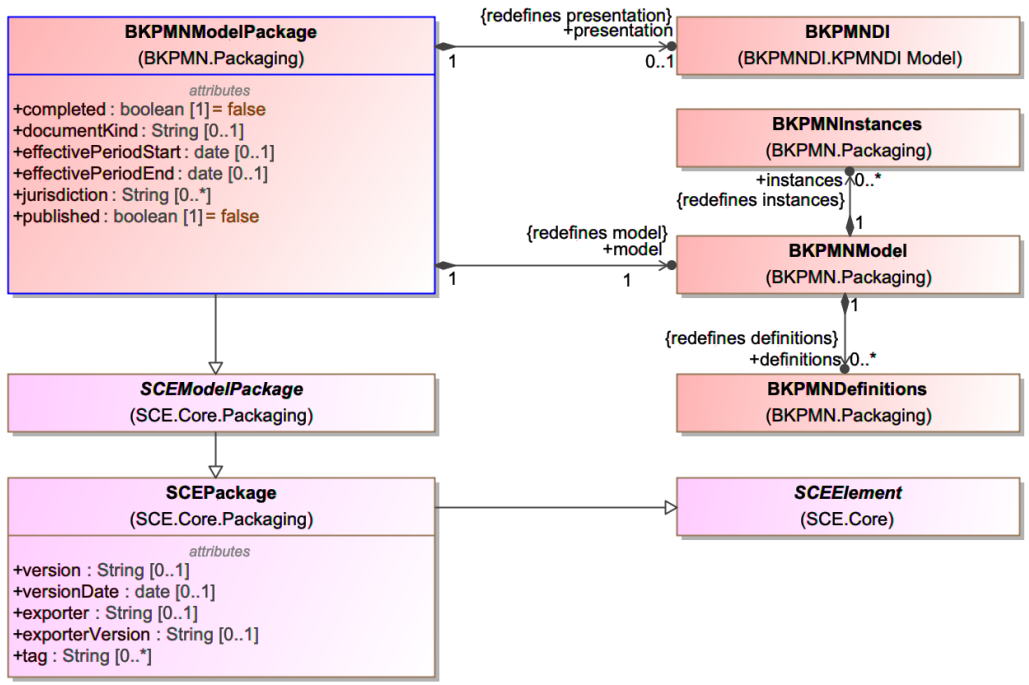


Figure 7: The BKPMNModelPackage Metamodel

Generalizations

The *BKPMNModelPackage* element inherits the attributes and/or associations of:

- *SCEModelPackage* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BKPMNModelPackage*:

Table 3. BKPMNModelPackage Attributes and/or Associations

Property/Association	Description
completed : boolean [1] default: false	This property is set to `true` when a Knowledge Package contains a complete and coherent set of models. This means that all the models that are referenced by the *Manifest* are completed and the dependencies (relationships) between those models are well defined. Further, all the dependencies (relationships) between Knowledge Package elements and the referenced models are also well defined – these dependencies SHALL be validated before the property can set to `true`. When `completed` is still `false` (the default setting), a Knowledge Package can still be discovered and/or distributed, but there is no expectation that the Knowledge Package is valid, complete, or ready to use in practice.
documentKind : String [0..1]	The `documentKind` setting provides a classification mechanism for the *BKPMNDefinitions*. This classification could be used as part of a search for a particular *BKPMNModelPackage*, for example.
effectivePeriodEnd : date [0..1]	This attribute defines the end date for when *BKPMNModelPackage* is no longer in effect.
effectivePeriodStart : date [0..1]	This attribute defines the start date for when *BKPMNModelPackage* is in effect.
jurisdiction : String [0..*]	This attribute defines the countries or other areas (such as states) where the *BKPMNModelPackage* is in effect.
model : BKPMNModel [1]	This the *BKPMNModel* sub-package contained within a *BKPMNModelPackage*. This redefines the `model` association of *SCEModelPackage*.
presentation : BKPMNDI [0..1]	This attribute contains the Diagram Interchange information contained within this package. This redefines the `presentation` association of *SCEModelPackage*. See the section entitled “BKPMN Diagram Interchange,” below, for more information about **BKPMN** diagram interchange.

published : boolean [1] default: false	This property is set to `true` when a Knowledge Package is "officially" published and available for review and consumption. This is analogous to the publishing of a book or the release of a version of software. The `completed` property SHALL be `true` before `published` property can set to `true`. When set to `true`, the content of the Knowledge Package, both internal and referenced, is considered immutable (locked). This includes the `versionDate` of the Knowledge Package. When the `version` of the Knowledge Package is updated, then the `published` property is reset to `false`. Beyond the validation that applies to the `complete` property, there is no specify mechanism to validate that a Knowledge Package is fully suitable for publishing. The Knowledge Package development team will determine when it is at a level of completeness that warrants setting `published` to `true`. When `published` is still `false` (the default setting), a Knowledge Package can still be discovered and/or distributed, but there is no expectation that the Knowledge Package is valid, complete, or ready to use in practice.

9.1.2 BKPMNModel

The *BKPMNModel* element is an intermediate packaging element that is included to follow the packaging pattern set by **SCE**. In **SCE**, the *SCEModel* package contains content for *BKPMNDefinitions*, instances, and profiles. **BKPMN** only includes a package for *BKPMNDefinitions*, but if future versions of **BKPMN** contain instances or profiles, the *BKPMNModel* will be the package that will contain this new content. The *BKPMNModel* element is contained within a *BKPMNModelPackage* package.

The following figure shows the *BKPMNModel* metamodel (which includes the standard instance provided by the **BKPMN** Library).

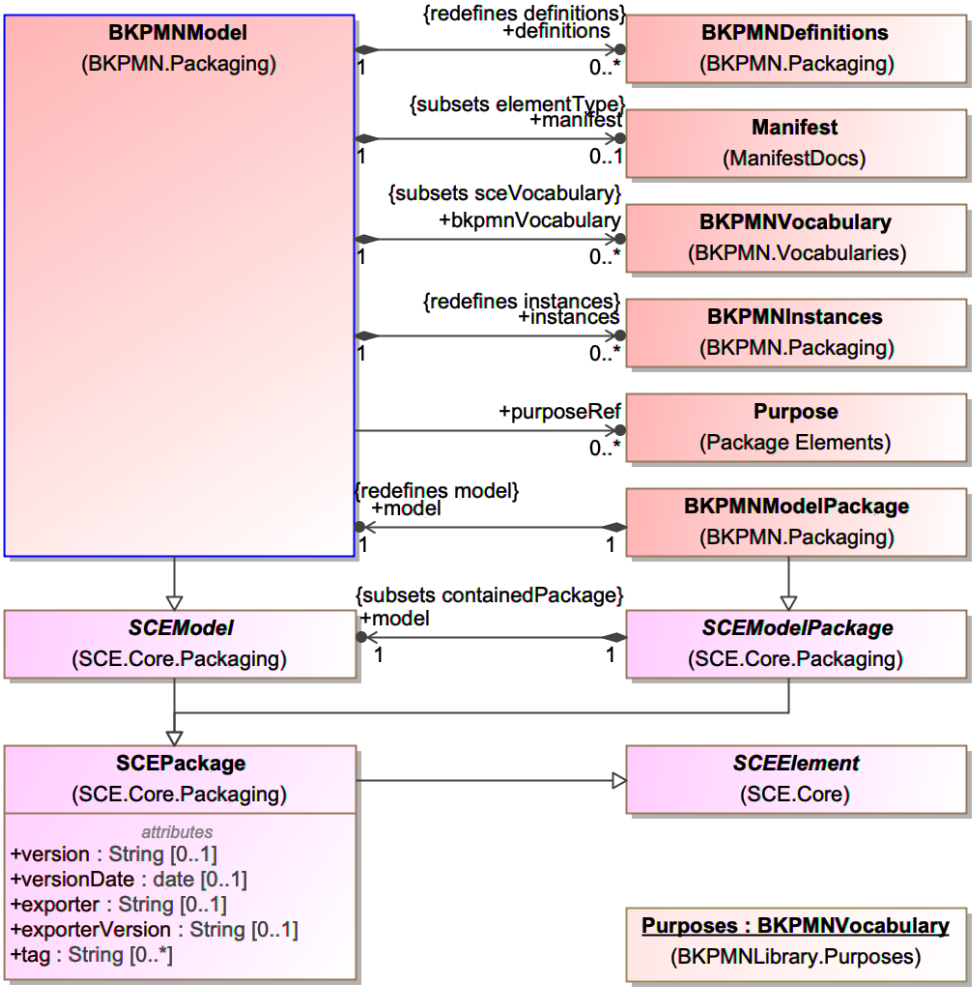


Figure 8: The BKPMNModel Metamodel

Generalizations

The *BKPMNModel* element inherits the attributes and/or associations of:

- *SCEModel* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BKPMNModel*:

Table 4. BKPMNModel Attributes and/or Associations

Property/Association	Description
bkpmnVocabulary : BKPMNVocabulary [0..*]	This is a list of the *BKPMNVocabularies* that are included in the *BKPMNModel*.

definitions : BKPMNDefinitions [0..*]	This is a list of the *BKPMNDefinitions* that are included in the *BKPMNModel*.
Instances : BKPMNInstances [0..*]	This is a list of the *BKPMNInstances* that are included in the *BKPMNModel*.
manifest : Manifest [0..1]	The *Manifest* is a list of files that contain the components of the *BKPMNModel*. This includes the files that contains the BPM+ models. See the section entitled “Manifest” for more information.
purposeRef : Purpose [0..*]	The *Purpose* element provides another classification mechanism for the *BKPMNDefinitions*. This classification could be used as part of a search for a particular *BKPMNModelPackage*, for example. This will be defined through an instance of the *Purpose* class as provided by the predefined instance of the *BKPMNVocabulary* element (see the section entitled “BKPMN Library” for more information).

9.1.3 BKPMNDefinitions

The *BKPMNDefinitions* element is one of the two main containers for the contents of a BPM+ Knowledge Package. It contains the *Manifest*, a set of *KnowledgeElements*, and a set of *BPMPlusKnowledgeModels* to organize the content and define the relationships. See the appropriate sections below for more details on each type of content.

The *BKPMNDefinitions* element is contained within a *BKPMNModel* package.

The figure below displays the *BKPMNDefinitions* metamodel.

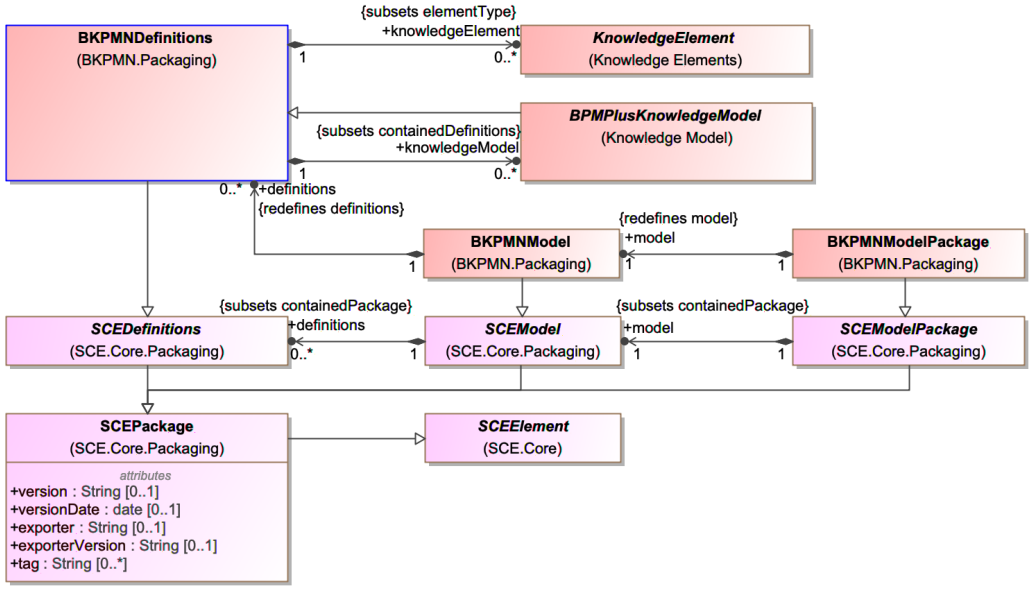


Figure 9: The BKPMN Metamodel

Generalizations

The *BKPMNDefinitions* element inherits the attributes and/or associations of:

- *SCEDefinitions* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BKPMNDefinitions*:

Table 5. BKPMNDefinitions Attributes and/or Associations

Property/Association	Description
knowledgeElement : KnowledgeElement [0..*]	The `knowledgeElement` association ... See the section entitled "KnowledgeElement" for the list of elements that are considered *KnowledgeElements*.
knowledgeModel : BPMPlusKnowledgeModel [0..*]	This is a list of **KnowledgeModels** that included in the *BKPMNDefinitions*. See the section entitled "BPM+ Knowledge Model," below, for more information.

9.1.4 BKPMNInstances

The *BKPMNInstances* element is one of the two main containers for the contents of a BPM+ Knowledge Package. It contains a set of *PackageElements*. See the appropriate sections below for more details on each type of content.

The *BKPMNInstances* element is contained within a *BKPMNModel* package.

The figure below displays the *BKPMNInstances* metamodel.

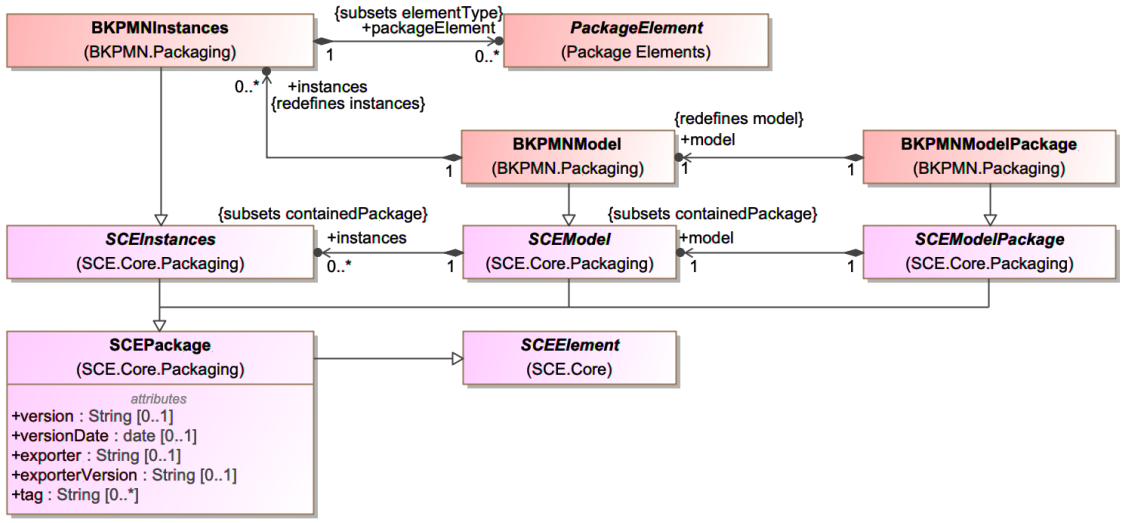


Figure 10: The BKPMNInstances Metamodel

Generalizations

The *BKPMNInstances* element inherits the attributes and/or associations of:

- *SCEInstances* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BKPMNDefinitions*:

Table 6. BKPMNInstances Attributes and/or Associations

Property/Association	Description
packageElement : PackageElement [0..*]	The `packageElement` association ... See the section entitled "PackageElement" for the list of elements that are considered *PackageElements*.

9.2 BKPMN Vocabularies

Vocabularies (lists of terms) can be added to a model package of a modeling language dependent on **SCE**. *BKPMNVocabularies* are sets of terms defined by an external ontology. The terms link to formal definitions for the model elements that are created by the modeling language. The *SemanticReference* element is used to provide a link to the terms that can be associated with the appropriate model elements. *SCEVocabularies* are contained within an *SCEModel* package.

The figure below displays the *BKPMNVocabulary* metamodel (which includes the standard instance provided by the **BKPMN** Library).

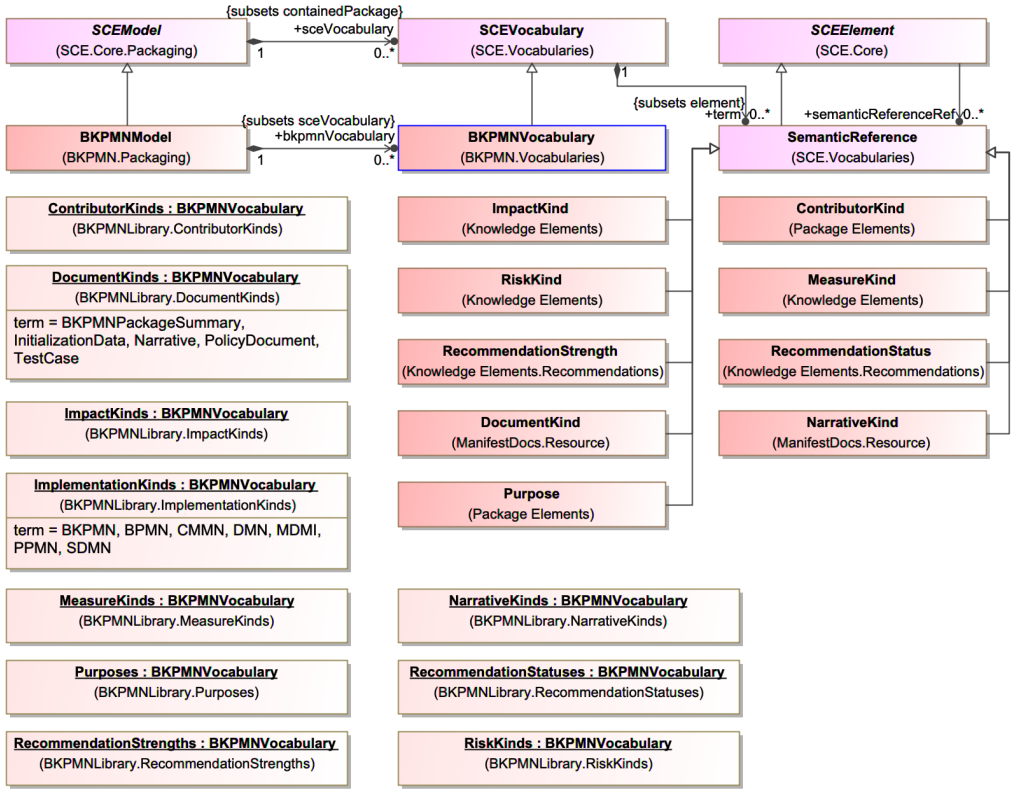


Figure 11: The BKPMNVocabulary Metamodel

9.2.1 BPKMNVocabulary

An *BKPMNVocabulary* is a list of terms, through the *SemanticReference* element, that can be used to relate to model elements to the external definition or meaning. The terms themselves do not represent the definitions or meanings

but provide links to an external source. Multiple *BKPMNVocabularies* can be defined. They are contained in an *SDMNModel.*

Further, *BKPMNVocabularies* can be used for creating a user-defined list of enumerated values for use within a **BKPMN** (as opposed to a fixed enumeration list). It is up to the **BKPMN** modeling tool to organize the *SDMNVocabularies* into the appropriate enumerated lists. Since the *SemanticReference* element has a name and the links to *BKPMNVocabularies* definitions are optional, the list (the "enumeration" *BKPMNVocabularies*) can be created before the specific external definitions are established.

BKPMN has nine pre-defined *BKPMNVocabularies* for the enumerated terms for the *ContributorKind* element (see the section entitled "ContributorKind" for more information), the *DocumentKind* element (see the section entitled "DocumentKind" for more information), the *ImpactKind* element (see the section entitled "ImpactKind" for more information), the *MeasureKind* element (see the section entitled "MeasureKind" for more information), the *NarrativeKind* element (see the section entitled "NarrativeKind" for more information), the *Purpose* element (see the section entitled "Purpose" for more information), the *RecommendationStatus* element (see the section entitled "RecommendationStatus" for more information), the *RecommendationStrength* element (see the section entitled "RecommendationStrength" for more information), and the *RiskKind* (see the section entitled "RiskKind" for more information).

Generalizations

The *BKPMNVocabulary* element inherits the attributes and/or associations of:

- *SCEVocabulary* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *BKPMNVocabulary* element does not have any additional attributes and/or associations.

10 Knowledge Elements

This chapter of the specification will define the *KnowledgeElement* and its subclasses.

10.1 KnowledgeElement

The *KnowledgeElement* abstract class is one of two intermediary classes to help with the organization of multiple elements that are contained within a *BKPMNDefinitions*. Instead of creating separate containment associations to *BKPMNDefinitions*, there is one containment association from *KnowledgeElement* to *BKPMNDefinitions* and then there are a set of concrete subclasses to *KnowledgeElement* (which can be seen in the figure below).

The class is named *KnowledgeElement* to indicate that its subclasses are elements that can be categorized as reflecting some aspect of the knowledge that is contained in the *BKPMNDefinitions*.

The figure below displays the *KnowledgeElement* metamodel.

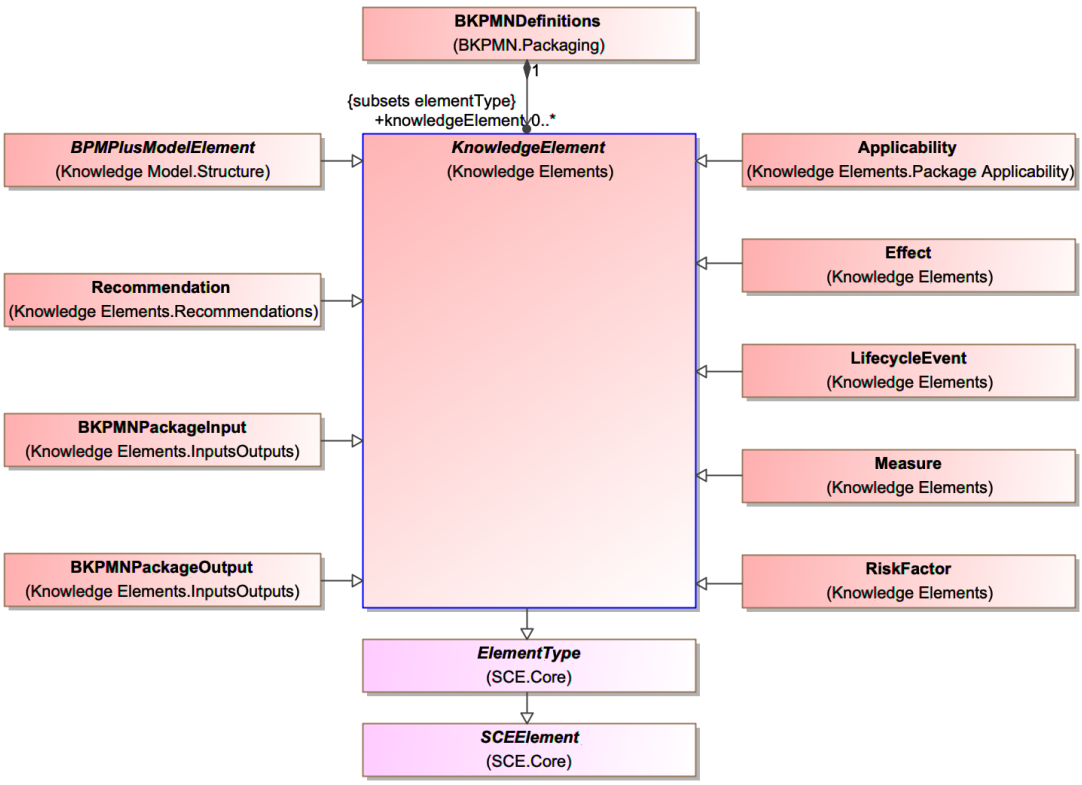


Figure 12: The KnowledgeElement Metamodel

Generalizations

The *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *KnowledgeElement* element does not have any additional attributes and/or associations.

10.2 Effect

An Effect is some change to the environment or data that may occur when the behaviors of BPM+ Knowledge Package is performed. In the healthcare domain, for example, a reduction in blood pressure may be the effect of the application of a medication. Each *BKPMNDefinitions* or *Recommendation* can contain a list of *Effects*.

The figure below displays the *Effects* metamodel (which includes the standard instance provided by the **BKPMN** Library).

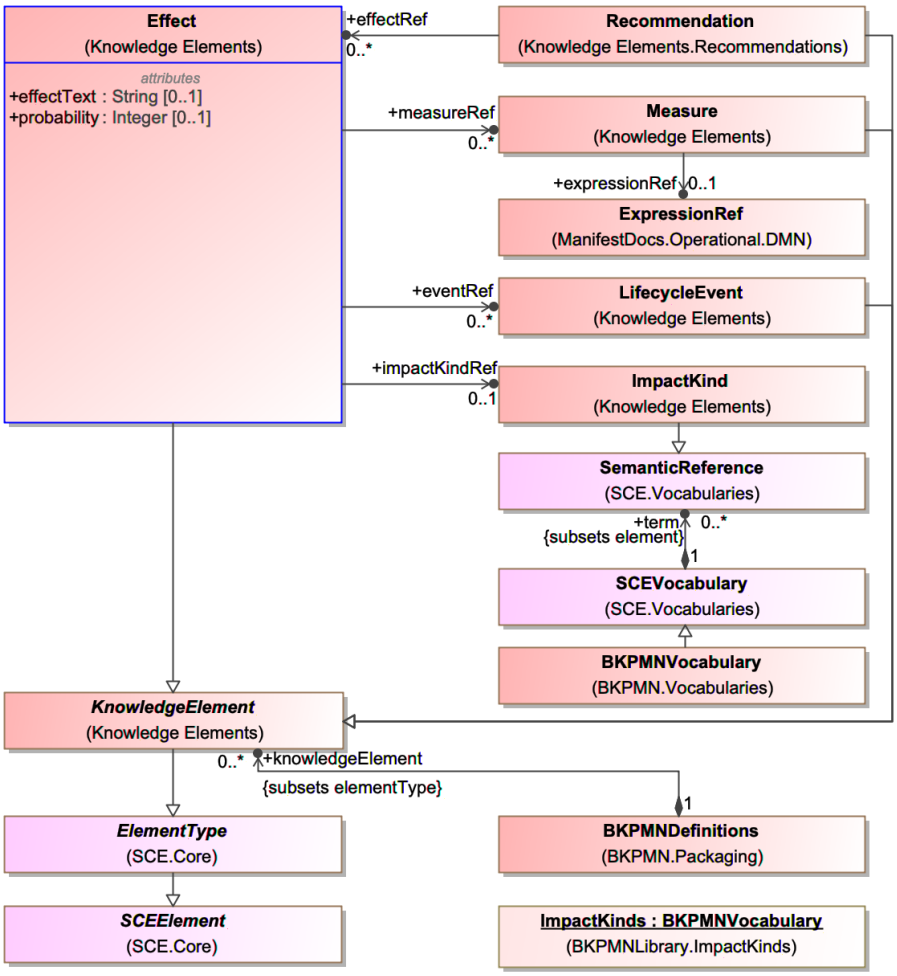


Figure 13: The Effects Metamodel

Generalizations

The *Effect* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *Effect*:

Table 7. Effect Attributes and/or Associations

Property/Association	Description
effectText : String [0..1]	An optional text description of the *Effect*.
eventRef : LifecycleEvent [0..*]	This allows the *BKPMNDefinitions* modeler to associate various **BPMN** events or **CMMN** milestones to the *Effect*. These events can be used to define a type of lifecycle for the *Effect*.
impactKindRef : ImpactKind [0..1]	This indicates the kind of impact that the *Effect* will have when the behaviors of the *BKPMNDefinitions* or *Recommendation* are executed. This will be defined through an instance of the *ImpactKind* class as provided by the predefined instance of the *BKPMNVocabulary* element (see the section entitled "BKPMN Library" for more information).
measureRef : Measure [0..*]	This identifies any *Measures* that are defined to determine whether or not the *Effect* occurs.
probability : Integer [0..1]	This is a probability rating that defines how likely the *Effect* will occur when the behaviors of the *BKPMNDefinitions* or *Recommendation* are performed.

10.3 ImpactKind

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that indicates the kind of impact that the *Effect* will have when the behaviors of the BPM+ Knowledge Package or *Recommendation* are executed. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*ImpactKind*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *ImpactKind*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element named "ImpactKinds" (see the section entitled "BKPMN Library" for more information). Example *ImpactKind* instances could include: negative; neutral; positive; and unknown.

In practice, when a modeler creates a model with an *Effect*, the *ImpactKind* will be instantiated by one of the instances in the Library created for the context of the model.

Generalizations

The *ImpactKind* element inherits the attributes and/or associations of:

- *SemanticReference* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *ImpactKind* element does not have any additional attributes and/or associations.

10.4 LifecycleEvent

A *LifecycleEvent* is a significant circumstance or event, as identified by the *BKPMNDefinitions* developer, that occurs during the performance of the behaviors of a *BKPMNDefinitions*. *LifecycleEvent* is contained within a *BKPMNDefinitions* and can be referenced by a *Recommendation*.

> *Note: lifecycle events will also be found in the Pedigree of the BKPMNDefinitions, if the Pedigree is being tracked.*

The following figure shows the *LifecycleEvent* metamodel.

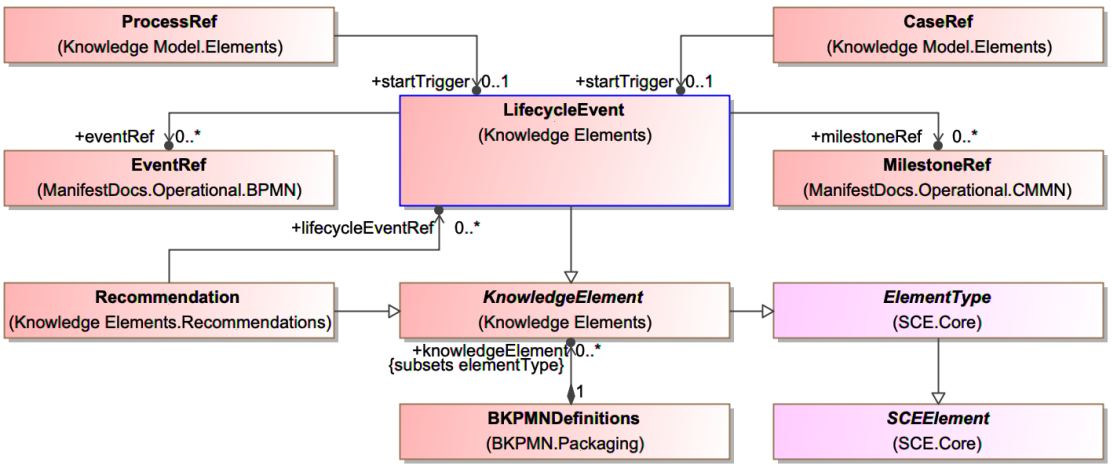


Figure 14: The LifecycleEvents Metamodel

Generalizations

The *LifecycleEvent* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Further, the *ElementType* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information).

Properties

The following table presents the additional attributes and/or associations for *LifecycleEvent*:

Table 8. LifecycleEvent Attributes and/or Associations

Property/Association	Description
eventRef : EventRef [0..*]	This relates the **BPMN** elements, such as Start Evenrts, that are associated with the *LifecycleEvent*. It is possible that multiple Process Events, across the Processes of the *BKPMNDefinitions*, may be associated with the *LifecycleEvent*. Both `EventRefs` and `MilestoneRefs` may be associated with a *LifecycleEvent*.
milestoneRef : MilestoneRef [0..*]	This relates the **CMMN** Milestones that are associated with the *LifecycleEvent*. It is possible that multiple Case elements, across the Cases of the *BKPMNDefinitions*, may be associated with the *LifecycleEvent*. Both `EventRefs` and `MilestoneRefs` may be associated with a *LifecycleEvent*.

10.5 Measure

A *Measure* is a mechanism to calculate something using an expression. In **BKPMN**, an *Effect* can utilize a *Measure* to determine the extent that the *Effect* has been realized for a particular *Recommendation* or the overall BPM+ Knowledge Package. The actual expression will be contained within a **DMN** model as part of a Decision or Business Knowledge Model. A *Measure* is contained within a *BKPMNDefinitions*.

The figure below displays the *Measure* metamodel (which includes the standard instance provided by the **BKPMN** Library).

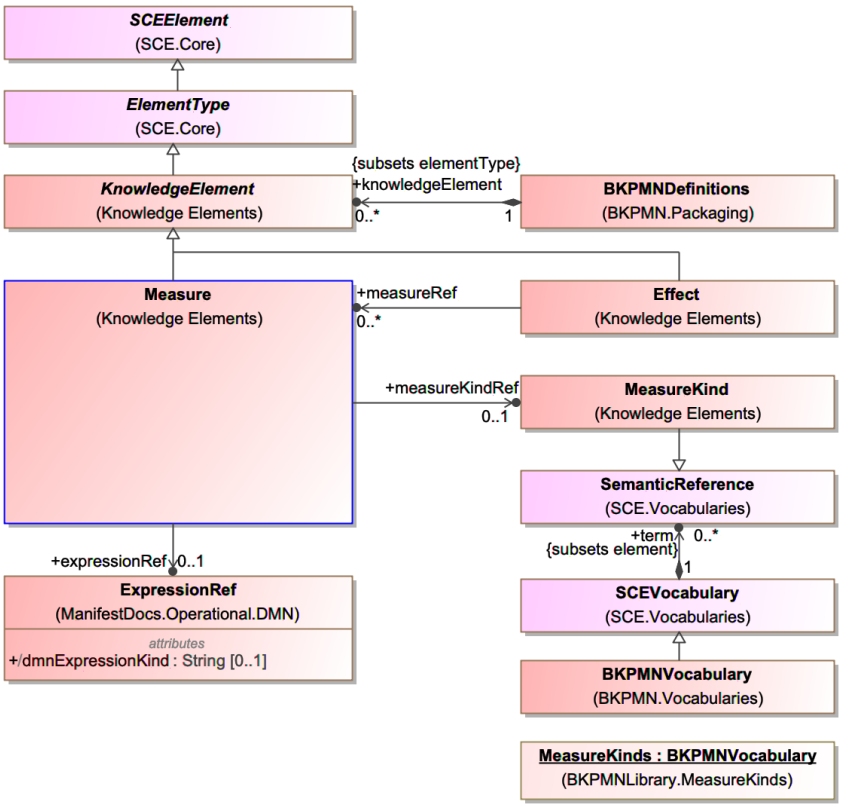


Figure 15: The Measure Metamodel

Generalizations

The *Measure* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *Measure*:

Table 9. Measure Attributes and/or Associations

Property/Association	Description
expressionRef : ExpressionRef [0..1]	This identifies the **DMN** expression that is used to evaluate the *Measure*. The expression will be contained within a **DMN** model as part of a Decision or Business Knowledge Model.
measureKindRef : MeasureKind [0..1]	The *MeasureKind* will define the kinds of measures that are used in the context of the BPM+ Knowledge Package. This will be defined through an instance of the *MeasureKind* class as provided by the predefined instance of the *BKPMNVocabulary* element (see the section entitled "BKPMN Library" for more information).

10.6 MeasureKind

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that indicates the kind of measure used to test the *Effect* will have when the behaviors of the BPM+ Knowledge Package or *Recommendation* are executed. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*MeasureKind*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *MeasureKind*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element named "MeasureKinds" (see the section entitled "BKPMN Library" for more information). Example *MeasureKind* instances could include: quality; process; perception; performance; and input.

In practice, when a modeler creates a model with an *Effect*, the *MeasureKind* will be instantiated by one of the instances in the Library created for the context of the model.

Generalizations

The *MeasureKind* element inherits the attributes and/or associations of:

- *SemanticReference* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *MeasureKind* element does not have any additional attributes and/or associations.

10.7 RiskFactor

Indicates the impact and probability of loss and can be calculated through an expression. The actual expression will be contained within a **DMN** model as part of a Decision or Business Knowledge Model. It is contained within a *BKPMNDefinitions*.

The figure below displays the *RiskFactor* metamodel (which includes the standard instance provided by the **BKPMN** Library).

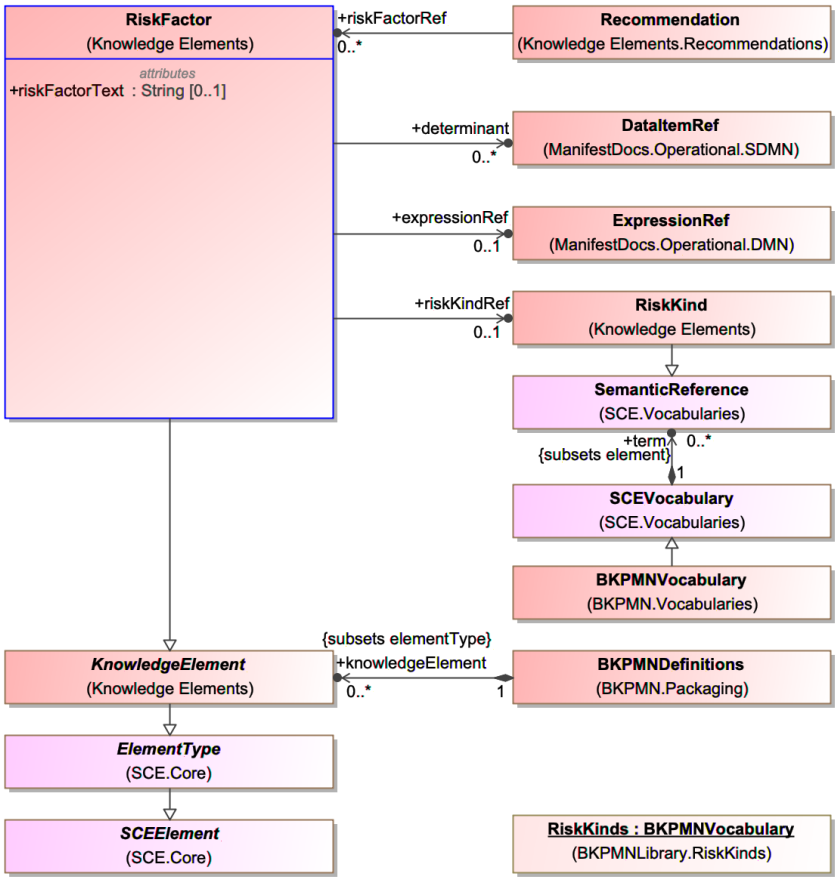


Figure 16: The RiskFactor Metamodel

Generalizations

The *RiskFactor* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *RiskFactor*:

Table 10. RiskFactor Attributes and/or Associations

Property/Association	Description
determinant : DataItemRef [0..*]	This identifies the data item that serves as the determinant for the *RiskFactor*.
expressionRef : ExpressionRef [0..1]	A *RiskFactor* can be expressed through an expression (e.g., "Age > 75 years"). The actual expression will be contained within a **DMN** model as part of a Decision or Business Knowledge Model.

riskFactorText : String [0..1]	This provides a description of the *RiskFactor*. Additional discussion or documentation can be included in the *Documentation* element.
riskKindRef : RiskKind [0..1]	The *RiskKind* element will define the kinds of measures that are used in the context of the BPM+ Knowledge Package. This will be defined through an instance of the *RiskKind* class as provided by the predefined instance of the *BKPMNVocabulary* element (see the section entitled "BKPMN Library" for more information).

10.8 RiskKind

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that indicates the kind of risk that the *RiskFactor* will have when the behaviors of the BPM+ Knowledge Package or *Recommendation* are executed. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*RiskKind*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *RiskKind*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element named "RiskKinds" (see the section entitled "BKPMN Library" for more information). Example *RiskKind* instances could include: fraction-of-incidences; hazard-ratio; increases-in-incidences; and relative.

In practice, when a modeler creates a model with an *Effect*, the *RiskKind* will be instantiated by one of the instances in the Library created for the context of the model.

Generalizations

The *RiskKind* element inherits the attributes and/or associations of:

- *SemanticReference* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *RiskKind* element does not have any additional attributes and/or associations.

10.9 Determining Applicability

Applicability describes the population or conditions to which the BPM+ Knowledge Package(or *Recommendation* within a BPM+ Knowledge Package) is intended. These conditions, if included, must be evaluated before that BPM+ Knowledge Package or *Recommendation* is enacted. It is possible that multiple BPM+ Knowledge Packages *or Recommendations* maybe triggered and enacted under the same conditions. A **DMN** Decision Service can be defined to express the formal logic of the applicability conditions.

The following figure shows the *Applicability* metamodel.

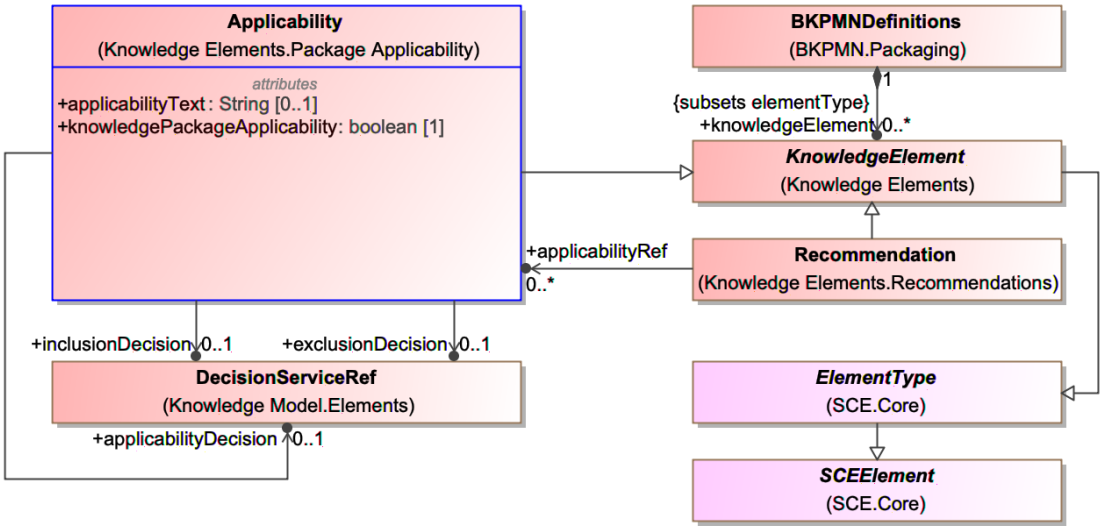


Figure 17: The Applicability Metamodel

The infrastructure for an organization that will implement the behaviors of a BPM+ Knowledge Package *or Recommendation* will likely need to include a Process that will evaluate the applicability of the specific context for the triggered BPM+ Knowledge Package *or Recommendation*.

The evaluation Process occurs outside the context of the BPM+ Knowledge Package *or Recommendation* and the same Process could be used for many of the BPM+ Knowledge Package *or Recommendation* the organization manages. (There could be a few variations of the evaluation process, but then there would have to be some mechanism for executing the appropriate one for a particular BPM+ Knowledge Package *or Recommendation*. This mechanism would have to be in the BPM+ Knowledge Package *or Recommendation* metadata).

The figure below presents a representative version of that Process (in the context of healthcare):

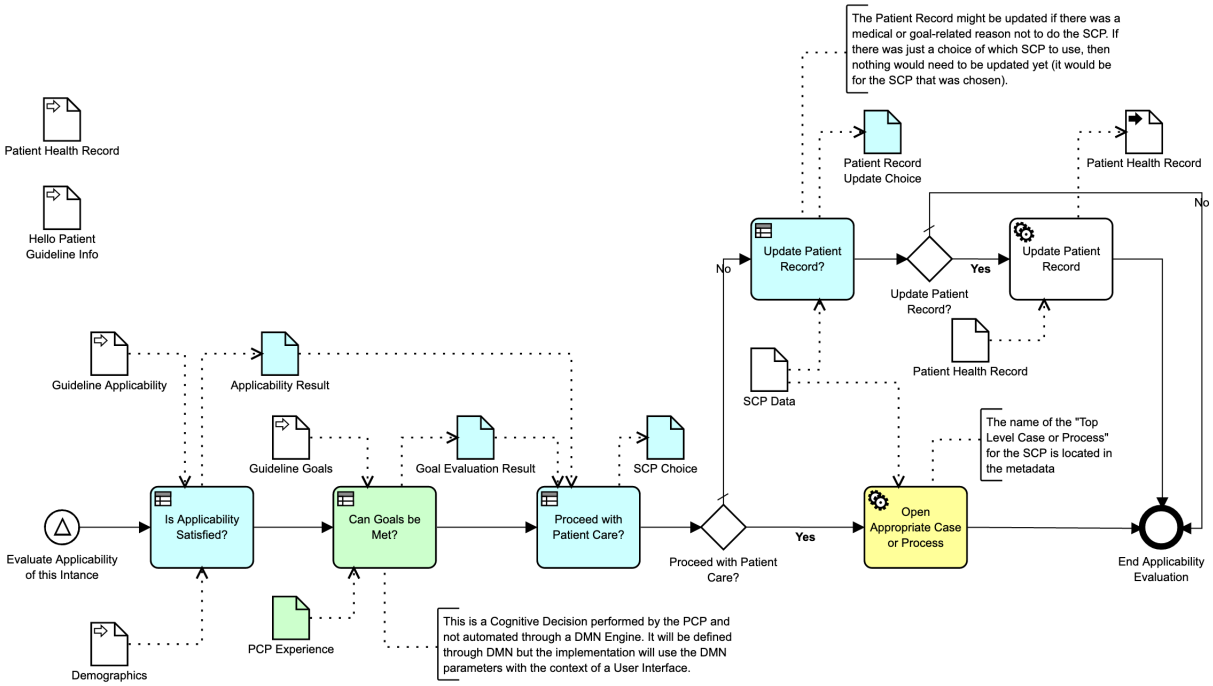


Figure 18: Process for Determining the Applicability of a BKPMN Package

Using a Service Task to launch the Case (see "Open Appropriate Case" above) allows the Process to be applicable to any Knowledge Package.

The figure below presents a representative version of Decisions that evaluate the conditions that exist for the evaluation Process shown in the figure above:

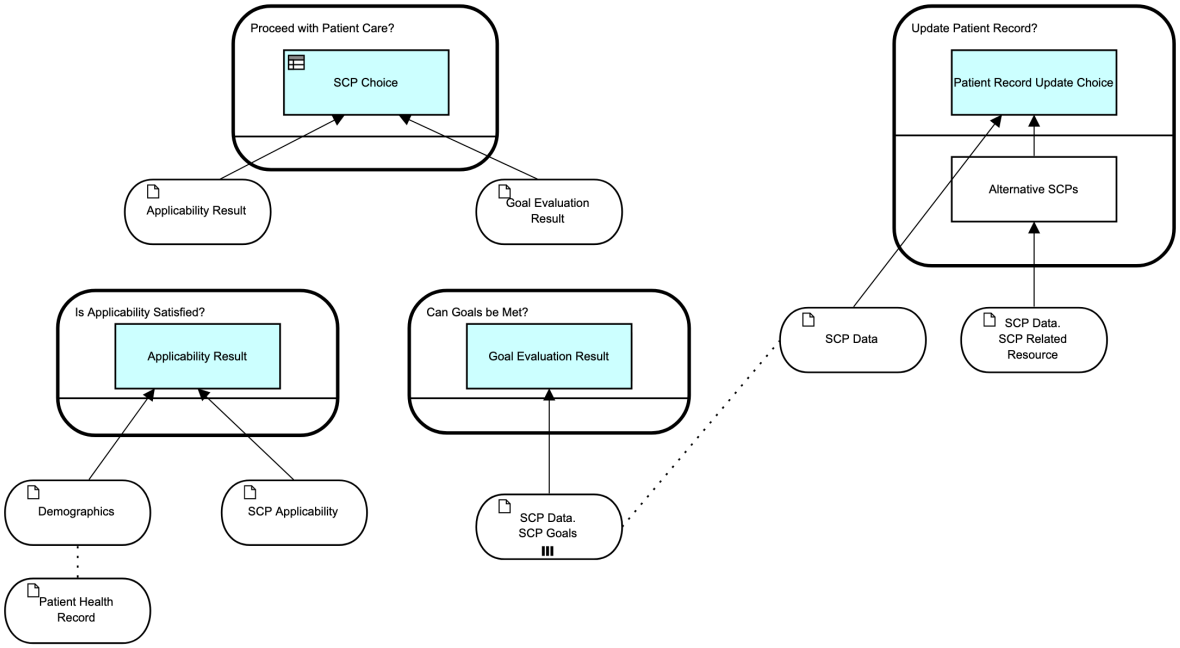


Figure 19: Decision Model for Determining the Applicability of a BKPMN Package

10.9.1 Applicability

The applicability of a BPM+ Knowledge Package *or Recommendation* is a statement of the conditions that must be met in order for the BPM+ Knowledge Package *or Recommendation* to be applied. the *Applicability* element is contained within a *BKPMNDefinitions*.

Generalizations

The *Applicability* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *Applicability*:

Table 11. Applicability Attributes and/or Associations

Property/Association	Description
applicabilityDecision : DecisionServiceRef [0..1]	This references the **DecisionServiceRef** that will execute the determination whether or not the given situation is applicable to the BPM+ Knowledge Package *or Recommendation*. The results of the `inclusionDecision` and `exclusionDecision` will provide input into the `applicabilityDecision`.
applicabilityText : String [0..1]	This is a brief summary of what constitutes the applicability for the BPM+ Knowledge Package *or Recommendation*. Additional description of the applicability can be provided by the *Documentation* element.
exclusionDecision : DecisionServiceRef [0..1]	This references the **DecisionServiceRef** that will execute the criteria that determines if the current context (preconditions) indicates that the current BPM+ Knowledge Package *or Recommendation* is not applicable (i.e., should *not* be performed).
inclusionDecision : DecisionServiceRef [0..1]	This references the **DecisionServiceRef** that will execute the criteria that determines if the current context (preconditions) indicates that the current BPM+ Knowledge Package *or Recommendation* is applicable (i.e., *should* be performed).
knowledgePackageApplicability : boolean [1]	If `true`, this specifies that this *Applicability* definition applies to the overall BPM+ Knowledge Package rather than a *Recommendation*.

10.10 Inputs and Outputs

In the same way that a specific business process has input and output data items, a BPM+ Knowledge Package can have data items that trigger the performance of the entire Knowledge Package (or a Recommendation within) as well as data items that are produced as a result.

The following figure shows the metamodel for *BKPMNPackageInputs* and *BKPNPackageOutputs*.

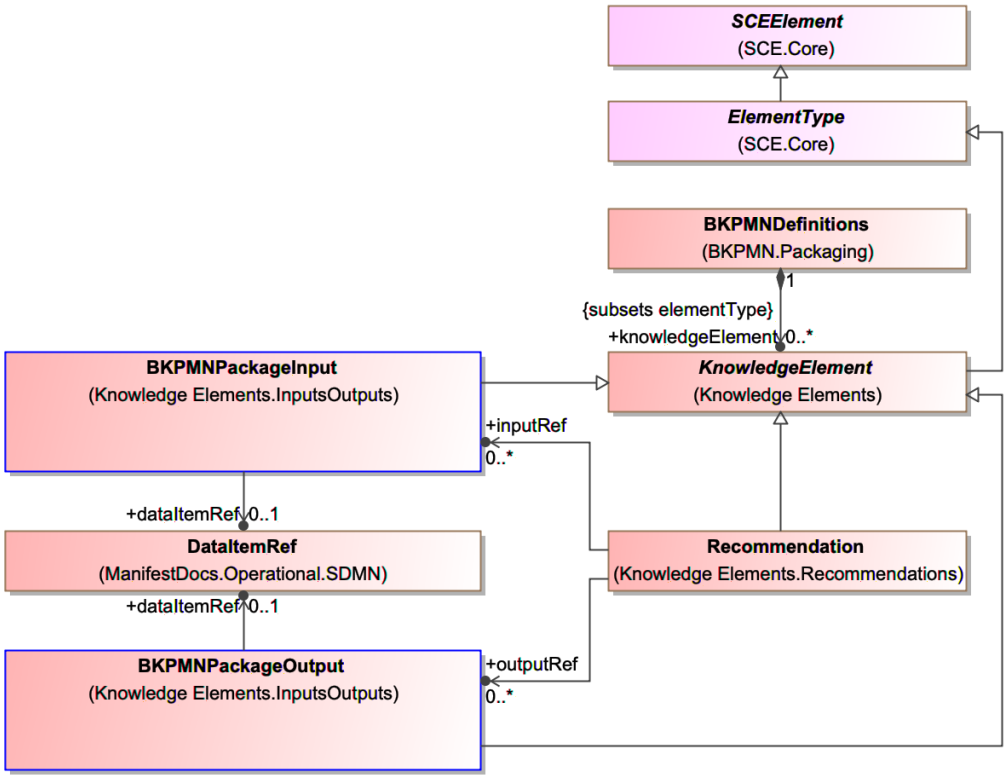


Figure 20: The metamodel for BKPMNPackageInputs and BKPMNPackageOutputs

10.10.1 BKPMNPackageInput

An *BKPMNPackageInput* represents a key **DataItem** that is necessary to be present at the start of a performance of a BPM+ Knowledge Package or a *Recommendation*. It is contained within a BPM+ Knowledge Package or a *Recommendation*.

Generalizations

The *BKPMNPackageInput* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BKPMNPackageInput*:

Table 12. BKPMNPackageInput Attributes and/or Associations

Property/Association	Description
dataItemRef : DataItemRef [0..1]	This attribute is optional since a *BKPMNPackage* can be developed before all the information is available. However, before a *BKPMNPackage* is considered complete, the *DataItemRef* for the *BKPMNPackageInput* should be set (e.g., there should be a Shared Data Model within the *BKPMNPackage* that contains the referenced Data Item).

10.10.2 BKPMNPackageOutput

A *BKPMNPackageOutput* represents a key Data Item that is a product at the end of a performance of a *BKPMNPackage*. It is contained within a *BKPMNPackage*.

Generalizations

The *BKPMNPackageOutput* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BKPMNPackageOutput*:

Table 13. BKPMNPackageOutput Attributes and/or Associations

Property/Association	Description
dataItemRef : DataItemRef [0..1]	This attribute is optional since a *BKPMNPackage* can be developed before all the information is available. However, before a *BKPMNPackage* is considered complete, the *DataItemRef* for the *BKPMNPackageOutput* should be set (e.g., there should be a Shared Data Model within the *BKPMNPackage* that contains the referenced Data Item).

10.11 Recommendations

The following sections describe *Recommendations* and related elements.

10.11.1 Recommendation

A BPM+ Knowledge Package can be considered a large-scale *Recommendation* and can contain many internal *Recommendations* that may or may not occur. A *Recommendation* defines, under specific circumstances, a set of behaviors that can have expected *Effects*.

The figure below displays the *Recommendations* metamodel (which includes the standard instances provided by the **BKPMN** Library).

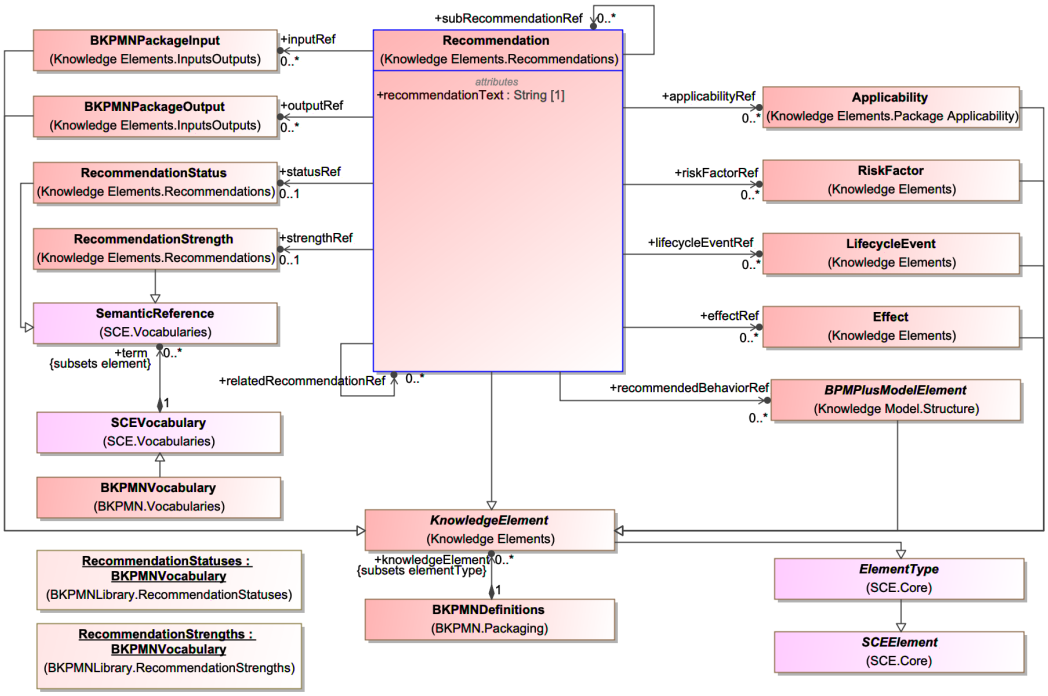


Figure 21: The Recommendations Metamodel

Generalizations

The *Recommendation* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *Recommendation*:

Table 14. Recommendation Attributes and/or Associations

Property/Association	Description
applicabilityRef : Applicability [0..*]	The applicability of a *Recommendation* is a statement of the conditions that must be met, after a *BKPMNPackageStartTrigger* occurs, in order for the *BKPMNDefinitions* to be applied. See the section entitled "Applicability" for more information.
effectRef : Effect [0..*]	The *Effects* of a *Recommendation* are statements as to a change in condition or a result that occurs due to enacting of the behaviors of the *Recommendation, S*ee the section entitled "Effect" for more information.

inputRef : BKPMNPackageInput [0..*]	This is a list of the key Data Items that are necessary to be present at the start of a performance of a *Recommendation*. See the section entitled “BKPM Knowledge Package Input” for more information.
lifecycleEventRef : LifecycleEvent [0..*]	These are the significant circumstances or events, as identified by the BPM+ Knowledge Package developer, that occur during the enactment of the *Recommendation*. See the section entitled “Lifecycle Event” for more information. *Note: the lifecycle events will also be found in the Pedigree of the BKPMNDefinitions, if the Pedigree is being tracked.*
outputRef : BKPMNPackageOutput [0..*]	This is a list of the key Data Items that are a product at the end of a performance of a *Recommendation*. See the section entitled “BKPM Knowledge Package Output” for more information.
recommendationText : String [1]	This is the written narrative of the *Recommendation*. It will often include “We recommend…” Additional discussion or documentation can be included in the *Documentation* element.
recommendedBehaviorRef : BPMPlusModelElement [0..*]	This identifies BPM+ model elements (e.g., a Process) that is related to the *Recommendation*.
relatedRecommendationRef : Recommendation [0..*]	This identifies another *Recommendation* that is related to this *Recommendation*.
riskFactorRef : RiskFactor [0..*]	The *RiskFactors* of a *Recommendation* are statements as to conditions that may result in negative effects or losses as a result of enacting the behaviors of the *Recommendation*. See the section entitled “Risk Factor” for more information.
statusRef : RecommendationStatus [0..1]	The *RecommendationStatus* defines how the *Recommendation* is related to *Recommendations* the of previous versions of the *BKPMNDefinitions*. See the section entitled “Recommendation Status” for more information.
strengthRef : RecommendationStrength [0..1]	The *RecommendationStrength* is an evaluation of the confidence that the *Recommendation* developers have regarding how the *Recommendation* should be applied. See the section entitled “Recommendation Strength” for more information.
subRecommendationRef : Recommendation [0..*]	This identifies another *Recommendation* that is related to this *Recommendation*.

10.11.2 RecommendationStatus

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that defines how the *Recommendation* is related to *Recommendations* the of previous versions of the BPM+ Knowledge Package. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*RecommendationStatus*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *RecommendationStatus*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element

named “RecommendationStatuses” (see the section entitled “BKPMN Library” for more information). Example *RecommendationStatus* instances could include: amended; deleted; new-added; new-replaced; not-changed.

In practice, when a modeler creates a model with a *Recommendation*, the *RecommendationStatus* will be instantiated by one of the instances in the Library created for the context of the model.

Generalizations

The *RecommendationStatus* element inherits the attributes and/or associations of:

- *SemanticReference* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *RecommendationStatus* element does not have any additional attributes and/or associations.

10.11.3 RecommendationStrength

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that is an evaluation of the confidence that the *Recommendation* developers have regarding how the *Recommendation* should be applied. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*RecommendationStrength*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *RecommendationStrength*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element named “RecommendationStrengths” (see the section entitled “BKPMN Library” for more information). Example *RecommendationStrength* instances could include: strong-against; strong-for; weak-against; weak-for.

In practice, when a modeler creates a model with a *Recommendation*, the *RecommendationStatus* will be instantiated by one of the instances in the Library created for the context of the model.

Generalizations

The *RecommendationStrength* element inherits the attributes and/or associations of:

- *SemanticReference* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *RecommendationStrength* element does not have any additional attributes and/or associations.

11 Package Elements

This chapter of the specification will define the *PackageElement* and its subclasses.

11.1 PackageElement

The *PackageElement* abstract class is one of two intermediary classes to help with the organization of multiple elements that are contained within a *BKPMNInstances*. Instead of creating separate containment associations to *BKPMNInstances* , there is one containment association from *PackageElement* to *BKPMNInstances* and then there are a set of concrete subclasses to *PackageElement* (which can be seen in the figure below).

The class is named *PackageElement* to indicate that its subclasses are elements that can be categorized as reflecting some aspect of the package itself that may help in the understanding or discovery of the *BKPMNModelPackage*.

The figure below displays the **PackageElement** metamodel.

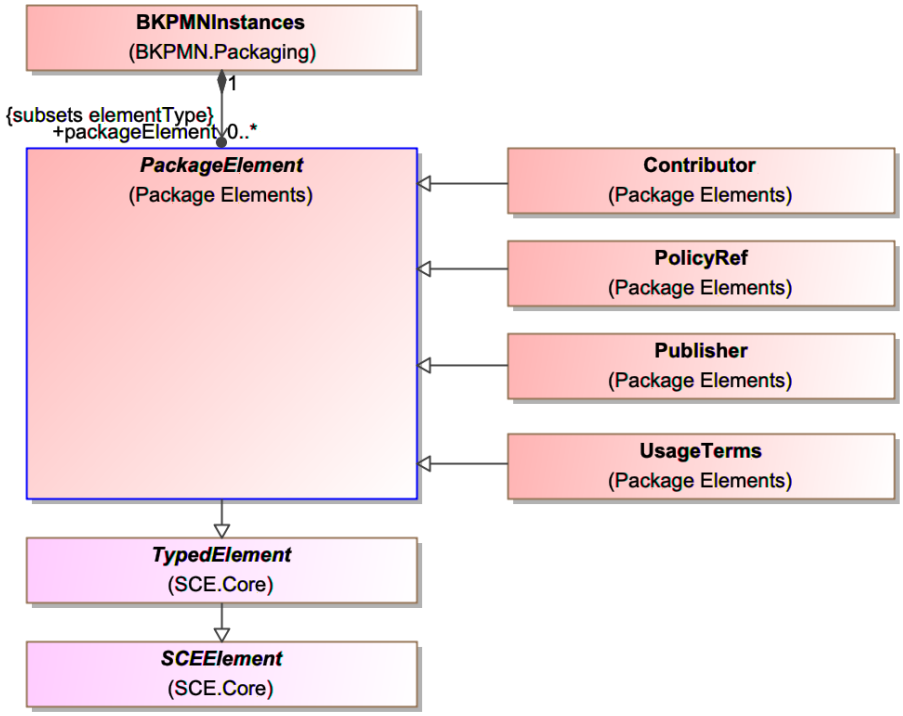


Figure 22: The PackageElement Metamodel

Generalizations

The *PackageElement* element inherits the attributes and/or associations of:

- *TypedElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *PackageElement* element does not have any additional attributes and/or associations.

11.2 Contributor

A *Contributor* is a person that assisted in the development of the *BKPMNDefinitions*. There are different kinds of Contributors, such as editors, reviewers, etc. A *Contributor* can contribute to the *BKPMNDefinitions* itself or any of the content that is reference by the *Manifest*. It is contained within a *BKPMNInstances*.

> *Note: Contributors will also be found in the Pedigree of the BKPMNDefinitions, if the Pedigree is being tracked.*

The figure below displays the *Contributor* metamodel (which includes the standard instance provided by the **BKPMN** Library).

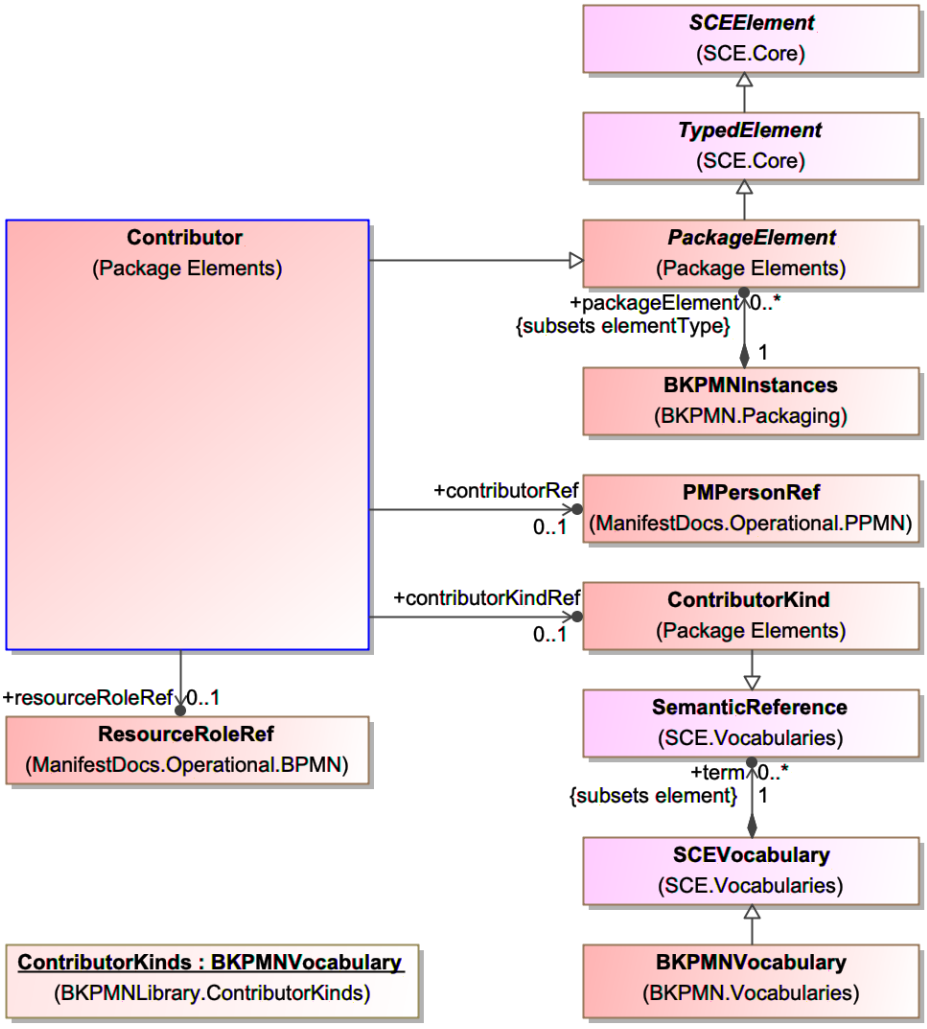


Figure 23: The Contributor Metamodel

Generalizations

The *Contributor* element inherits the attributes and/or associations of:

- *PackageElement* (see the section entitled "PackageElement" for more information).

Further, the *PackageElement* element inherits the attributes and/or associations of:

- *TypedElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *Contributor*:

Table 15. Contributor Attributes and/or Associations

Property/Association	Description
contributorRef : PMPersonRef [0..1]	If there is a Pedigree and Provenance (**PPMN**) model associated with the *BKPMNDefinitions*, the *Contributor* can be associated to a *Role* within the **PPMN** model.
contributorKindRef : ContributorKind [0..1]	This attribute sets the kind of contribution provided by the *Contributor*. See the section below for the information on the *ContributorKind* element.
resourceRoleRef : ResourceRoleRef [0..1]	A particular *Contributor* can be associated with a resource (performer) of a Process that is part of the Knowledge Package. The *ResourceRoleRef* provides that link.

11.3 ContributorKind

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that indicates the kind of *Contributor* that was involved in the development of the BPM+ Knowledge Package. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*ContributorKind*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *ContributorKind*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element named "ContributorKinds" (see the section entitled "BKPMN Library" for more information). Example *ContributorKind* instances could include: author; editor; endorser; reviewer; subject-matter-expert.

In practice, when a modeler creates a model with a *Contributor*, the *ContributorKind* will be instantiated by one of the instances in the Library created for the context of the model.

Generalizations

The *ContributorKind* element inherits the attributes and/or associations of:

- *SemanticReference* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *ContributorKind* element does not have any additional attributes and/or associations.

11.4 Publisher

A Publisher is an organization that will publish and distribute the BPM+ Knowledge Package. It is contained within a *BKPMNInstances*.

> Note: the publisher will also be found in the Pedigree of the *BKPMNPackage*, if the Pedigree is being tracked.

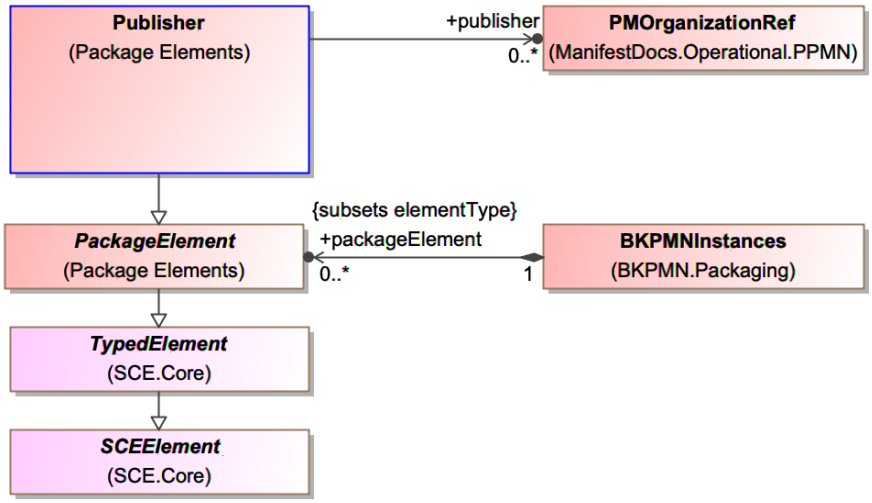


Figure 24: Publisher MM

Generalizations

The *Publisher* element inherits the attributes and/or associations of:

- *PackageElement* (see the section entitled "PackageElement" for more information).

Further, the *PackageElement* element inherits the attributes and/or associations of:

- *TypedElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *Publisher*:

Table 16. Publisher Attributes and/or Associations

Property/Association	Description
publisher : PMOrganizationRef [0..*]	

11.5 ParticipantRef

A Participant is distinguished from a Performer. Performers are those resources, often Human, that are responsible for performing activities within a Process or a Case. It is contained within a *BKPMNDefinitions*.

The following figure shows the *Participants* metamodel.

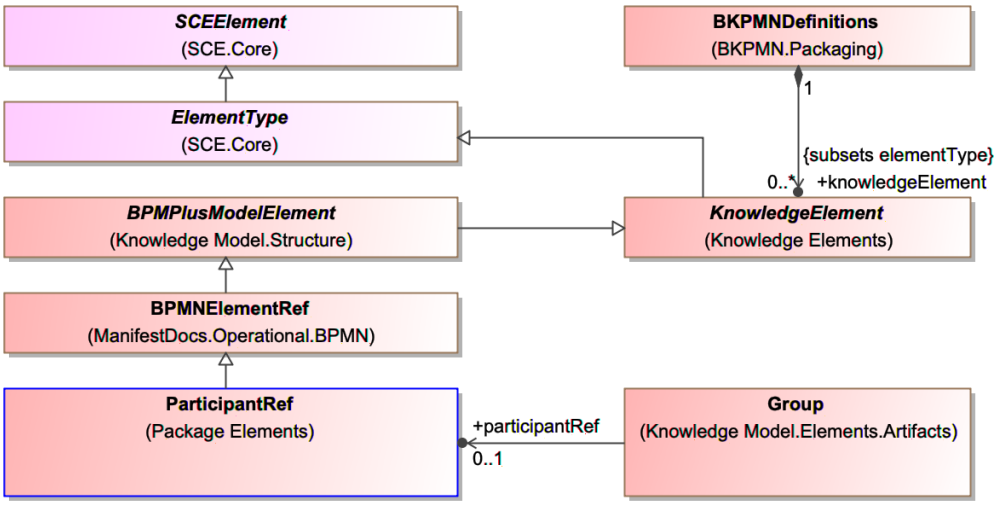


Figure 25: The Participants Metamodel

Generalizations

The *ParticipantRef* element inherits the attributes and/or associations of:

- *BPMNElementRef* (see the section entitled "BPMNElementRef" for more information).

Further, the *BPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *ParticipantRef* element does not have any additional attributes and/or associations.

11.6 PolicyRef

The *PolicyRef* identifies a policy document that is relevant to the BPM+ Knowledge Package. It is contained within a *BKPMNInstances*.

The following figure shows the *PolicyRef* metamodel.

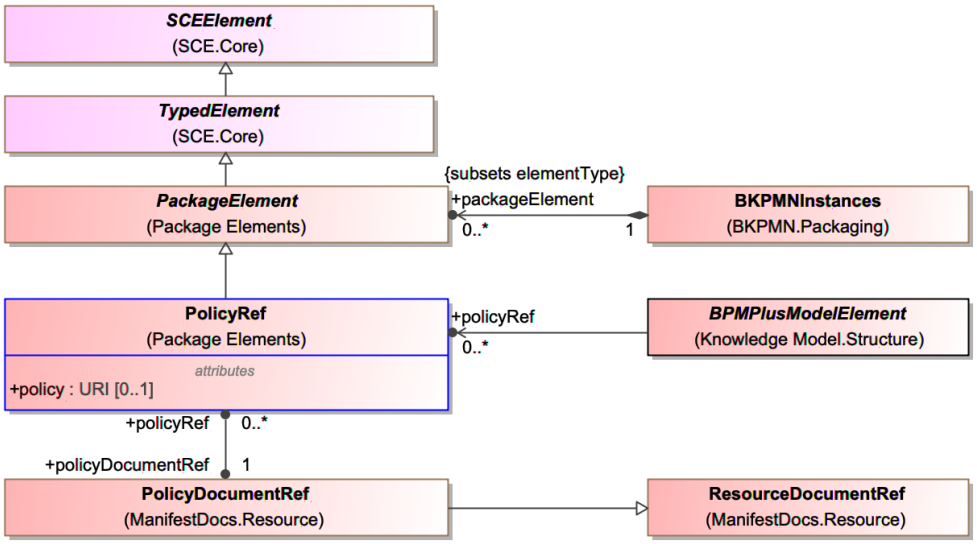


Figure 26: The PolicyRef Metamodel

Generalizations

The *PolicyRef* element inherits the attributes and/or associations of:

- *PackageElement* (see the section entitled "PackageElement" for more information).

Further, the *PackageElement* element inherits the attributes and/or associations of:

- *TypedElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *PolicyRef*:

Table 17. PolicyRef Attributes and/or Associations

Property/Association	Description
policyRef : URI [0..1]	This identifies a specific policy (as identified through the `URI`) that is containted within the Policy Document.
policyDocumentRef : PolicyDocumentRef [1]	This identifies the Policy Document (through the *PolicyDocumentRef*) that contains the Policy element. This document SHALL be identified.

11.7 Purpose

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that indicates the kind of *Contributor* that was involved in the development of the BPM+ Knowledge Package. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*Purpose*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *Purpose*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element named "Purposes" (see the section entitled "BKPMN Library" for more information). Example *Purpose* instances could include: assessment; education. This

classification could be used as part of a search for a particular *BKPMNModel*, for example.

In practice, when a modeler creates a BPM+ Knowledge Package, the *Purpose* will be instantiated by one of the instances in the Library created for the context of the model.

The following figure shows the *Purpose* metamodel.

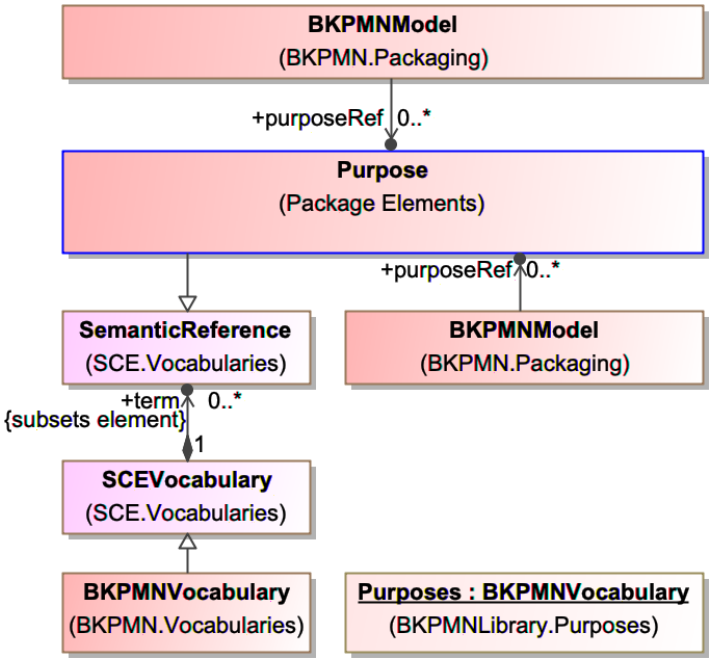


Figure 27: The Purpose Metamodel

Generalizations

The *Purpose* element inherits the attributes and/or associations of:

- *SemanticReference* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *Purpose* element does not have any additional attributes and/or associations.

11.8 UsageTerms

The *UsageTerms* defines when and where it is appropriate to perform the behaviors of the BPM+ Knowledge Package. It is contained within a *BKPMNInstances*.

Generalizations

The *UsageTerms* element inherits the attributes and/or associations of:

- *PackageElement* (see the section entitled "PackageElement" for more information).

Further, the *PackageElement* element inherits the attributes and/or associations of:

- *TypedElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *UsageTerms*:

Table 18. UsageTerms Attributes and/or Associations

Property/Association	Description
rightsDeclaration : String [0..1]	

12 Manifest Documents

The *Manifest* is a list of files that contain the components of the BPM+ Knowledge Package. The following sections will define the *Manifest* and documents it may contain.

12.1 Manifest

Each *BKPMNModel* will have one Manifest. Most of the time, a *Manifest* file will reference multiple BPM+ model files for the *BKPMNModel* Elements. For example, a **BPMN** xml file can contain many or all of the **BPMN** Processes that are included in the *BKPMNModel* . That is why the *Manifest* is separate element in the *BKPMNModel* metamodel rather than just having a list of the BPM+ models. Further, other files, such as narratives, will be in the *Manifest*.

The figure below displays the *Manifest* metamodel (which includes the standard instance provided by the **BKPMN** Library).

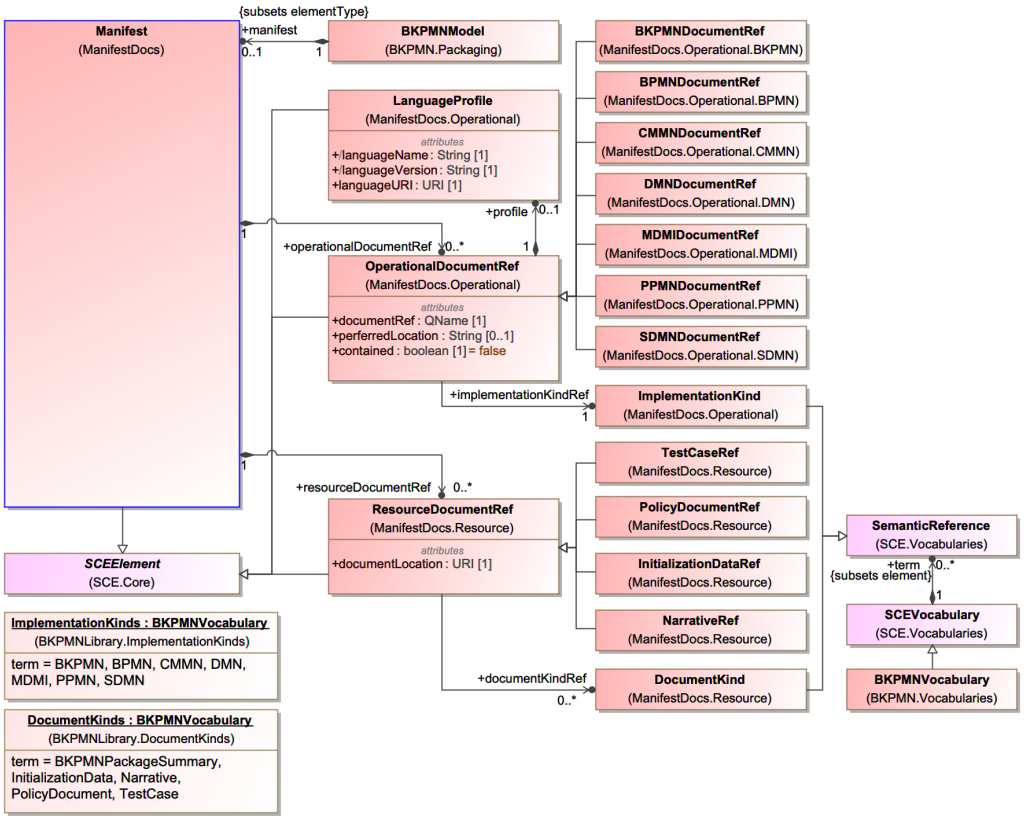


Figure 28: The Manifest Metamodel

Generalizations

The *Manifest* element inherits the attributes and/or associations of:

- *SCEElement* (see the section entitled "SCEElement" for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *Manifest*:

Table 19. Manifest Attributes and/or Associations

Property/Association	Description
operationalDocumentRef : OperationalDocumentRef [0..*]	This association provides the list of **BKPMN** documents (extension ".bkpmn") that are part of the *BKPMNDefinitions*.
resourceDocumentRef : ResourceDocumentRef [0..*]	This association provides the list of documents containing documents that are used a resource information that help in the understanding and purpose of the *BKPMNDefinitions*.

12.2 Operational Documents

The *OperationalDocumentRef* element is an element that provides a common set of attributes for the various kinds of operational or behavioral language documents that are referenced by the *Manifest*. There are currently 7 document types classes that are specializations of the *OperationalDocumentRef* element. Those classes are:

- *BKPMNDocumentRef*,
- *BPMNDocumentRef*,
- *CMMNDocumentRef*,
- *DMNDocumentRef*,
- *MDMIDocumentRef*,
- *PPMNDocumentRef*, and
- *SDMNDocumentRef*.

The figure below displays the *OperationalDocumentRef* metamodel (which includes the standard instance provided by the **BKPMN** Library).

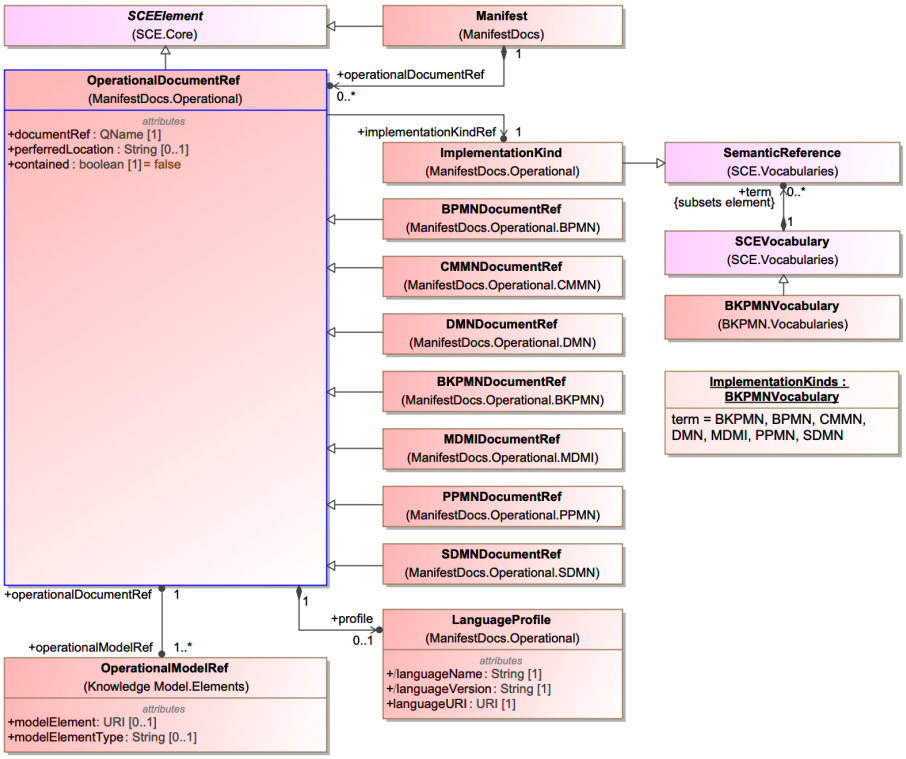


Figure 29: The OperationalDocumentRef Metamodel

12.2.1 OperationalDocumentRef

This element is concrete to allow for non-BPM+ operational documents to be included within the *BKPMNModel*.

Generalizations

The *OperationalDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *OperationalDocumentRef*:

Table 20. OperationalDocumentRef Attributes and/or Associations

Property/Association	Description
documentLocation : URI [1]	The URI where the Operational Document is located. The `documentLocation` SHALL be specified in a URI format.

implementationKind : String [1]	The implementation kind could be derived from the extension of the target file. e.g., a file with an extension of ".bpmn" would be listed as a **BPMN** implementation. This will be defined through an instance of the *ImplementationKind* class as provided by the predefined instance of the *BKPMNVocabulary* element (see the section entitled “BKPMN Library” for more information).
profile : LanguageProfile [0..1]	The *languageProfile* identifies the published versions of the types documents within the BPM+ Knowledge Package; particularly those that are models of a standard.
operationalModelRef : OperationalModelRef [1..*]	This identifies the relevant operational model.

12.2.2 LanguageProfile

A BPM+ Knowledge Package includes (references) multiple types of modeling languages that represent the expected behaviors (e.g., **BPMN**, **CMMN**, **DMN**). Each of the modeling languages evolve over time and can have multiple versions published. The *LanguageProfile* element identifies the version of the modeling language for an *OperationalDocumentRef*.

The figure below displays the *LanguageProfile* metamodel.

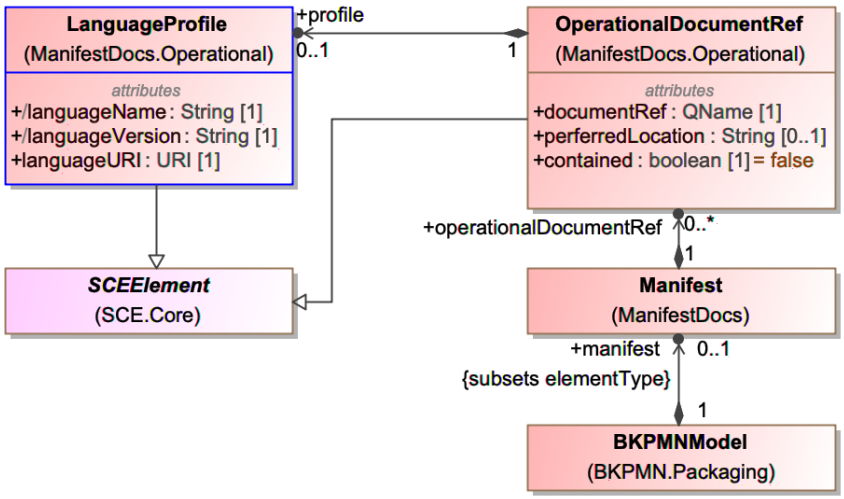


Figure 30: The Profile metamodel

Generalizations

The *LanguageProfile* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *Profile*:

Table 21. LanguageProfile Attributes and/or Associations

Property/Association	Description
languageName : String [1]	The name of the modeling language.
languageURI : URI [1]	The URI to the definition of the *ModelingLanguage*.
languageVersion : String [1]	The version of the modeling language.

12.2.3 References to BKPMN Elements

12.2.3.1 BKPMNDocumentRef

The Manifest lists zero or more **BKPMN** Documents, which are XML documents, usually with the file extension ".bkpmn." Within a single **BKPMN** Document there will be one *BKPMNDefinitions*. A *BKPMNDocumentRef* element references the XML document, thus including the **BKPMN** Document in the *Manifest*. It is contained within a *Manifest* through the *OperationalDocumentRef*.

The figure below displays the *BKPMNDocumentRef* metamodel.

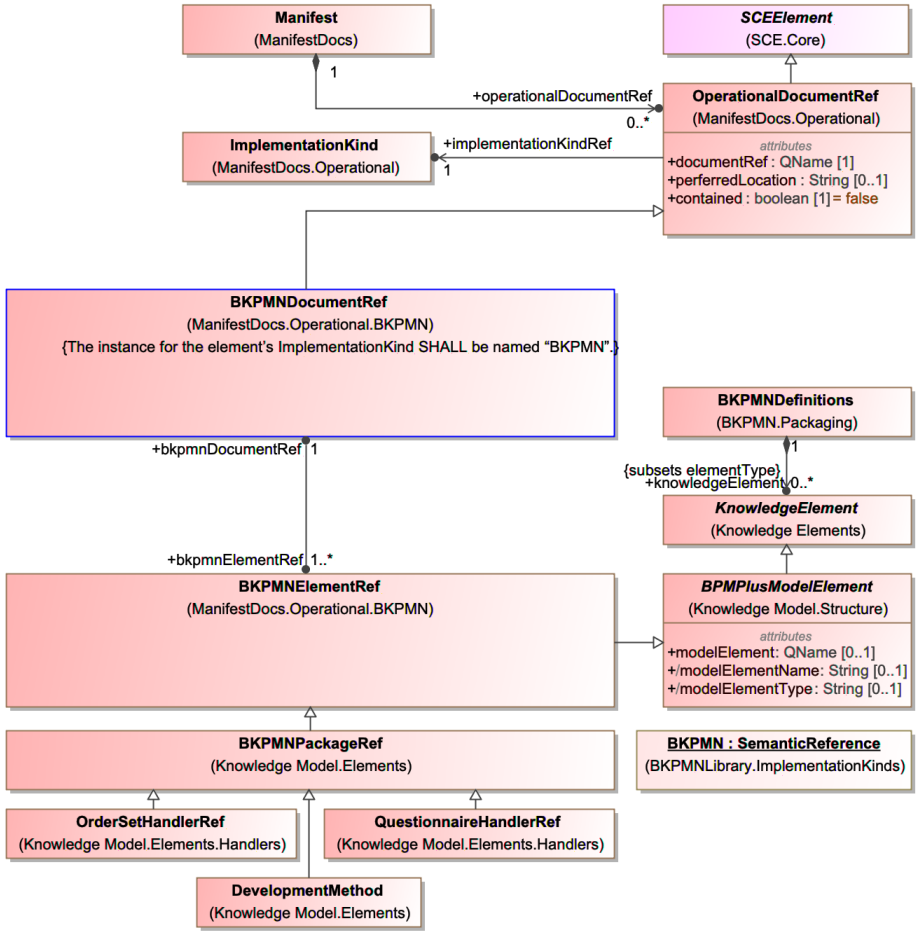


Figure 31: The BKPMNDocument Metamodel

Generalizations

The *BKPMNDocumentRef* element inherits the attributes and/or associations of:

- *OperationalDocumentRef* (see the section entitled "OperationalDocumentRef" for more information).

Further, the *OperationalDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *BKPMNDocumentRef* is a type of *OperationalDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *ImplementationKind* SHALL be named "BKPMN".

Properties

The following table presents the additional attributes and/or associations for *BKPMNDocumentRef*:

Table 22. BKPMNDocumentRef Attributes and/or Associations

Property/Association	Description
bkpmnElementRef : BKPMNElementRef [1..*]	This provides the list of the **BKPMN** elements that are referenced within the *BKPMNDefinitions*. There SHALL be at least one element referenced otherwise the *BPMNDocumentRef* does not need to be included in the *Manifest*. See the section "BKPMNElementRef," above, for more information.

12.2.3.2 BKPMNElementRef

There is currently 1 class that are specializations of the *BKPMNElementRef* element. That class is: *BKPMNPackageRef*. The *BKPMElement* of **BKPMN** is used in this context to provide the flexibility to extend **BKPMN** with references **BKPMN** elements that are not on this list. It is contained within a *BKPMNDefinitions*.

The figure below displays the *BKPMNElementRef* metamodel.

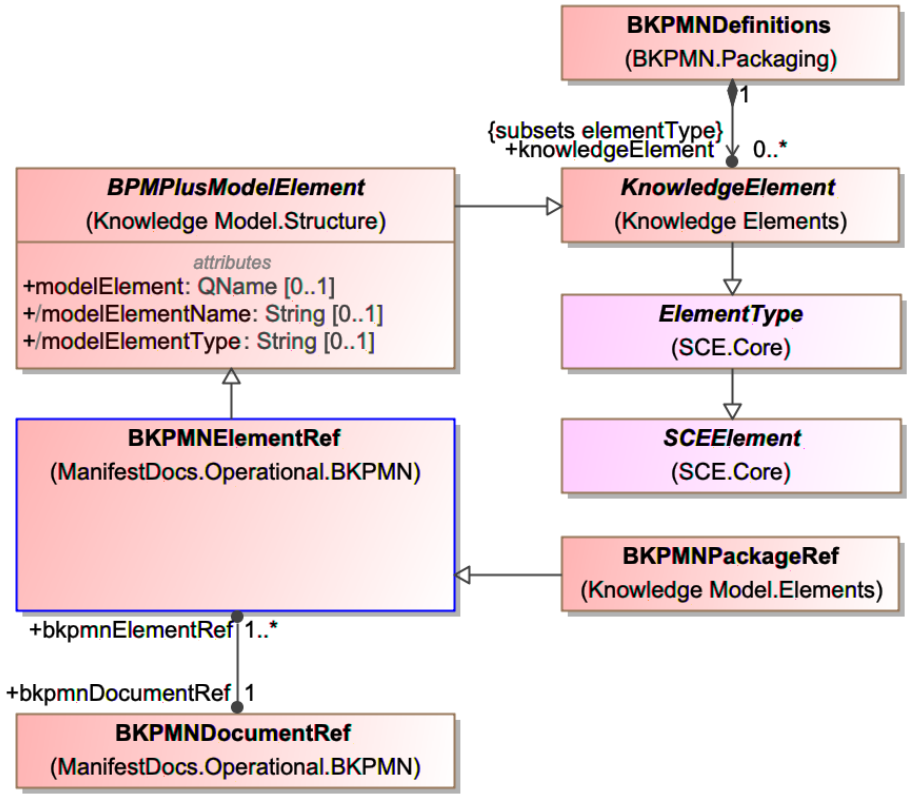


Figure 32: The BKPMNElementRef Metamodel

Generalizations

The *BKPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BKPMNElementRef*:

Table 23. BKPMNElementRef Attributes and/or Associations

Property/Association	Description
kpmnDocumentRef : BKPMNDocumentRef [1]	This identifies the **BKPMN** Document (through the BKPMNDocumentRef) that contains the BKPMN element referenced by the concrete sub-class of this BKPMModelElementRef. This document SHALL be identified.

12.2.4 References to BPMN Elements

12.2.4.1 BPMNDocumentRef

The Manifest lists zero or more **BPMN** Documents, which are XML documents, usually with the file extension ".bpmn." Within a single **BPMN** Document there can be multiple Processes, Choreographies, and/or Collaborations. A *BPMNDocumentRef* element references the XML document, thus including the **BPMN** Document in the *Manifest*. It is contained within a *Manifest* through the *OperationalDocumentRef*.

The figure below displays the *BPMNDocumentRef* metamodel.

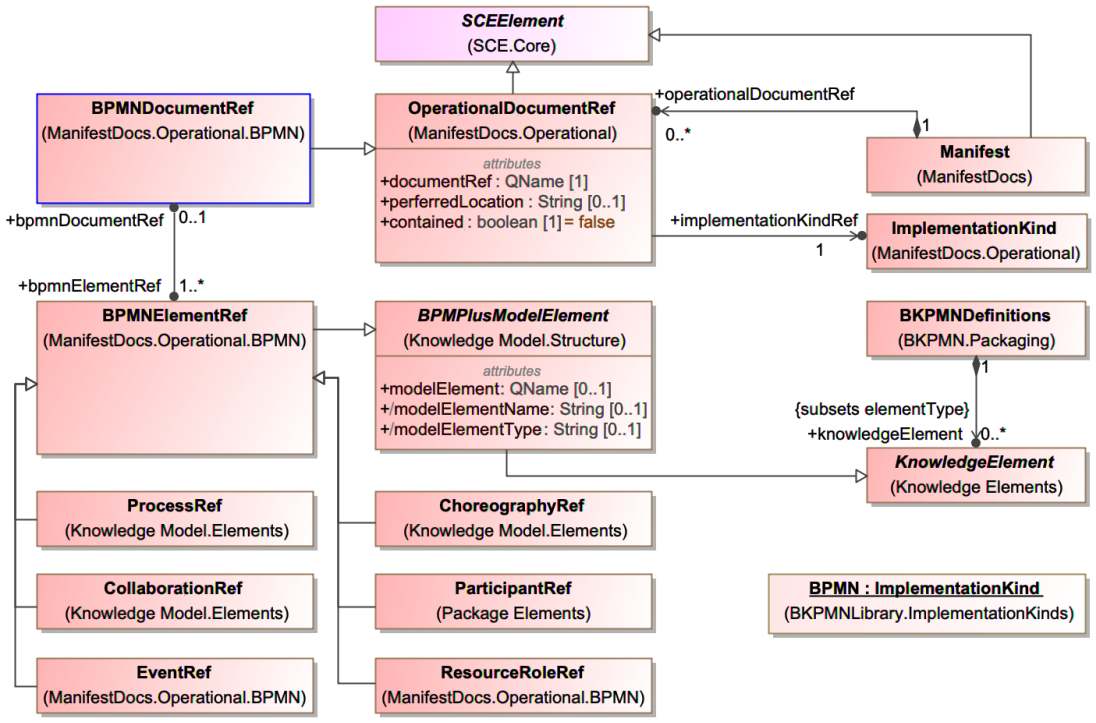


Figure 33: The BPMNDocument Metamodel

Generalizations

The *BPMNDocumentRef* element inherits the attributes and/or associations of:

- *OperationalDocumentRef* (see the section entitled "OperationalDocumentRef" for more information).

Further, the *OperationalDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *BPMNDocumentRef* is a type of *OperationalDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *ImplementationKind* SHALL be named "BPMN".

Properties

The following table presents the additional attributes and/or associations for *BPMNDocumentRef*:

Table 24. BPMNDocumentRef Attributes and/or Associations

Property/Association	Description
bpmnElementRef : BPMNElementRef [1..*]	This provides the list of the **BPMN** elements that are referenced within the *BKPMNDefinitions*. There SHALL be at least one element referenced otherwise the *BPMNDocumentRef* does not need to be included in the *Manifest*. See the section "BPMNElementRef," above, for more information.

12.2.4.2 BPMNElementRef

There are currently 6 classes that are specializations of the *BPMNElementRef* element. Those classes are: **ProcessRef**, *EventRef*, **CollaborationRef**, **ChoreographyRef**, *ResourceRoleRef*, and *ParticipantRef*. These 6 kinds of **BPMN** elements have been identified as being relevant for the definition of the *BKPMNDefinitions*. The *RootElement* of **BPMN** is used in this context to provide the flexibility to extend **BKPMN** with references **BPMN** elements that are not on this list. It is contained within a *BKPMNDefinitions*.

The figure below displays the *BPMNElementRef* metamodel.

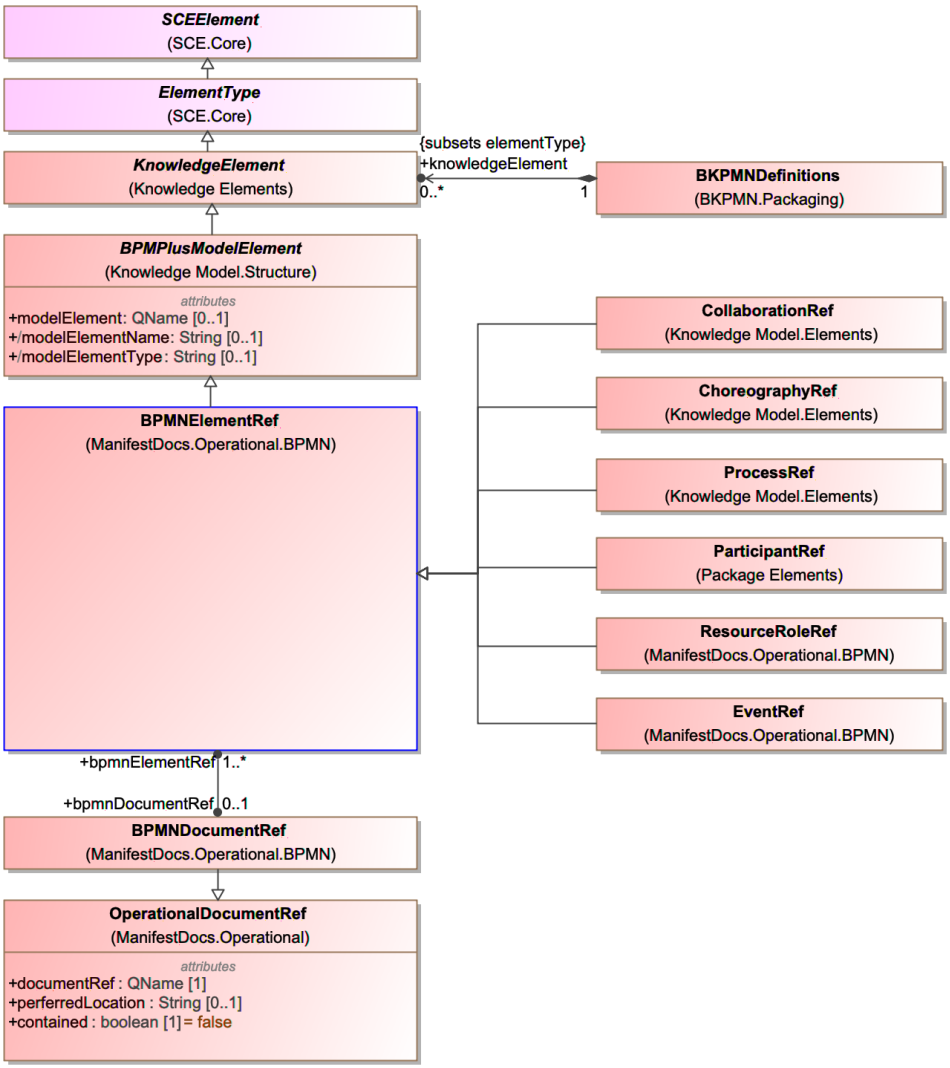


Figure 34: The BPMNElementRef Metamodel

Generalizations

The *BPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BPMNElementRef*:

Table 25. BPMNElementRef Attributes and/or Associations

Property/Association	Description
bpmnDocumentRef : BPMNDocumentRef [0..1]	This identifies the **BPMN** Document (through the *BPMNDocumentRef*) that contains the **BPMN** element referenced by the concrete sub-class of this *BPMPlusModelElementRef*. This document SHALL be identified.

12.2.4.3 EventRef

This element identifies a significant event that occurs within one of the behaviors of the BPM+ Knowledge Package (e.g., a Process or a Case). It is referenced by a *LifecycleEvent* and is contained within a *BKPMNDefinitions*.

The figure below displays the *EventRef* metamodel.

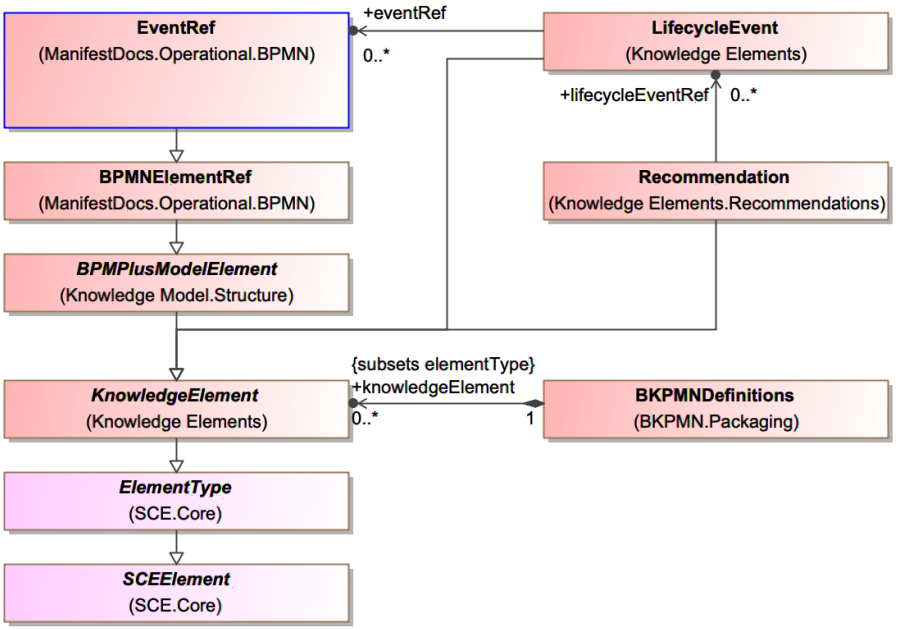


Figure 35: The EventRef Metamodel

Generalizations

The *EventRef* element inherits the attributes and/or associations of:

- *BPMNElementRef* (see the section entitled "BPMNElementRef" for more information).

Further, the *BPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *EventRef* element does not have any additional attributes and/or associations.

12.2.4.4 ResourceRoleRef

ResourceRoles are contained within a **BPMN** Process. In the context of **BKPMN**, they can be associated with a BPM+ Knowledge Package *Contributor*.

Generalizations

The *ResourceRoleRef* element inherits the attributes and/or associations of:

- *BPMNElementRef* (see the section entitled "BPMNElementRef" for more information).

Further, the *BPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *ResourceRoleRef* element does not have any additional attributes and/or associations.

12.2.5 References to CMMN Elements

12.2.5.1 CMMNDocumentRef

The Manifest lists zero or more CMMN Documents, which are XML documents, usually with the file extension ".cmmn." Within a single CMMN Document there can be multiple Cases. A *CMMNDocumentRef* element references the XML document, thus including the CMMN Document in the *Manifest*. It is contained within a *Manifest* through the *OperationalDocumentRef*.

The figure below displays the *CMMNDocumentRef* metamodel.

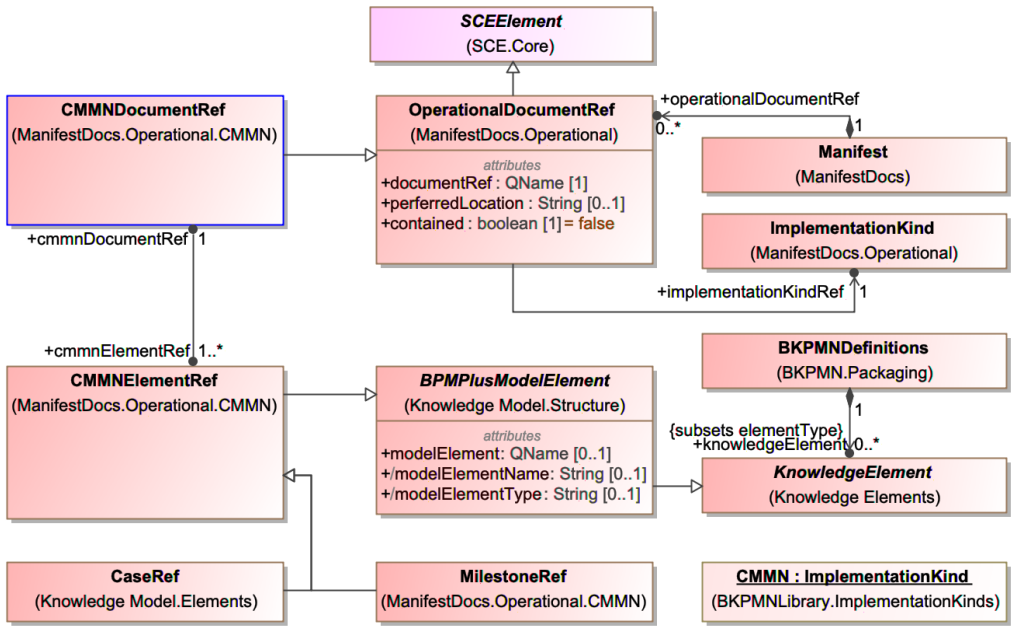


Figure 36: The CMMNDocument Metamodel

Generalizations

The *CMMNDocumentRef* element inherits the attributes and/or associations of:

- *OperationalDocumentRef* (see the section entitled "OperationalDocumentRef" for more information).

Further, the *OperationalDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *CMMNDocumentRef* is a type of *OperationalDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *ImplementationKind* SHALL be named "CMMN".

Properties

The following table presents the additional attributes and/or associations for *CMMNDocumentRef*:

Table 26. CMMNDocumentRef Attributes and/or Associations

Property/Association	Description
cmmnElementRef : CMMNElementRef [1..*]	This provides the list of the **CMMN** elements that are referenced within the *BKPMNDefinitions*. There SHALL be at least one element referenced otherwise the *CMMNDocumentRef* does not need to be included in the *Manifest*. See the section "CMMNElementRef," above, for more information.

12.2.5.2 CMMNElementRef

There are currently 4 classes that are specializations of the *CMMNElementRef* element. Those classes are: **CaseRef**, *MilestoneRef*, *ExitCriterionRef*, and *CaseRoleRef*. These 4 kinds of **CMMN** elements have been identified as being relevant for the definition of the *BKPMNDefinitions*. The *CMMNElement* of **CMMN** is used in this context to provide the flexibility to extend **BKPMN** with references **CMMN** elements that are not on this list. It is contained within a *BKPMNDefinitions*.

The figure below displays the *CMMNElementRef* metamodel.

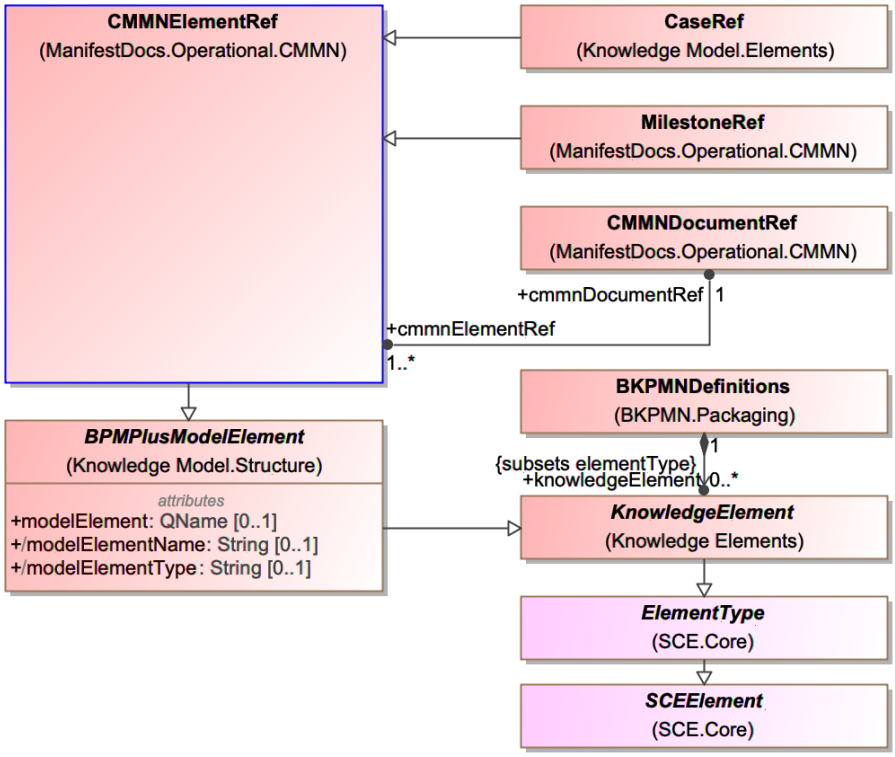


Figure 37: The CMMNElementRef Metamodel

Generalizations

The *CMMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *CMMNElementRef*:

Table 27. CMMNElementRef Attributes and/or Associations

Property/Association	Description
cmmnDocumentRef : CMMNDocumentRef [1]	This identifies the **CMMN** Document (through the *CMMNDocumentRef*) that contains the **CMMN** element referenced by the concrete sub-class of this *BPMPlusModelElementRef*. This document SHALL be identified.

12.2.5.3 MilestoneRef

This element identifies a significant milestone that occurs within one of the behaviors of the BPM+ Knowledge Package (Case). It is referenced by a *LifecycleEvent* and is contained within a *BKPMNDefinitions*.

Generalizations

The *MilestoneRef* element inherits the attributes and/or associations of:

- *CMMNElementRef* (see the section entitled "CMMNElementRef" for more information).

Further, the *CMMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *MilestoneRef* element does not have any additional attributes and/or associations.

12.2.6 References to DMN Elements

12.2.6.1 DMNDocumentRef

The Manifest lists zero or more DMN Documents, which are XML documents, usually with the file extension ".dmn." Within a single DMN Document there can be multiple Decision Services. A *DMNDocumentRef* element references the XML document, thus including the DMN Document in the *Manifest*. It is contained within a *Manifest* through the *OperationalDocumentRef*.

The figure below displays the *DMNDocumentRef* metamodel.

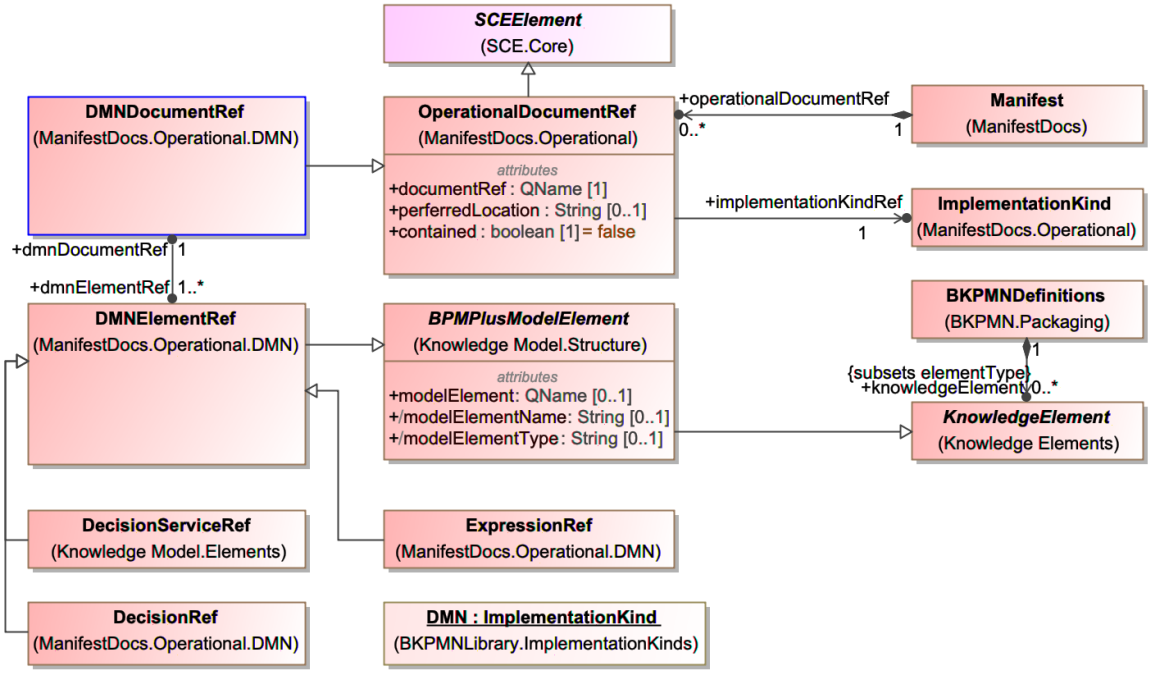


Figure 38: The DMNDocument Metamodel

Generalizations

The *DMNDocumentRef* element inherits the attributes and/or associations of:

- *OperationalDocumentRef* (see the section entitled "OperationalDocumentRef" for more information).

Further, the *OperationalDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *DMNDocumentRef* is a type of *OperationalDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *ImplementationKind* SHALL be named "DMN".

Properties

The following table presents the additional attributes and/or associations for *DMNDocumentRef*:

Table 28. DMNDocumentRef Attributes and/or Associations

Property/Association	Description
dmnElementRef : DMNElementRef [1..*]	This provides the list of the **DMN** elements that are referenced within the *BKPMNDefinitions*. There SHALL be at least one element referenced otherwise the *DMNDocumentRef* does not need to be included in the *Manifest*. See the section "DMNElementRef," above, for more information.

12.2.6.2 DMNElementRef

There are currently 3 classes that are specializations of the *DMNElementRef* element. Those classes are: **DecisionServiceRef**, *DecisionRef*, and *ExpressionRef*. These 3 kinds of **DMN** elements have been identified as being relevant for the definition of the *BKPMNDefinitions*. The *DMNElement* of **DMN** is used in this context to provide the flexibility to extend **BKPMN** with references **DMN** elements that are not on this list. It is contained within a *BKPMNDefinitions*.

The figure below displays the *DMNElementRef* metamodel.

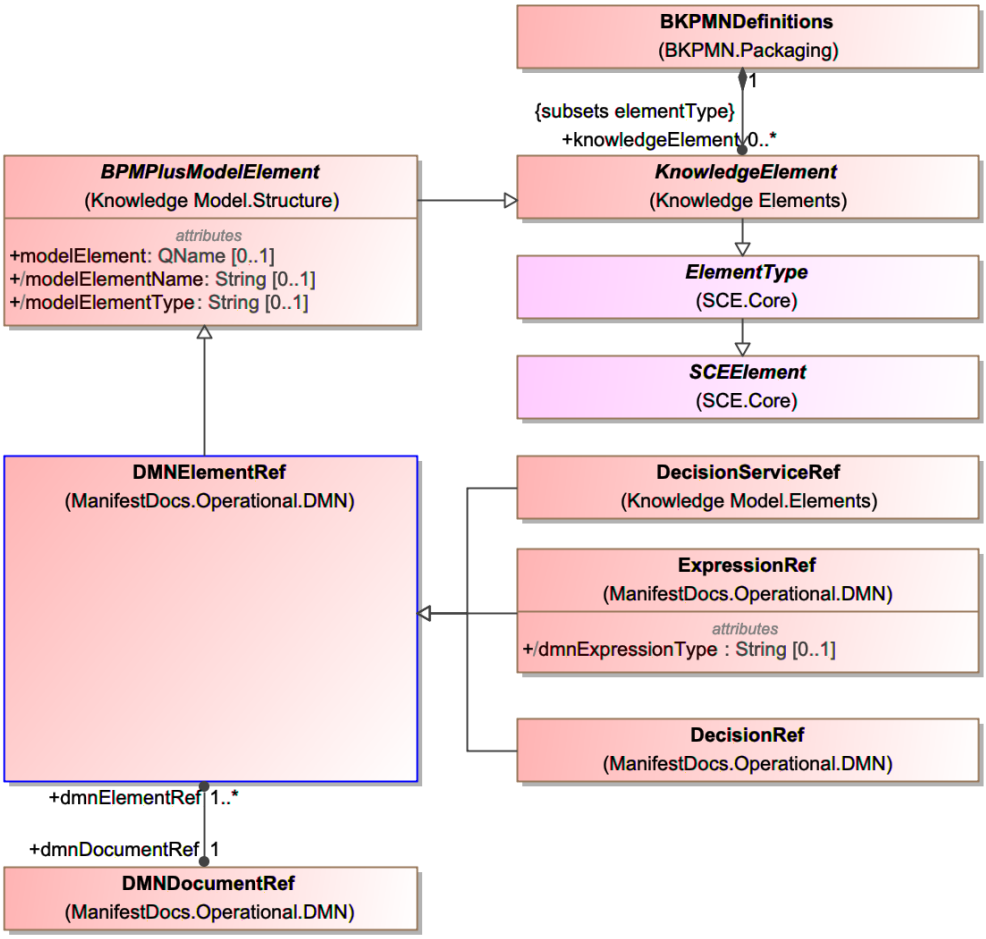


Figure 39: The DMNElementRef Metamodel

Generalizations

The *DMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *DMNElementRef*:

Table 29. DMNElementRef Attributes and/or Associations

Property/Association	Description
dmnDocumentRef : DMNDocumentRef [1]	This identifies the **CMMN** Document (through the *CMMNDocumentRef*) that contains the **CMMN** element referenced by the concrete sub-class of this *BPMPlusModelElementRef*. This document SHALL be identified.

12.2.6.3 DecisionRef

This element identifies a significant decision that occurs within one of the behaviors of the BPM+ Knowledge Package (a Decision Model). It may be used in place of a *DecisionServiceRef* and is contained within a *BKPMNDefinitions*.

Generalizations

The *DecisionRef* element inherits the attributes and/or associations of:

- *DMNElementRef* (see the section entitled "DMNElementRef" for more information).

Further, the *DMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *DecisionRef* element does not have any additional attributes and/or associations.

12.2.6.4 ExpressionRef

BKPMN does not directly support the definition of executable expressions. If a *BKPMNDefinitions*developer requires an executable expression, then the capabilities of **DMN** should be used. The **BKPMN** *Expression* can then be linked to a **DMN** Expression that is part of the *BKPMNDefinitions*. The expression will be contained within a **DMN** model as part of a Decision or Business Knowledge Model.

Generalizations

The *ExpressionRef* element inherits the attributes and/or associations of:

- *DMNElementRef* (see the section entitled "DMNElementRef" for more information).

Further, the *DMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *ExpressionRef*:

Table 30. ExpressionRef Attributes and/or Associations

Property/Association	Description
dmnExpressionKind : String [0..1]	This identifies the type of expression that is being referenced. See the **DMN** specification for the possible kinds of expressions.

12.2.7 References to MDMI Elements

12.2.7.1 MDMIDocumentRef

The Manifest lists zero or more **MDMI** (Model Driven Message Interoperability) Documents, which are XML documents, usually with the file extension ".mdmi." Within a single **MDMI** Document there will be multiple **MDMI** models. A *MDMIDocumentRef* element references the XML document, thus including the MDMI Document in the *Manifest*. It is contained within a *Manifest* through the *OperationalDocumentRef*.

Generalizations

The *MDMIDocumentRef* element inherits the attributes and/or associations of:

- *OperationalDocumentRef* (see the section entitled "OperationalDocumentRef" for more information).

Further, the *OperationalDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *MDMIDocumentRef* is a type of *OperationalDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *ImplementationKind* SHALL be named "MDMI".

Properties

The following table presents the additional attributes and/or associations for *MDMIDocumentRef*:

Table 31. MDMIDocumentRef Attributes and/or Associations

Property/Association	Description
mdmiElementRef : MDMIElementRef [1..*]	This provides the list of the **MDMI** elements that are referenced within the *BKPMNDefinitions*. There SHALL be at least one element referenced otherwise the *MDMIDocumentRef* does not need to be included in the *Manifest*. See the section "MDMIElementRef," above, for more information.

12.2.7.2 MDMIElementRef

The *MDMIElement* of **MDMI** is used in this context to provide the flexibility to extend **BKPMN** with references **MDMI** elements that have not been added to **BKPMN**. It is contained within a *BKPMNDefinitions*.

The figure below displays the *MDMIElementRef* metamodel.

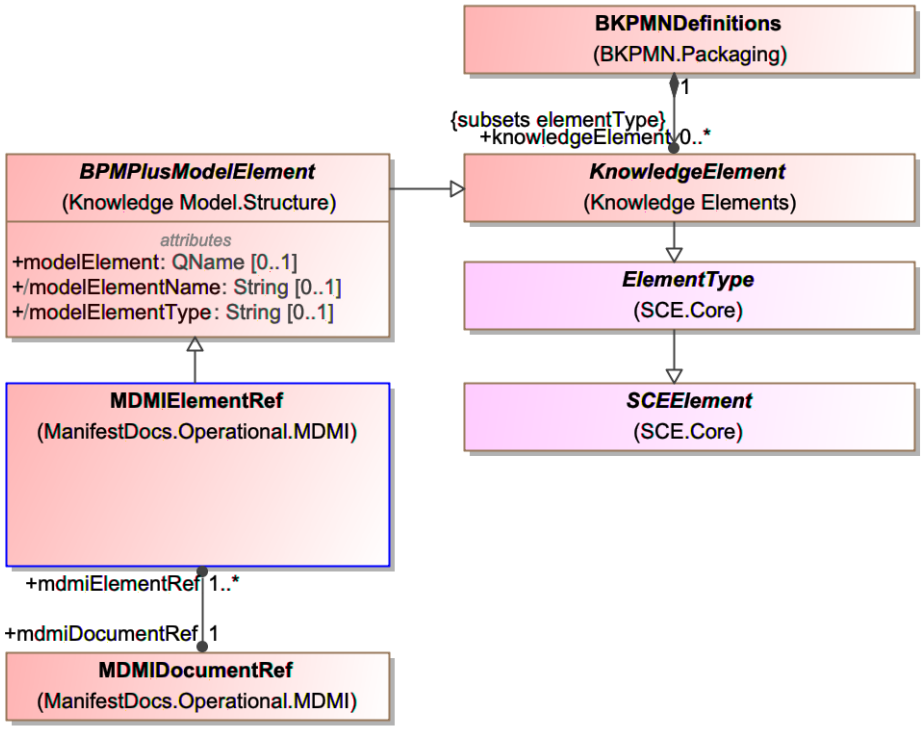


Figure 40: The MDMIElementRef Metamodel

Generalizations

The *MDMIElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *MDMIElementRef*:

Table 32. MDMIElementRef Attributes and/or Associations

Property/Association	Description
mdmiDocumentRef : MDMIDocumentRef [1]	This identifies the **MDMI** Document (through the *MDMIDocumentRef*) that contains the **MDMI** element referenced by the concrete sub-class of this *BPMPlusModelElement*. This document MUST be identified.

12.2.8 References to PPMN Elements

12.2.8.1 PPMNDocumentRef

The Manifest lists zero or more PPMN Documents, which are XML documents, usually with the file extension ".ppmn." Within a single PPMN Document there will be one Pedigree and Provenance Model. A *PPMNDocumentRef* element references the XML document, thus including the PPMN Document in the *Manifest*. It is contained within a *Manifest* through the *OperationalDocumentRef*.

The figure below displays the *PPMNDocumentRef* metamodel.

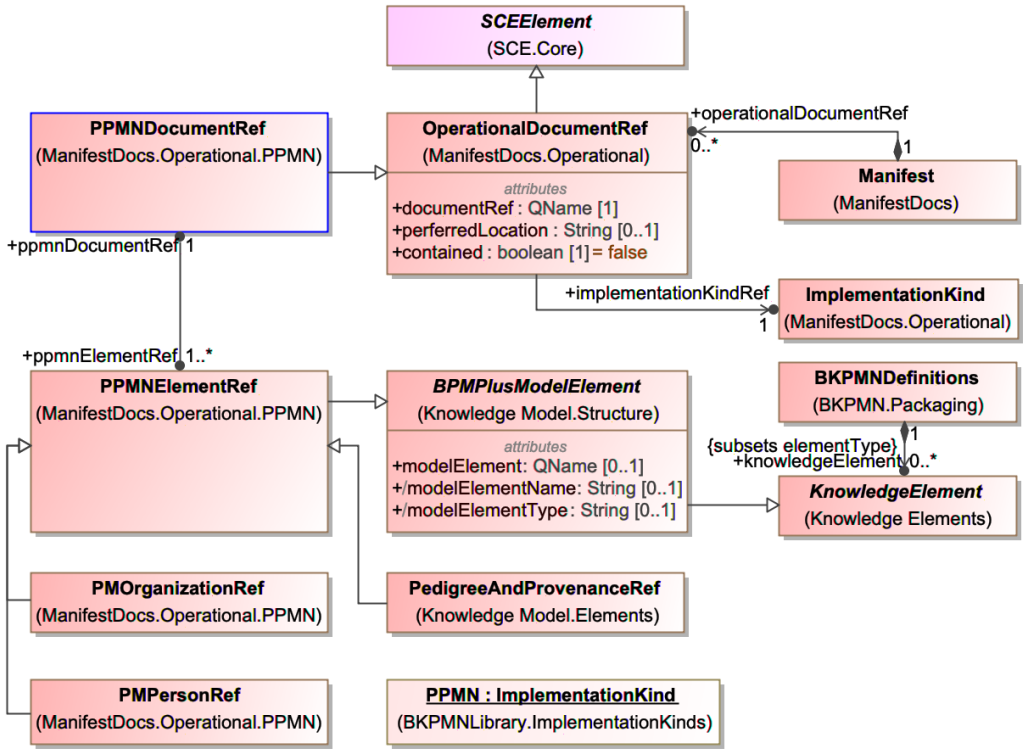


Figure 41: PPMNDocumentRef Metamodel

Generalizations

The *PPMNDocumentRef* element inherits the attributes and/or associations of:

- *OperationalDocumentRef* (see the section entitled "OperationalDocumentRef" for more information).

Further, the *OperationalDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *PPMNDocumentRef*:

Table 33. PPMNDocumentRef Attributes and/or Associations

Property/Association	Description
ppmnElementRef : PPMNElementRef [1..*]	This provides the list of the **PPMN** elements that are referenced within the *BKPMNDefinitions*. There SHALL be at least one element referenced otherwise the *PPMNDocumentRef* does not need to be included in the *Manifest*. See the section "PPMNElementRef," above, for more information.

12.2.8.2 PPMNElementRef

There are currently 3 classes that are specializations of the *PPMNElementRef* element. Those classes are: **PedigreeAndProvenanceRef**, *PMOrganizationRef*, and **PMPersonRef**. The *PPMNElementRef* of **PPMN** is used in this context to provide the flexibility to extend **BKPMN** with references **PPMN** elements that are not on this list. It is contained within a *BKPMNDefinitions*.

The figure below displays the *PPMNElementRef* metamodel.

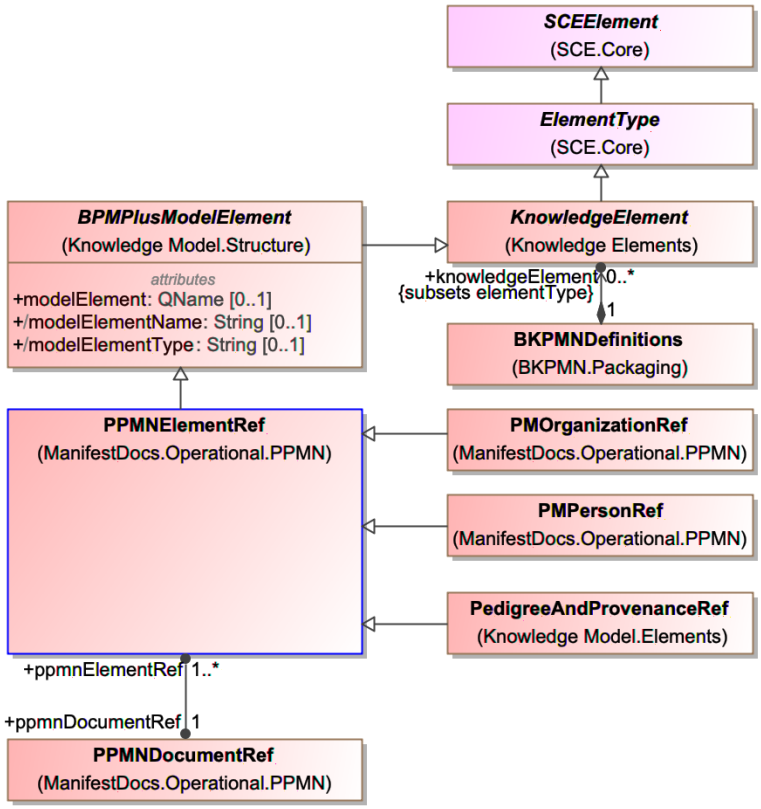


Figure 42: The PPMNElementRef Metamodel

Generalizations

The *PPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *PPMNElementRef*:

Table 34. PPMNElementRef Attributes and/or Associations

Property/Association	Description
ppmnDocumentRef : PPMNDocumentRef [1]	This identifies the **PPMN** Document (through the *PPMNDocumentRef*) that contains the PP**MN** element referenced by the concrete sub-class of this *BPMPlusModelElement*. This document MUST be identified.

12.2.8.3 PMOrganizationRef

Generalizations

The *PMOrganizationRef* element inherits the attributes and/or associations of:

- *PPMNElementRef* (see the section entitled "PPMNElementRef" for more information).

Further, the *PPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *PMOrganizationRef* element does not have any additional attributes and/or associations.

12.2.8.4 PMPersonRef

Generalizations

The *PMPersonRef* element inherits the attributes and/or associations of:

- *PPMNElementRef* (see the section entitled "PPMNElementRef" for more information).

Further, the *PPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *PMPersonRef* element does not have any additional attributes and/or associations.

12.2.9 References to SDMN Elements

12.2.9.1 SDMNDocumentRef

The *Manifest* lists zero or more SDMN Documents, which are XML documents, usually with the file extension ".sdmn." Within a single SDMN Document there will be one Shared Data Model. A *SDMNDocumentRef* element references the XML document, thus including the SDMN Document in the *Manifest*. It is contained within a *Manifest* through the *OperationalDocumentRef*.

The figure below displays the *SDMNDocumentRef* metamodel.

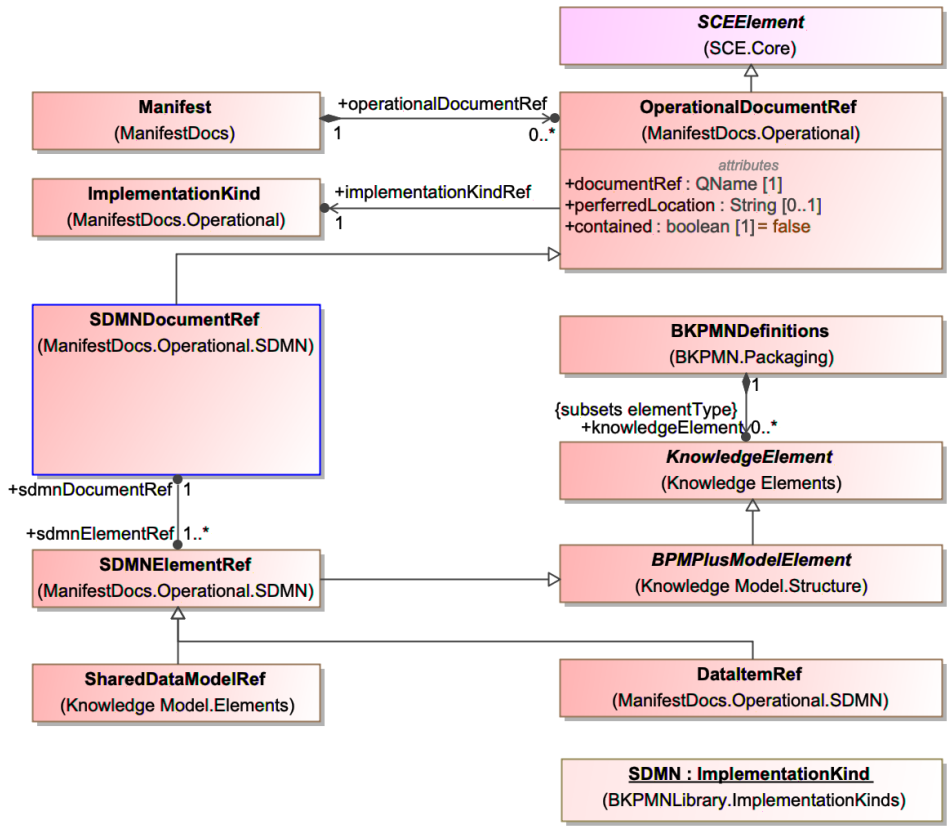


Figure 43: The SDMNDocument Metamodel

Generalizations

The *SDMNDocumentRef* element inherits the attributes and/or associations of:

- *OperationalDocumentRef* (see the section entitled "OperationalDocumentRef" for more information).

Further, the *OperationalDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *SDMNDocumentRef* is a type of *OperationalDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *ImplementationKind* SHALL be named "SDMN".

Properties

The following table presents the additional attributes and/or associations for *SDMNDocumentRef*:

Table 35. SDMNDocumentRef Attributes and/or Associations

Property/Association	Description
sdmnElementRef : SDMNElementRef [1..*]	This provides the list of the **SDMN** elements that are referenced within the *BKPMNDefinitions*. There SHALL be at least one element referenced otherwise the *SDMNDocumentRef* does not need to be included in the *Manifest*. See the section "SDMNElementRef," above, for more information.

12.2.9.2 SDMNElementRef

There are currently 2 classes that are specializations of the *SDMNElementRef* element. Those classes are: *DataItemRef*, and **SharedDataModelRef**. The *SDMNElement* of **SDMN** is used in this context to provide the flexibility to extend **BKPMN** with references **SDMN** elements that are not on this list. It is contained within a *BKPMNDefinitions*.

The figure below displays the *SDMNElementRef* metamodel.

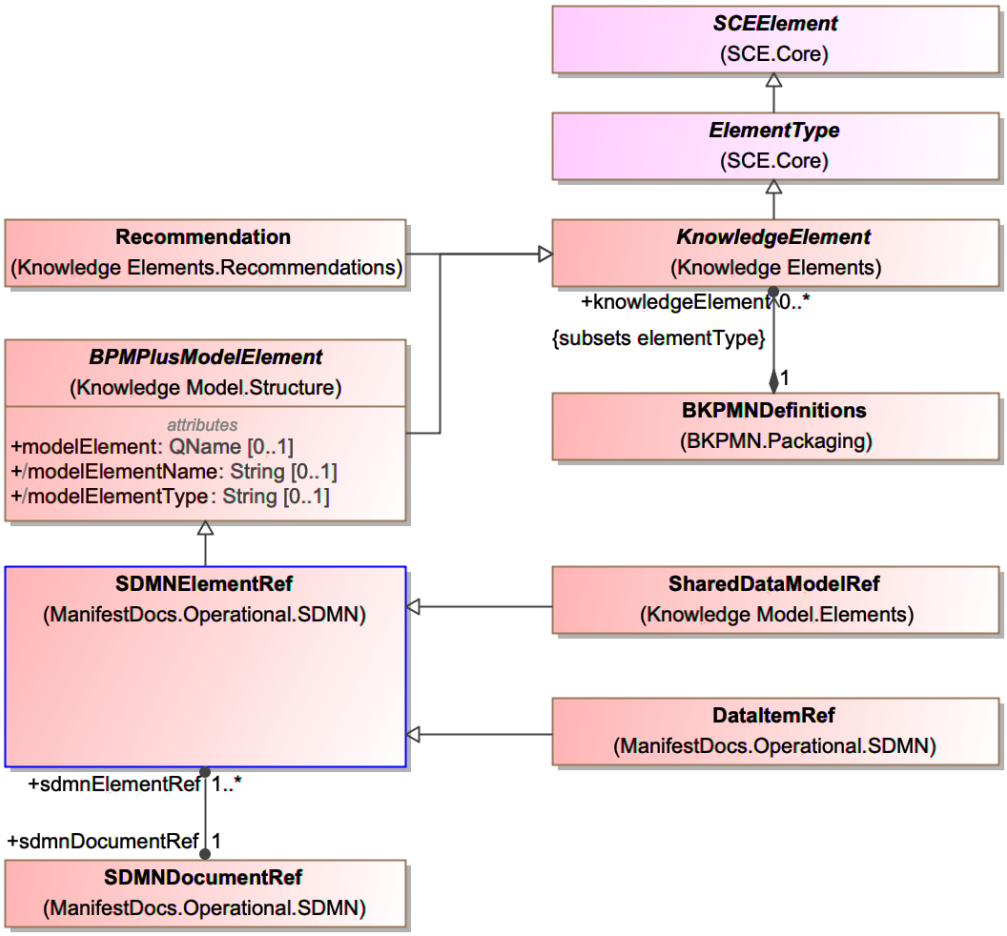


Figure 44: The SDMNElementRef Metamodel

Generalizations

The *SDMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *SDMNElementRef*:

Table 36. SDMNElementRef Attributes and/or Associations

Property/Association	Description
sdmnDocumentRef : SDMNDocumentRef [1]	This identifies the **SDMN** Document (through the *SDMNDocumentRef*) that contains the **SDMN** element referenced by the concrete sub-class of this *BPMPlusModelElementRef*. This document SHALL be identified.

12.2.9.3 DataItemRef

This element identifies a significant data items that occurs within the behaviors of the BPM+ Knowledge Package (e.g., Process, Case, or Decision Model). It is referenced by a *RiskFactor*, *BKPMNPackageInput*, and *BKPMNPackageOutput* and is contained within a *BKPMNDefinitions*.

The figure below displays the *DataItemRef* metamodel.

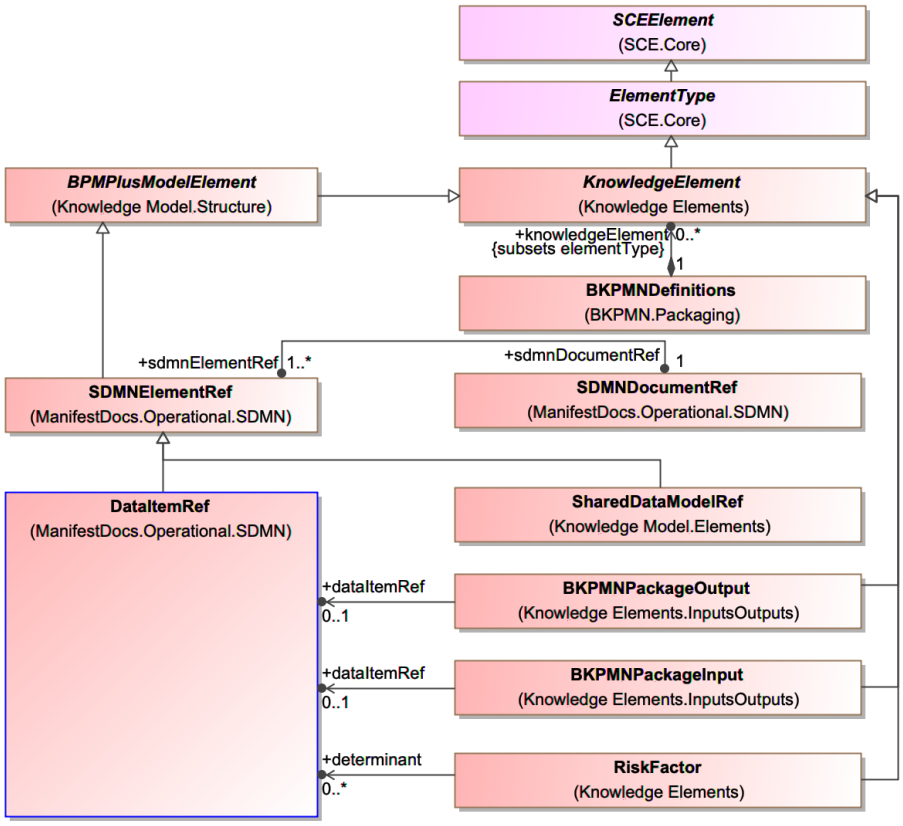


Figure 45: The DataItemRef Metamodel

Generalizations

The *DataItemRef* element inherits the attributes and/or associations of:

- *SDMNElementRef* (see the section entitled "SDMNElementRef" for more information).

Further, the *SDMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *DataItemRef* element does not have any additional attributes and/or associations.

12.3 Resource Documents

The *ResourceDocumentRef* element is an element that provides a common set of attributes for the various kinds of supporting documents that are referenced by the *Manifest*. There are currently 4 document kinds classes that are specializations of the *ResourceDocumentRef* element. Those classes are:

- *BKPMNPackageSummary*
- *InitializationDataRef*,
- *NarrativeRef*,
- *PolicyDocumentRef*, and
- *TestCaseRef*.

The figure below displays the *ResourceDocumentRef* metamodel (which includes the standard instance provided by the **BKPMN** Library).

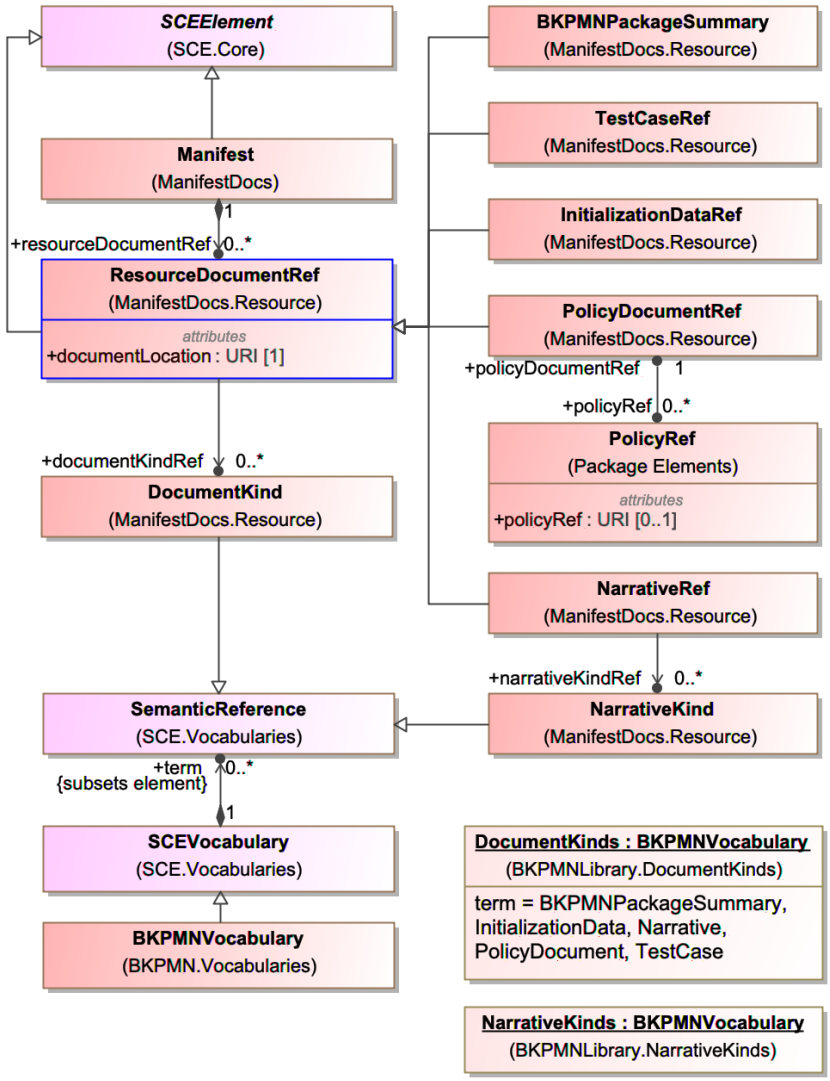


Figure 46: The ResourceDocumentRef Model

12.3.1 ResourceDocumentRef

As kind of element, *ResourceDocumentRefs* are not graphically shown on a **KnowledgeModel**. The concrete elements that are specializations of *ResourceDocumentRef* are contained within a *Manifest*.

Generalizations

The *ResourceDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *ResourceDocumentRef*:

Table 37. ResourceDocumentRef Attributes and/or Associations

Property/Association	Description
documentLocation : URI [1]	The URI where the *RelatedResourceRef* is located. The `documentLocation` SHALL be specified in a URI format.
documentKindRef : DocumentKind [0..1]	This will be defined through an instance of the *DocumentKind* class as provided by the predefined instance of the *BKPMNVocabulary* element (see the section entitled "BKPMN Library" for more information).

12.3.2 DocumentKind

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that indicates the kind of document that the *ResourceDocumentRef* is. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*DocumentKind*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *DocumentKind*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element named "DocumentKinds" (see the section entitled "BKPMN Library" for more information). Example *DocumentKind* instances could include: 5WH Library; citation; composed-of; depends-on; derived-from; documentation; education; initialization-data; justification; narrative; policy-document; predecessor; successor; supporting-evidence; test-case.

In practice, when a modeler creates a model with a *ResourceDocumentRef*, the *DocumentKind* will be instantiated by one of the instances in the Library created for the context of the model.

Generalizations

The *DocumentKind* element inherits the attributes and/or associations of:

- *SemanticReference* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *DocumentKind* element does not have any additional attributes and/or associations.

12.3.3 BKPMNPackageSummary

This is a document that provides and description and summary of the BPM+ Knowledge Package. It is contained within a *Manifest*.

Generalizations

The *BKPMNPackageSummary* element inherits the attributes and/or associations of:

- *ResourceDocumentRef* (see the section entitled "ResourceDocumentRef" for more information).

Further, the *ResourceDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *BKPMNPackageSummary* is a type of *ResourceDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *DocumentKind* SHALL be named "BKPMNPackageSummary".

Properties

The following table presents the additional attributes and/or associations for *BKPMNPackageSummary*:

Table 38. BKPMNPackageSummary Attributes and/or Associations

Property/Association	Description
language : String [0..1]	This attribute sets the written language used for the *BKPMNPackageSummary*. If this attribute is not set, then the setting from the *BKPMNDefinitions* element will be used.

12.3.4 InitializationDataRef

These documents provide information about the initialization of data items relevant to the BPM+ Knowledge Package. It is contained within a *Manifest* through the *ResourceDocumentRef*.

Generalizations

The *InitializationDataRef* element inherits the attributes and/or associations of:

- *ResourceDocumentRef* (see the section entitled "ResourceDocumentRef" for more information).

Further, the *ResourceDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *InitializationDataRef* is a type of *ResourceDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *DocumentKind* SHALL be named "InitializationData".

Properties

The *InitializationDataRef* element does not have any additional attributes and/or associations.

12.3.5 NarrativeRef

Narratives are text or video documents that provide supporting information to help understand the behaviors of a *BKPMNDefinitions*. They add supporting descriptions that would help someone navigate the models or understand why they are structured the way that they are. It is contained within a *Manifest* through the *ResourceDocumentRef*.

Generalizations

The *NarrativeRef* element inherits the attributes and/or associations of:

- *ResourceDocumentRef* (see the section entitled "ResourceDocumentRef" for more information).

Further, the *ResourceDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *NarrativeRef* is a type of *ResourceDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *DocumentKind* SHALL be named "Narrative".

Properties

The following table presents the additional attributes and/or associations for *NarrativeRef*:

Table 39. NarrativeRef Attributes and/or Associations

Property/Association	Description
narrativeKindRef : NarrativeRef [0..*]	

12.3.6 NarrativeKind

This class is a type of *SemanticReference* that serves as the `terms` for an *SDMNVocabulary* that indicates the kind of document that the *NarrativeRef* is. Instead of being defined a fixed enumerated list, the kinds can be defined through a class (*NarrativeKind*) and instances of that class. **BKPMN** does not provide any pre-defined instances of *NarrativeKind*. These can be added by a modeler or an implementation of **BKPMN** as terms for the instance of the *SDMNVocabulary* element named "NarrativeKinds" (see the section entitled "BKPMN Library" for more information). Example *NarrativeKind* instances could include: background; discussion; scope.

In practice, when a modeler creates a model with a *NarrativeRef*, the *NarrativeKind* will be instantiated by one of the instances in the Library created for the context of the model.

Generalizations

The *NarrativeKind* element inherits the attributes and/or associations of:

- *SemanticReference* (see the section entitled "SemanticReference" for more information).

Further, the *SemanticReference* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *NarrativeType* element does not have any additional attributes and/or associations.

12.3.7 PolicyDocumentRef

A *PolicyDocumentRef* is a document that contains one or more policies that are relevant to the BPM+ Knowledge Package. It is contained within a *Manifest* through the *ResourceDocumentRef*.

Generalizations

The *PolicyDocumentRef* element inherits the attributes and/or associations of:

- *ResourceDocumentRef* (see the section entitled "ResourceDocumentRef" for more information).

Further, the *ResourceDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *PolicyDocumentRef* is a type of *ResourceDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *DocumentKind* SHALL be named "PolicyDocument".

Properties

The following table presents the additional attributes and/or associations for *PolicyDocumentRef*:

Table 40. PolicyDocumentRef Attributes and/or Associations

Property/Association	Description
policyRef : PolicyRef [0..*]	This identifies the policies used in the *BKPMNDefinitions* that are contained in the policy document referenced by the *PolicyDocumentRef*.

12.3.8 TestCaseRef

A *TestCaseRef* is a document that contains test case data about the topic and influenced the content of the BPM+ Knowledge Package. It is contained within a *Manifest* through the *ResourceDocumentRef*.

Generalizations

The *TestCaseRef* element inherits the attributes and/or associations of:

- *ResourceDocumentRef* (see the section entitled "ResourceDocumentRef" for more information).

Further, the *ResourceDocumentRef* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Constraints

A *TestCaseRef* is a type of *ResourceDocumentRef*, but is distinguished with this constraint:

- The instance for the element's *DocumentKind* SHALL be named "TestCase".

Properties

The *TestCaseRef* element does not have any additional attributes and/or associations.

13 BPM+ Knowledge Model

The topics addressed by a BPM+ Knowledge Package may be complex and may involve a large number of Process, Cases, and Decisions. These models also interact with each other. A simple Manifest that lists the files that contain all the behavioral models does not provide an adequate view of the scope and nature of the Knowledge Package.

Early work on prototype BPM+ Knowledge Packages found that a diagram of the behavioral model elements (the Processes, Cases, and Decisions) and how they interact provided a good representation of the content and scope of the Knowledge Package.

The following figure shows the *BPMPlusKnowledgeModel* metamodel.

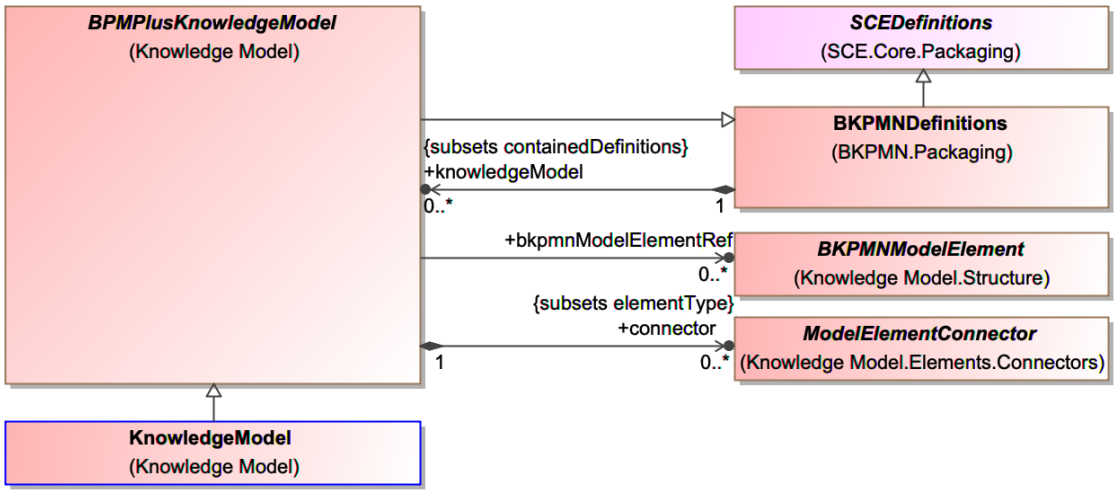


Figure 47: The BPMPlusKnowledgeModel Metamodel

13.1 BPMPlusKnowledgeModel

A model that can be presented with a visual representation of the breadth and scope of a *BKPMNDefinitions* in terms of the BPM+ models it contains. It is contained within a *BKPMNDefinitions*.

Generalizations

The *BPMPlusKnowledgeModel* element inherits the attributes and/or associations of:

- *BKPMNDefinitions* (see the section entitled "BKPMNDefinitions" for more information).

Further, the *BKPMNDefinitions* element inherits the attributes and/or associations of:

- *SCEDefinitions* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BPMPlusKnowledgeModel*:

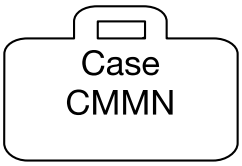
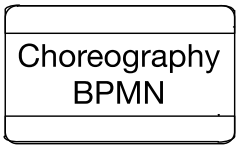
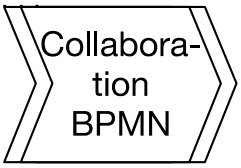
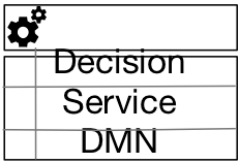
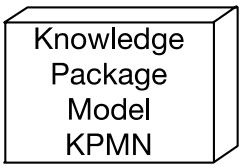
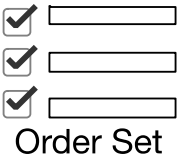
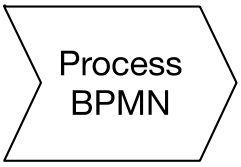
Table 41. BPMPlusKnowledgeModel Attributes and/or Associations

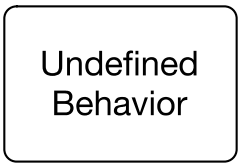
Property/Association	Description
bkpmnModelElementRef : BKPMNModelElement [0..*]	This is a list of the *BKPMNModelElements* (**BKPMNPackageRefs**, **CaseRefs**, **ChoreographyRefs**, **CollaborationRefs**, **DecisionServiceRefs**, and **ProcessRefs**) that are within the *BPMPlusKnowledgeModel.*
connector : ModelElementConnector [0..*]	This is a list of the *ModelElementConnectors* that are within the *BPMPlusKnowledgeModel*.

13.1.1 Graphical Elements

The table below displays the graphical elements of the representation of a **KnowledgeModel**:

Table 1: KnowledgeModel Graphical Elements

Element	Description	Notation
Case	This represents one of the Cases that is part of the BPM+ Knowledge Package. In the **BKPMN** model, it is a reference to a Case within a **CMMN** file that can be used in multiple *BKPMNDefinitions*.	
Choreography	This represents the Choreography model that is part of the BPM+ Knowledge Package. In the **BKPMN** model, it is a reference to a Choreography within a **BPMN** file that can be used in multiple *BKPMNDefinitions*. There should be only one Choreography model for a given BPM+ Knowledge Package.	
Collaboration	This represents a Collaboration model that is part of the BPM+ Knowledge Package. In the **BKPMN** model, it is a reference to a Collaboration within a **BPMN** file that can be used in multiple *BKPMNDefinitions*.	
Decision Service	This represents one of the Decision Service that is part of the BPM+ Knowledge Package. In the **BKPMN** model, it is a reference to a Decision Service within a **DMN** file that can be used in multiple *BKPMNDefinitions*.	
BPM+ Knowledge Package Model	This represents other *BKPMNPackage* that interact with this *BKPMNDefinitions*.	
Order Set	An Order Set can be considered a "mini *BKPMNPackage*." Because of its special place in healthcare situations, it is given its own model element and notation. Note that this object is specific to the healthcare domain.	
Process	This represents one of the Processes that is part of the BPM+ Knowledge Package. In the **BKPMN** model, it is a reference to a Process within a **BPMN** file that can be used in multiple *BKPMNPackages*.	

Pedigree and Provenance Model	This represents a **PPMN** model that is part of the BPM+ Knowledge Package.	
Shared Data Model	This represents an **SDMN** model that is part of the BPM+ Knowledge Package.	
Questionnaire	A Questionnaire can be considered a "mini *BKPMNPackage*. Because of its special place in healthcare situations, it is given its own model element and notation. While this object is often used in the healthcare domain, it can be used in other business domains.	
Undefined Behavior	The Undefined Behavior element is used as a placeholder for one of the other behavioral elements. It is mainly used early in the development of a *BKPMNDefinitions*. A specific behavior is known to be part of the pathway, but it is not clear at that point whether the behavior is a Process or a Case. This allows the inclusion of the behavior in the overall context before the modeler is ready to set its type.	
Model Link	A **ModelLink** is used to show a relationship (calling) between behavioral model elements of a **KnowledgeModel** (see the section entitled "ModelLink", below).	
Reference Link	A **ReferenceLink** is used to show a relationship (referencing) between behavioral model elements of a **KnowledgeModel** (see the section entitled "ReferenceLink", below).	
Association (see the **SCE** specification)	The **Association** connector, defined in **SCE**, allows a **KnowledgeModel** developer to connect two objects in the diagram. The connection does not have any semantic or behavioral meaning, but just shows there is a relationship between the two objects. The **Association** is typically used with a **Text Annotation** to association text with an object (see table row below).	
Text Annotation (attached with an Association) (see the **SCE** specification)	**Text Annotations**, defined in **SCE**, are a mechanism for a modeler to provide additional information for the reader of a **KnowledgeModel**.	

Group (see the **SCE** specification)	A **Group** object, defined in **SCE**, is a graphical box that surrounds the **KnowledgeModel** behavioral elements. There are no specific semantics associated with **Groups**. However a **Group** can be associated with a Participant of the **KnowledgeModel** (such as the Processes of a Primary Care Provider and the Processes of a specialist).	

13.2 KnowledgeModel

A **KnowledgeModel** is the specific model that can be notated in **BKPMN**. It is the concrete specialization of the abstract *BPMPlusKnowledgeModel* element. In future versions of **BKPMN**, additional concrete models may be added to represent additional types of information contained in a *BPMPlusKnowledgeModel*. A **KnowledgeModel** is contained in a *BKPMNDefinitions*.

Generalizations

The **KnowledgeModel** element inherits the attributes and/or associations of:

- *BPMPlusKnowledgeModel* (see the section entitled "BPMPlusKnowledgeModel" for more information).

Further, the *BPMPlusKnowledgeModel* element inherits the attributes and/or associations of:

- *BKPMNDefinitions* (see the section entitled "BKPMNDefinitions" for more information).

Further, the *BKPMNDefinitions* element inherits the attributes and/or associations of:

- *SCEDefinitions* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The **KnowledgeModel** element does not have any additional attributes and/or associations.

13.3 Model Structural Elements

The following figure shows the Knowledge Model structural elements through *BKPMNModelElement* metamodel.

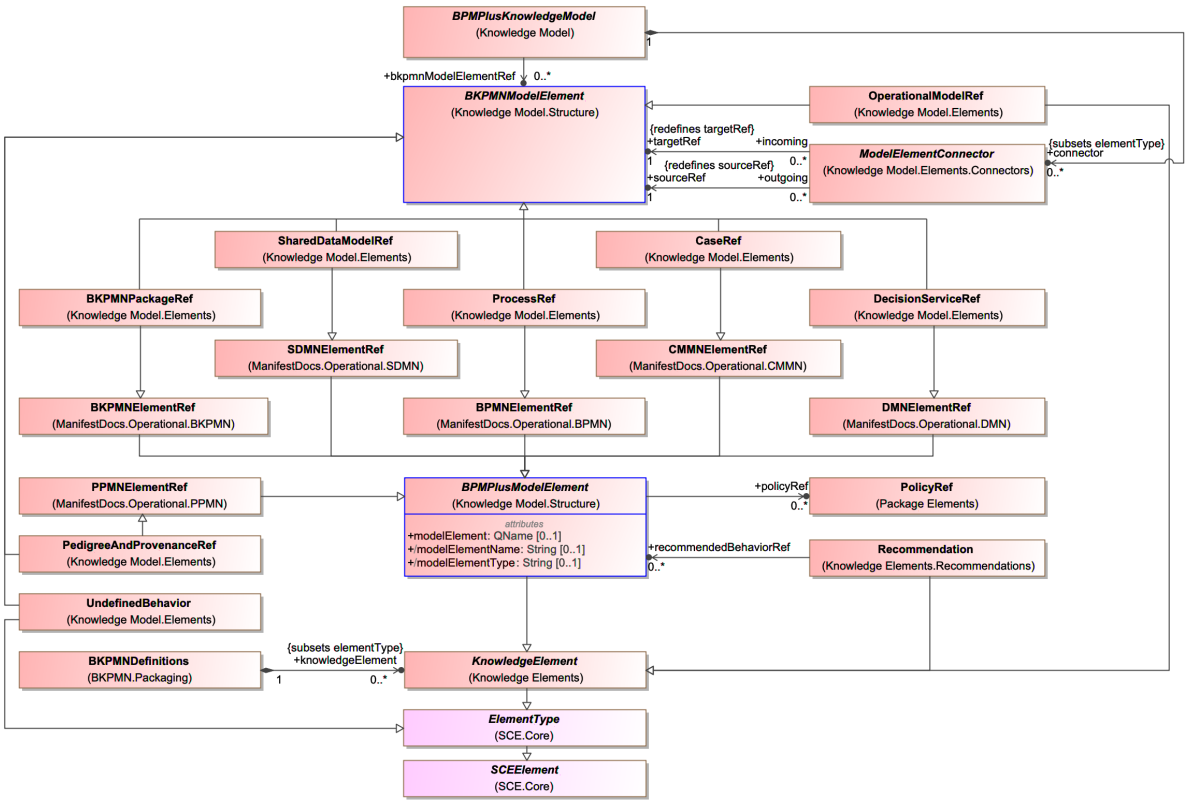


Figure 48: The BKPMNModelElement Metamodel

13.3.1 BKPMNModelElement

This class is included in the metamodel to serve as a mechanism to group seven other classes and provide a single association for the *BKPMNModel* class.

Generalizations

The *BKPMNModelElement* element does not inherit any attributes or associations of from another element.

Properties

The *BKPMNModelElement* element does not have any additional attributes and/or associations.

13.3.2 BPMPlusModelElement

A *BPMPlusModelElement* is the abstract class that provides the properties for locating specific BPM+ language elements that can be found in the files referenced within the *Manifest*. Its concrete subclasses are contained within a *BKPMNDefinitions*. For example, a **ProcessRef** is a concrete specialization of *BPMPlusModelElement* and it is used to represent a Process that is contained within a **BPMN** document referenced in the *Manifest*.

Generalizations

The *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09] [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *BPMPlusModelElement*:

Table 42. BPMPlusModelElement Attributes and/or Associations

Property/Association	Description
incoming : Connector [0..*]	This attribute identifies the incoming *ModelElementConnector* of the *BKPMNDefinitions*.
modelElement : QName [0..1]	This identifies the `id` (`QName`) of the element that the concrete *BPMPlusModelElement* represents. The `QName` will be found in the appropriate model definition file referenced in the *Manifest*.
modelElementName : String [0..1]	This identifies the name of the element of the element that the concrete *BPMPlusModelElement* represents. The name is derived from the details provided by the *ModelElement*.
modelElementType : String [0..1]	This identifies the type of the The type SHALL match a defined model element type that The type is derived from the details provided by the *ModelElement*.
outgoing : Connector [0..*]	This attribute identifies the outgoing *ModelElementConnector* of the *BKPMNDefinitions*.
policyRef : PolicyRef [0..*]	This identifies any policies that are related to the *BPMPlusModelElement*.

13.4 Knowledge Model Elements

The figure below displays the metamodel that highlights the **KnowledgeModel** graphical elements.

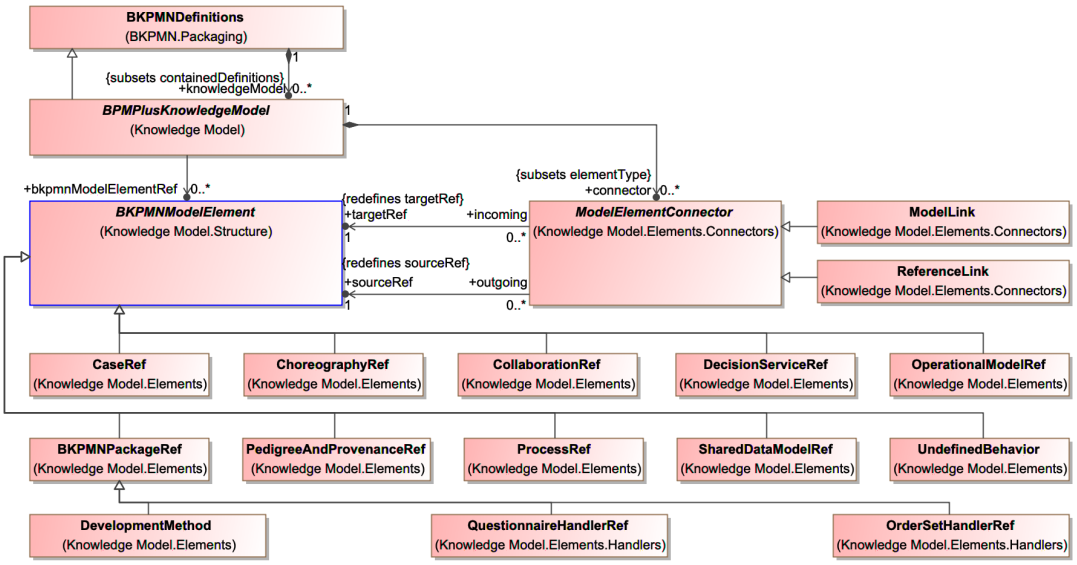


Figure 49: The Knowledge Model Elements Metamodel

13.4.1 BKPMNPackageRef

The figure below displays the **BKPMNPackageRef** metamodel.

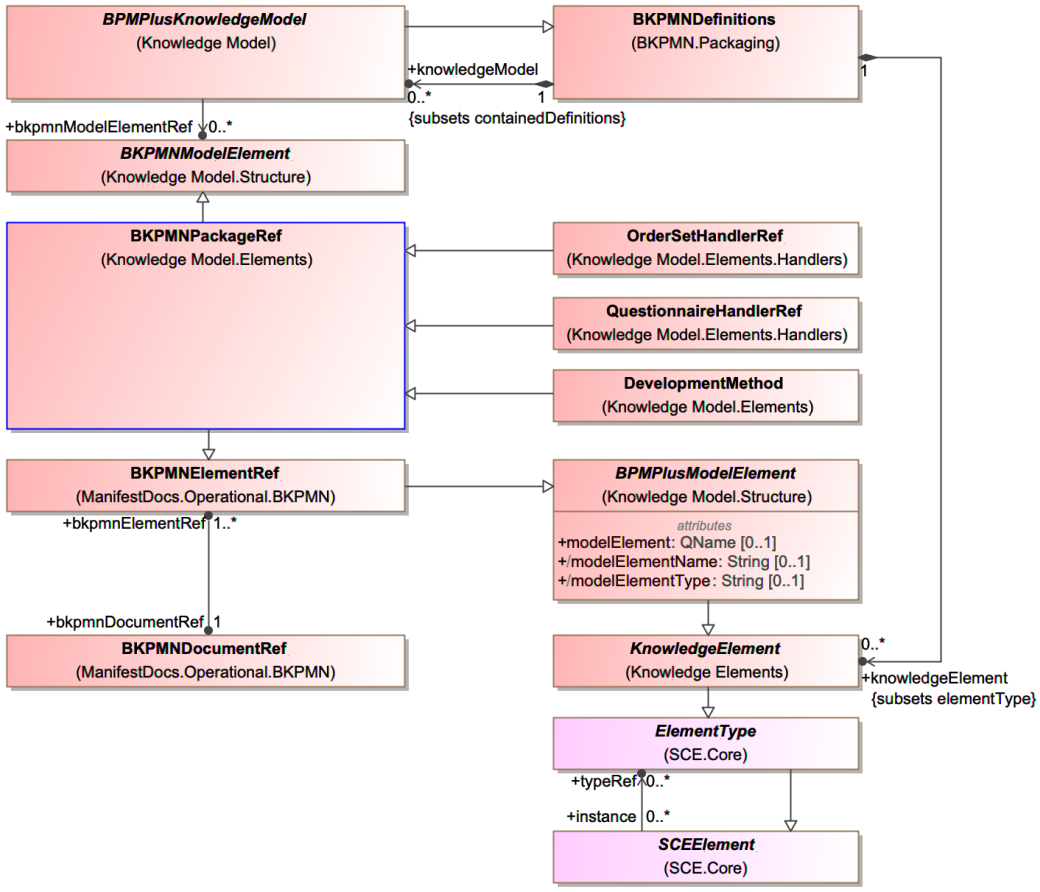


Figure 50: The KnowledgePackageRef Metamodel

Generalizations

The **BKPMNPackageRef** element inherits the attributes and/or associations of:

- *BKPMNElementRef* (see the section entitled "BKPMNElementRef" for more information).

Further, the *BKPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the **BKPMNPackageRef** element inherits the attributes and/or associations of:

- *BKPMNModelElement* (see the section entitled "BKPMNModelElement" for more information).

Properties

The **BKPMNPackageRef** element does not have any additional attributes and/or associations.

13.4.2 CaseRef

This represents one of the Cases that is part of the *BKPMNDefinitions*. In the **BKPMN** model, it is a reference to a Case within a **CMMN** file. It is contained within a *BKPMNDefinitions*.

The figure below displays the **CaseRef** metamodel.

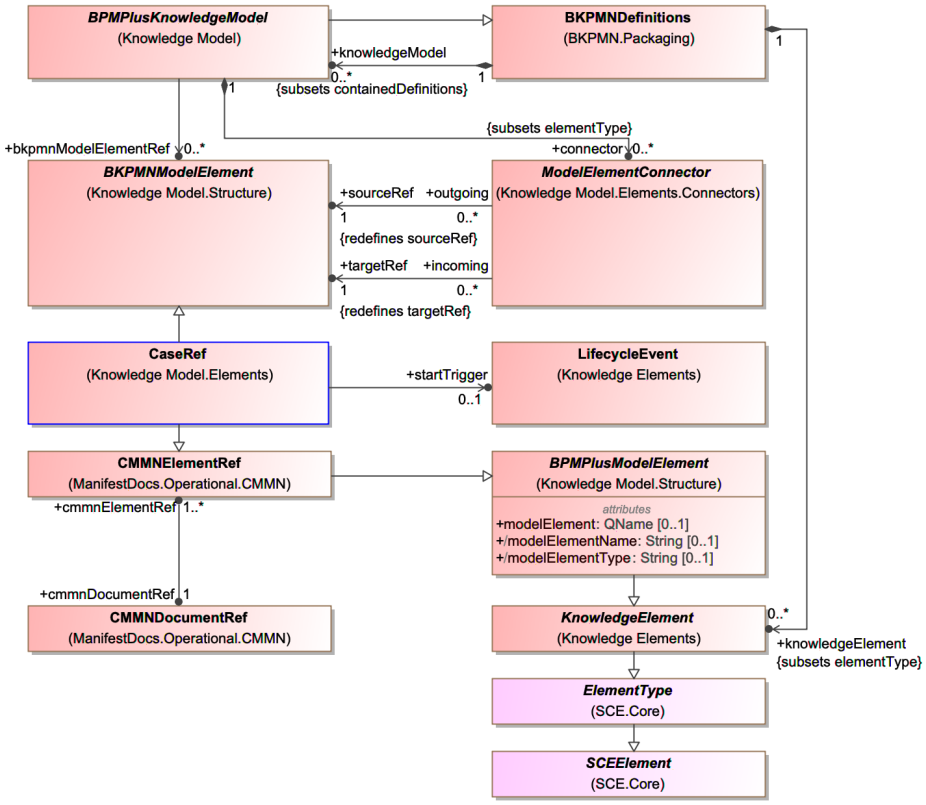


Figure 51: The CaseRef Metamodel

Notation

The following statements define the notation for a **CaseRef**:

- A **CaseRef** is a shape that SHALL be a suitcase shape drawn with a dashed single line (see below).
  - The use of text, color, size, and lines for a **Reference Connector** SHALL follow the rules defined in the section entitled “Use of Text, Color, Size, and Lines in a Diagram” above.

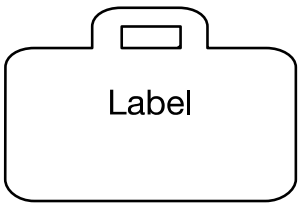


Figure 52: A CaseRef Object

Generalizations

The **CaseRef** element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

In addition, the **CaseRef** element inherits the attributes and/or associations of:

- *CMMNElementRef* (see the section entitled "CMMNElementRef" for more information).

Further, the *CMMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for **CaseRef**:

Table 43. CaseRef Attributes and/or Associations

Property/Association	Description
startTrigger : LifecycleEvent [0..1]	This identifies the Event that triggers the start of the overall Knowledge Package.

13.4.3 ChoreographyRef

This represents the Choreography model that is part of the *BKPMNDefinitions*. In the **BKPMN** model, it is a reference to a Choreography within a **BPMN** file that can be used in multiple *BKPMNDefinitions* . It is contained within a *Definitions*.

There should be only one Choreography model for a given *BKPMNDefinitions* .

The figure below displays the *ChoreographyRef* metamodel:

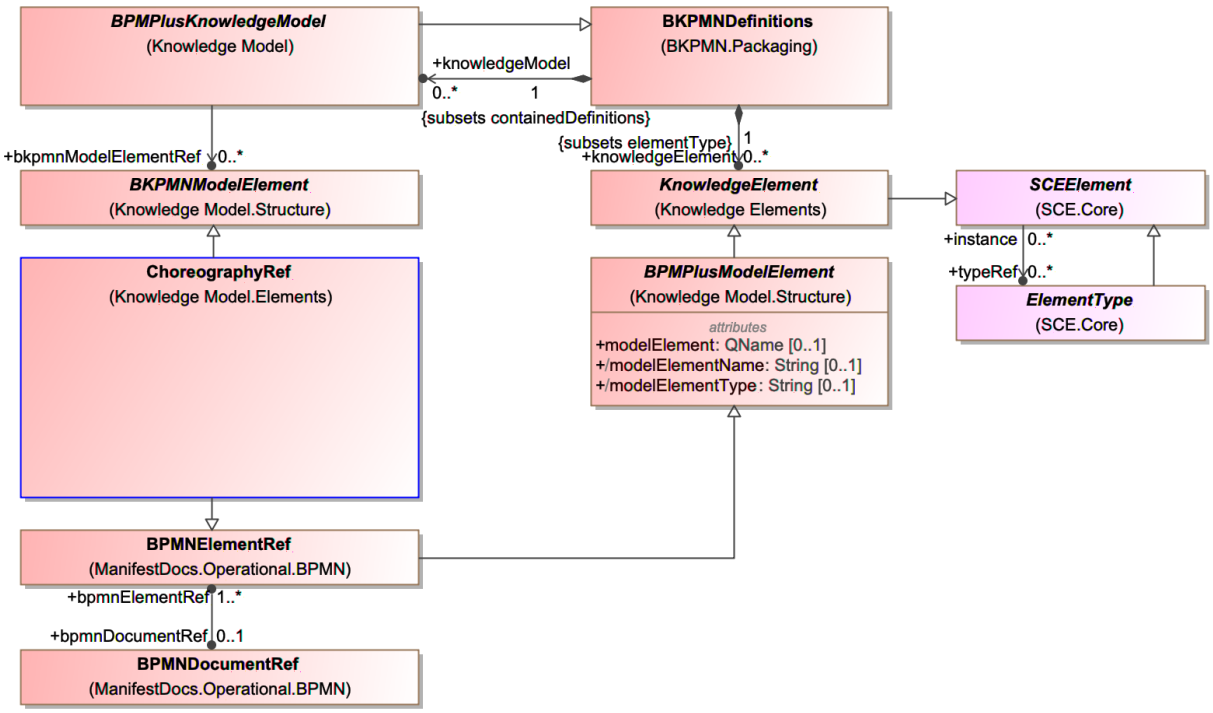


Figure 53: The ChoreographyRef Metamodel

Generalizations

The **ChoreographyRef** element inherits the attributes and/or associations of:

- *BPMNElementRef* (see the section entitled "BPMNElementRef" for more information).

Further, the *BPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the **ChoreographyRef** element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

Properties

The **ChoreographyRef** element does not have any additional attributes and/or associations.

13.4.4 CollaborationRef

This represents a Collaboration model that is part of the *BKPMNDefinitions*. In the **BKPMN** model, it is a reference to a Collaboration within a **BPMN** file that can be used in multiple *BKPMNDefinitions*. A Collaboration will be linked to one or more Process elements in a *BKPMNDefinitions*. It is contained within a *BKPMNDefinitions*.

The figure below displays the *CollaborationRef* metamodel.

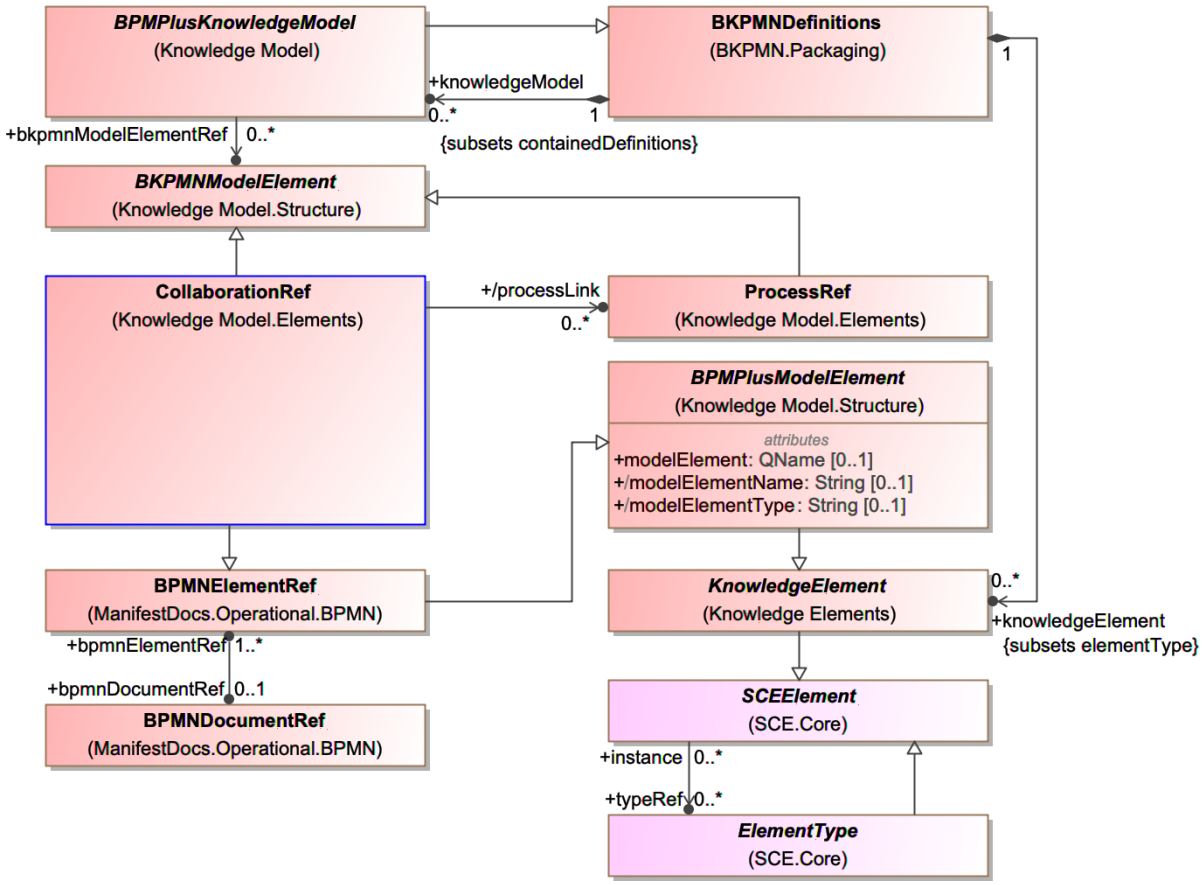


Figure 54: The CollaborationRef Metamodel

Generalizations

The **CollaborationRef** element inherits the attributes and/or associations of:

- *BPMNElementRef* (see the section entitled "BPMNElementRef" for more information).

Further, the *BPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the **CollaborationRef** element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

Properties

The **CollaborationRef** element does not have any additional attributes and/or associations.

13.4.5 DevelopmentMethod

Many *BKPMNDefinitions* (particularly in healthcare) will contain the details of the methodology that was used to create the *BKPMNDefinitions*. This type of information is also captured in the Pedigree of business elements. It is contained within a *BKPMNDefinitions*.

The figure below displays the *DevelopmentMethod* metamodel.

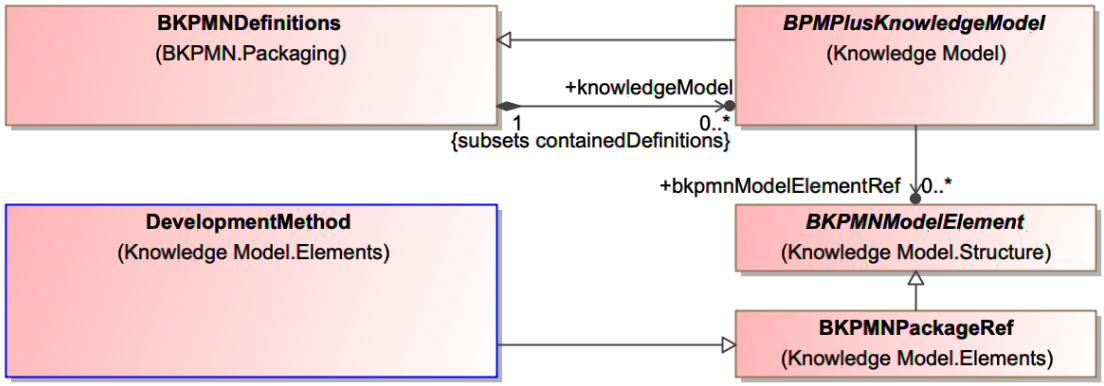


Figure 55: The Development Method Metamodel

Generalizations

The **DevelopmentMethod** element inherits the attributes and/or associations of:

- *BKPMNPackageRef* (see the section entitled "BKPMNPackageRef" for more information).

Further, the **BKPMNPackageRef** element inherits the attributes and/or associations of:

- *BKPMNElementRef* (see the section entitled "BKPMNElementRef" for more information).

Further, the *BKPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the *SCEElement* element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

Properties

The **DevelopmentMethod** element does not have any additional attributes and/or associations.

13.4.6 DecisionServiceRef

This represents one of the Decision Services that is part of the *BKPMNDefinitions*. In the **BKPMN** model, it is a

reference to a Decision Service within a **DMN** file that can be used in multiple *BKPMNDefinitions*. It is contained within a *BKPMNDefinitions*.

The figure below displays the *DecisionServiceRef* metamodel.

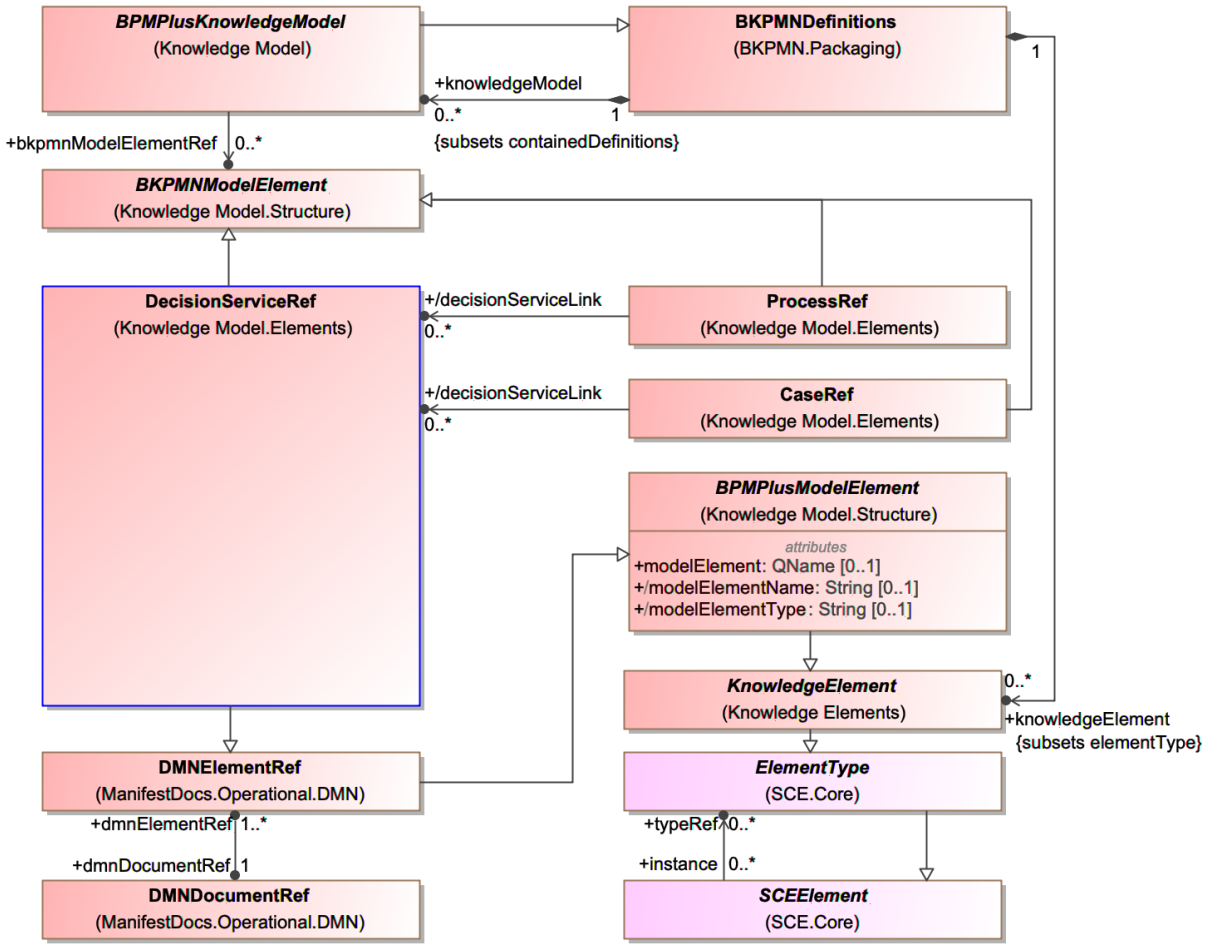


Figure 56: The DecisionServiceRef Metamodel

Generalizations

The **DecisionServiceRef** element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

In addition, the **DecisionServiceRef** element inherits the attributes and/or associations of:

- *DMNElementRef* (see the section entitled "DMNElementRef" for more information).

Further, the *DMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The **DecisionServiceRef** element does not have any additional attributes and/or associations.

13.4.7 OperationalModelRef

The figure below displays the **OperationalModelRef** metamodel.

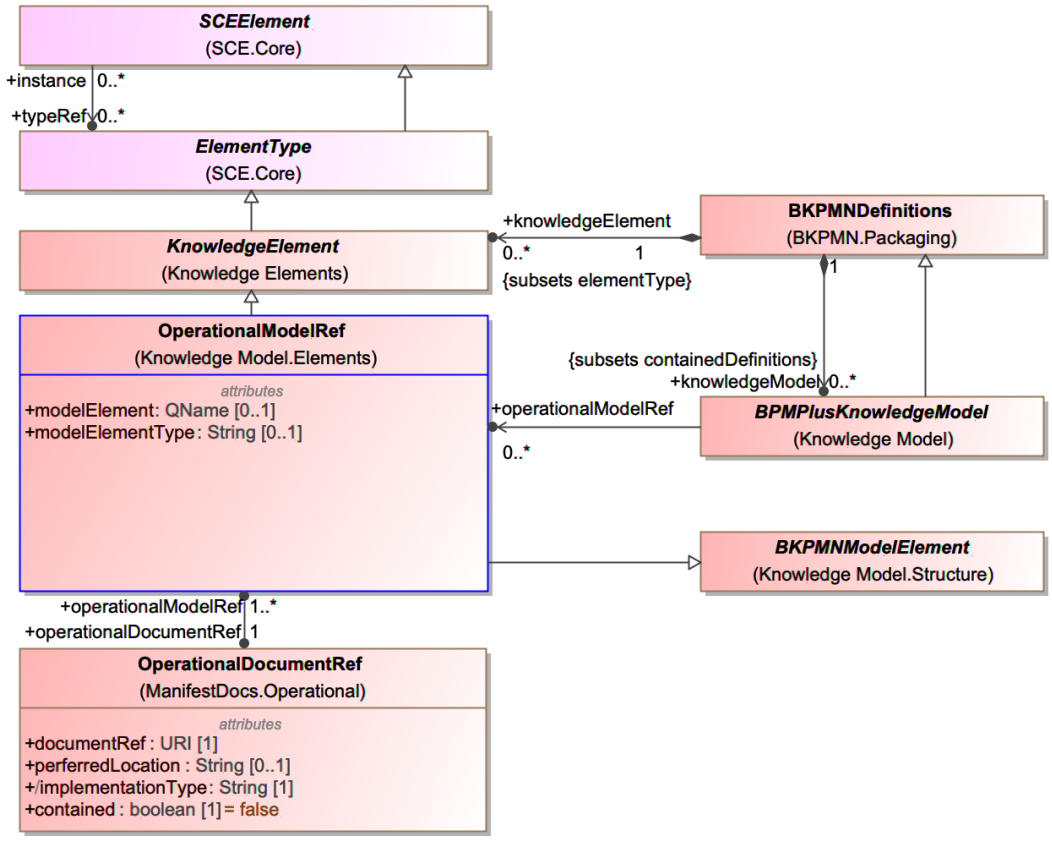


Figure 57: The OperationalModelRef Metamodel

Generalizations

The **OperationalModelRef** element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the **OperationalModelRef** element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

Properties

The following table presents the additional attributes and/or associations for **OperationalModelRef**:

Table 44. OperationalModelRef Attributes and/or Associations

Property/Association	Description
modelElement : QName [0..1]	This identifies the id (`QName`) of the element that the concrete **OperationalModelRef** represents. The `QName` will be found in the appropriate model definition file referenced in the *Manifest*.
modelElementType : String [0..1]	This identifies the type of element that is being referenced (e.g., Task, Decision, CaseFileItem, etc.).
\operationalDocumentRef : OperationalDocumentRef [1]	The *implementationKind* of the referenced *OperationalDocumentRef* SHALL NOT be of the types that are listed as the specializations of the *OperationalDocumentRef* element, such as **BPMN** and **CMMN**, etc. The figure above displays all the document types that are excluded from being referenced by **OperationalModelRef** element.

13.4.8 ProcessRef

This represents one of the **BPMN** Processes that is part of the *BKPMNDefinitions*. In the **BKPMN** model, it is a reference to a Process within a **BPMN** file that can be used in multiple *BKPMNDefinitions*. It is contained within a *BKPMNDefinitions*.

This element points to a Process that is contained within a **BPMN** file (*BKPMNDefinitions*).

This element is graphically represented in a **KnowledgeModel**.

- The Process Knowledge Element has an “startTrigger” attribute.
  - Any Process where this is True is technically outside the Knowledge Package. But it is the Process that triggers the top-level Case of the BPM+ Knowledge Package. It should be shown in the Knowledge Package for documentation purposes.
  - As small circle (like a **BPMN** Start Event) is added to the right side of the Process Knowledge Element shape to mark that this is a trigger Process (see figure 1).
  - There can be multiple Processes that are triggers for the Knowledge Package.

The figure below displays the *ProcessRef* metamodel.

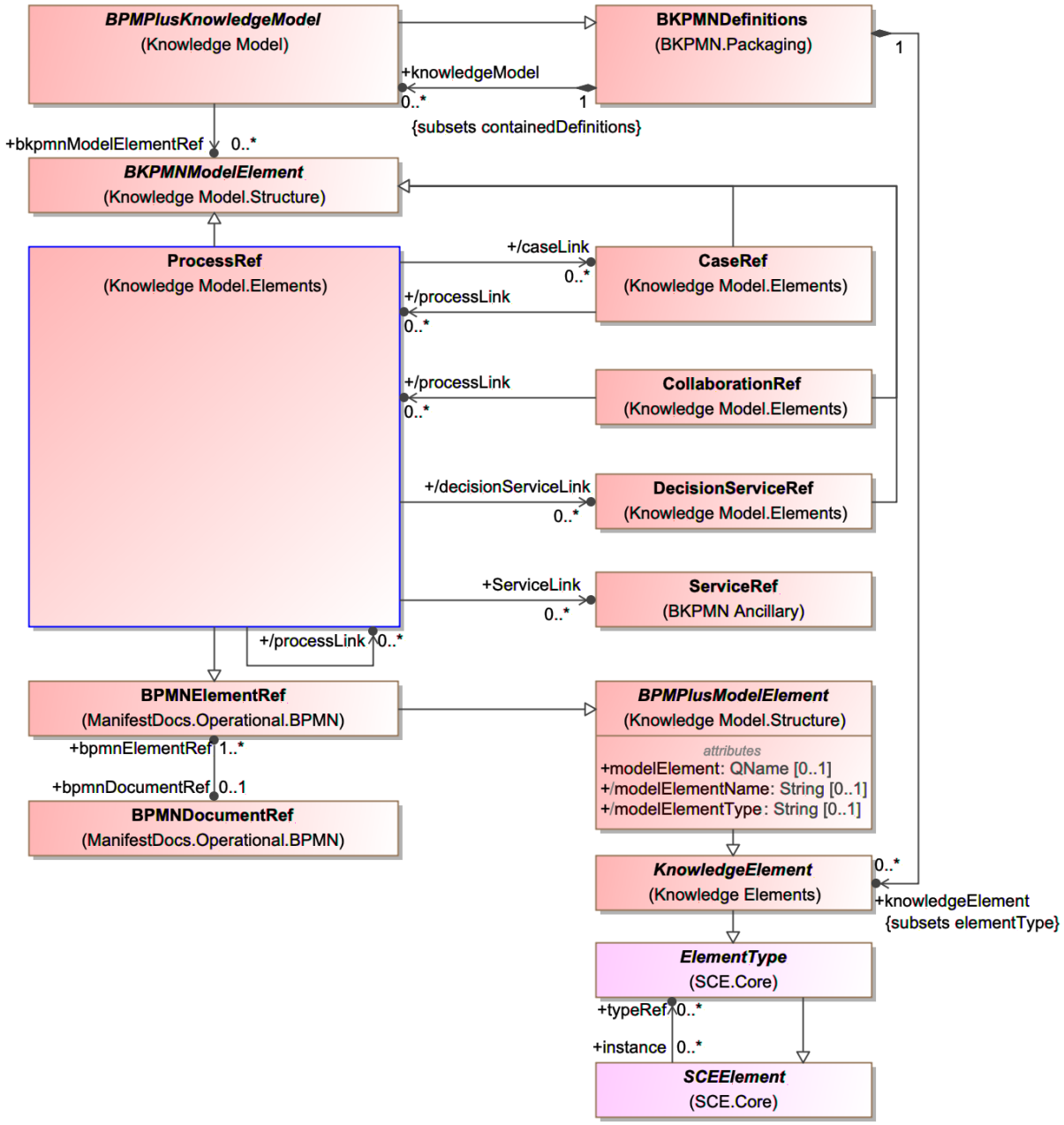


Figure 58: The ProcessRef Metamodel

Generalizations

The **ProcessRef** element inherits the attributes and/or associations of:

- *BPMNElementRef* (see the section entitled "BPMNElementRef" for more information).

Further, the *BPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the **ProcessRef** element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

Properties

The following table presents the additional attributes and/or associations for **ProcessRef**:

Table 45. ProcessRef Attributes and/or Associations

Property/Association	Description
startTrigger : LifecycleEvent [0..1]	This identifies the Event that triggers the start of the overall Knowledge Package.

13.4.9 SharedDataModelRef

The figure below displays the **SharedDataModelRef** metamodel.

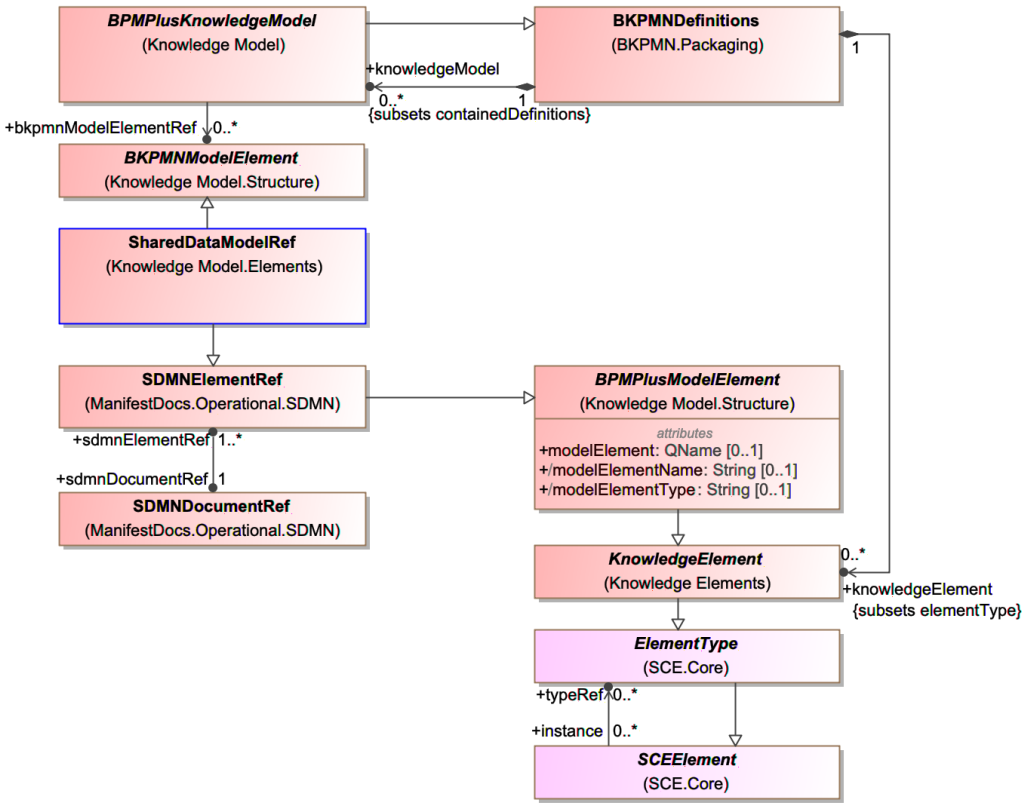


Figure 59: The SharedDataModelRef Metamodel

Generalizations

The **SharedDataModelRef** element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

In addition, the **SharedDataModelRef** element inherits the attributes and/or associations of:

- *SDMNElementRef* (see the section entitled "SDMNElementRef" for more information).

Further, the *SDMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The **SharedDataModelRef** element does not have any additional attributes and/or associations.

13.4.10 UndefinedBehavior

The *UndefinedBehavior* element is used as a placeholder for one of the other behavioral elements. It is mainly used early in the development of a *BKPMNDefinitions*. A specific behavior is known to be part of the pathway, but it is not clear at that point whether the behavior is a Process or a Case. This allows the inclusion of the behavior in the overall context before the modeler is ready to set its type. It is contained within a *BKPMNDefinitions*.

Generalizations

The *UndefinedBehavior* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the **UndefinedBehavior** element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

Properties

The **UndefinedBehavior** element does not have any additional attributes and/or associations.

13.4.11 PedigreeAndProvenanceRef

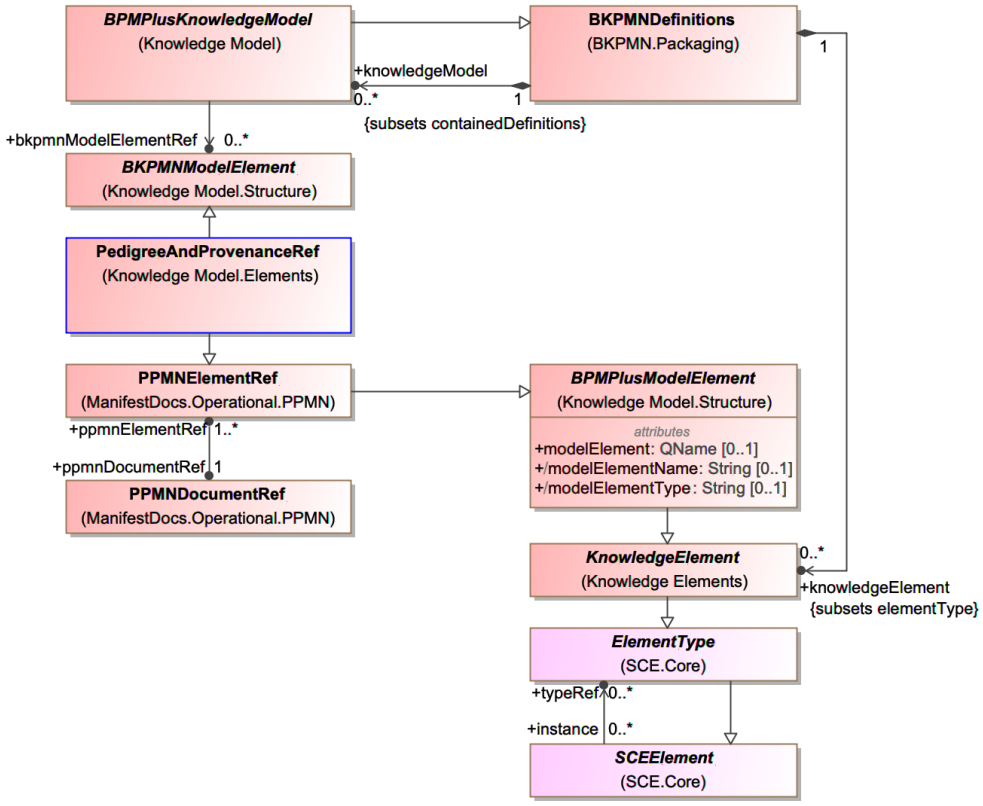


Figure 60: PedigreeAndProvenanceRefMM

Generalizations

The *PedigreeAndProvenanceRef* element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

In addition, the *PedigreeAndProvenanceRef* element inherits the attributes and/or associations of:

- *PPMNElementRef* (see the section entitled "PPMNElementRef" for more information).

Further, the *PPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The *PedigreeAndProvenanceRef* element does not have any additional attributes and/or associations.

13.4.12 Order Set Handlers and Questionnaire Handlers

Order Set Handlers and Questionnaire Handlers can be considered to be "mini" *BKPMNPackages*. Most of their

content is shared data, but there are Process, Case and/or and Decision elements. Order Set Handlers and Questionnaire Handlers can be developed independently or part of a larger *BKPMNPackage*. These mini *BKPMNPackages* would have their own life-cycle and metadata. More than one *BKPMNPackage* may use the same Order Set Handler or Questionnaire Handler.

13.4.12.1 OrderSetHandlerRef

It should be noted that Order Sets are specific to the healthcare domain. Thus, they are appropriate for modeling Shareable Clinical Pathways, but are not appropriate to be defined as an element of a generic *BKPMNPackage*. We will have to find the appropriate metamodel mechanisms to define generic *BKPMNPackages* that will allow domain-specific extensions, such as Order Sets. This includes the notation of these elements in a *BKPMNPackage*.

Generalizations

The **OrderSetHandlerRef** element inherits the attributes and/or associations of:

- *BKPMNPackageRef* (see the section entitled "BKPMNPackageRef" for more information).

Further, the **BKPMNPackageRef** element inherits the attributes and/or associations of:

- *BKPMNElementRef* (see the section entitled "BKPMNElementRef" for more information).

Further, the *BKPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the *SCEElement* element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

Properties

The **OrderSetHandlerRef** element does not have any additional attributes and/or associations.

13.4.12.2 QuestionnaireHandlerRef

Questionnaire Handlers, on the other hand, are key to healthcare but could also be used for other domains and, thus, can be included as part of a *BKPMNPackage* definition.

Generalizations

The **QuestionnaireHandlerRef** element inherits the attributes and/or associations of:

- *BKPMNPackageRef* (see the section entitled "BKPMNPackageRef" for more information).

Further, the **BKPMNPackageRef** element inherits the attributes and/or associations of:

- *BKPMNElementRef* (see the section entitled "BKPMNElementRef" for more information).

Further, the *BKPMNElementRef* element inherits the attributes and/or associations of:

- *BPMPlusModelElement* (see the section entitled "BPMPlusModelElement" for more information).

Further, the *BPMPlusModelElement* element inherits the attributes and/or associations of:

- *KnowledgeElement* (see the section entitled "KnowledgeElement" for more information).

Further, the *KnowledgeElement* element inherits the attributes and/or associations of:

- *ElementType* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

In addition, the *SCEElement* element inherits the attributes and/or associations of:

- *BPMPlusDiagramElement* (see the section entitled "BPMPlusDiagramElement" for more information).

Properties

The **QuestionnaireHandlerRef** element does not have any additional attributes and/or associations.

13.4.13 Connectors

The **KnowledgeModel** currently has only two types of *ModelElementConnectors* – the **ModelLink** and the **ReferenceLink**. This does not include the **Association**, which is a *ModelArtifact*. Early drafts of this diagram contained other types of connectors and it is possible that additional connectors will be added to the diagram in the future.

The figure below displays the *Connectors* metamodel.

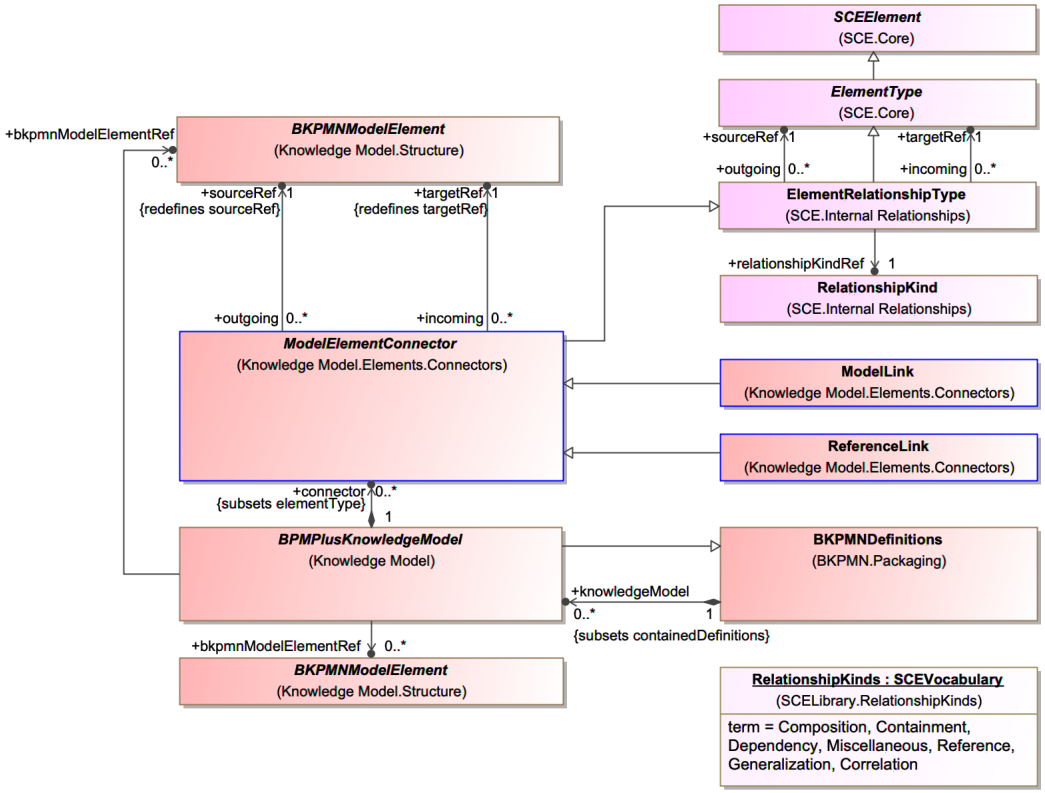


Figure 61: The Connectors Metamodel

13.4.13.1 ModelElementConnector

These types of connector defines a specific model link between elements of different modeling languages. For example, a **CMMN** ProcessTask links to a specific **BPMN** Process.

Generalizations

The *ModelElementConnector* element inherits the attributes and/or associations of:

- *ElementRelationshipType* (see the **SCE** specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for *ModelElementConnector*:

Table 46. ModelElementConnector Attributes and/or Associations

Property/Association	Description
sourceRef : BPMPlusModelElement [1]	This identifies the **KnowledgeModel** element that is at the source end of the *ModelElementConnector*. This attribute redefines the `sourceRef` attribute of **SCE** *ElementRelationshipType*.
targetRef : BPMPlusModelElement [1]	This identifies the **KnowledgeModel** element that is at the target end of the *ModelElementConnector*. The arrowhead will be at the end of the *ModelElementConnector* attached to this element. This attribute redefines the `targetRef` attribute of **SCE** *ElementRelationshipType*.

13.4.13.2 ModelLink

This type of *ModelElementConnector* defines a specific model link between elements of different modeling languages. For example, a **CMMN** ProcessTask links to a specific **BPMN** Process. These kinds of connections can be validated by inspecting the source model file to find the specific link.

A **ModelLink** is used to show a relationship (calling/referencing) relationship between behavioral model elements of a **KnowledgeModel**. It is contained within a *BKPMNDefinitions*. There are 6 different types of relationships:

- **ProcessRef** to **ProcessRef**
  - This is realized through a **BPMN** Call Activity referencing another Process.
- **ProcessRef** to **CaseRef**
  - This is realized through a **BPMN** Case Task (extension) referencing a **CMMN** Case.
- **ProcessRef** to **DecisionServiceRef**
  - This is realized through a **BPMN** Business Rule Task referencing a **DMN** Decision Service.
- **CaseRef** to **ProcessRef**
  - This can be validated if:
    - The Case referenced by the CaseRef can be found within a CMMN file identified in the Manifest. realized through a **CMMN** Process Task referencing a **BPMN** Task.
- **CaseRef** to **CaseRef**
  - This is realized through a **CMMN** Case Task referencing another Case.
- **CaseRef** to **DecisionServiceRef**
  - This is realized through a **CMMN** Decision Task referencing a **DMN** Decision Service.

*Note that a **BKPMN** model does not directly contain the information required to identify these relationships (other than the Connectors). That information is contained within the Tasks of a **BPMN***

*Process or a **CMMN** Case. A property of those Tasks identifies the target of the relationship (within a different **BPMN** Process, **CMMN** Case, or **DMN** model).*

The addition of a **ModelLink** within a **KnowledgeModel** can be done in two ways:

- A modeler can use a tool mechanism to draw the connector between two behavioral model elements (e.g., between a **BPMN** Process and a **CMMN** Case).
- A modeling tool could inspect the **BPMN**, **CMMN**, and **DMN** files referenced by the **KnowledgeModel** elements (or perhaps the *Manifest*) and derive the relationships and add the connectors to the diagram.
- A **ModelLink** is line that SHALL be drawn with a thick dashed single line with a filled arrowhead (see figure below).
    - The use of text, color, size, and lines for an **ModelLink** SHALL follow the rules defined in the section entitled "Use of Text, Color, Size, and Lines in a Diagram" above.

Figure 62: A ModelLink

Generalizations

The **ModelLink** element inherits the attributes and/or associations of:

- *ModelElementConnector* (see the section entitled "ModelElementConnector" for more information).

Further, the *Connector* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Further, the *SCEElement* element inherits the attributes and/or associations of:

- *SCERootElement* (see the **SCE** Specification for more information).

Constraints

A **ModelLink** is a type of **SCE** *ElementRelationshipType*, through the *ModelElementConnector* element, but is distinguished with this constraint:

- The instance for the element's *RelationshipKind* SHALL be named "Dependency".

Properties

The **ModelLink** element does not have any additional attributes and/or associations.

13.4.13.3 Connector Rules and Restrictions

Connectors are only allowed between Behavioral Elements, but there are additional restrictions for the connectors.

- A **ModelLink** MAY connect the following behavioral elements (in these directions):
    - A **ProcessRef** to another **ProcessRef**.
    - A **ProcessRef** to a **CaseRef**.
    - A **ProcessRef** to a **DecisionServiceRef**.
    - A **CaseRef** to another **CaseRef**.
    - A **CaseRef** to a **ProcessRef**.
    - A **CaseRef** to a **DecisionServiceRef**.
- A **ModelLink** MAY NOT connect other combinations of *BPMPlusModelElementRef* that are not listed above.

13.4.13.4 ReferenceLink

This type of *ModelElementConnector* defines a specific model link between elements of different modeling languages. For example, a **CMMN** ProcessTask links to a specific **CQL** function. These kinds of connections *cannot* be validated by inspecting the source model file to find the specific link.

There are 5 different types of known relationships (additional types can be created through adding operational model elements that have not been specified by this version of **BKPMN**):

- **ProcessRef** to **BKPMNPackageRef**, including **OrderSets** and **Questionnaires**.
- **CaseRef** to **BKPMNPackageRef**, including **OrderSets** and **Questionnaires**.
- **CollaborationRef** to **BKPMNPackageRef**
- **BKPMNPackageRef**, including **OrderSets** and **Questionnaires**, to **ProcessRef**
- **BKPMNPackageRef**, including **OrderSets** and **Questionnaires**, to **CaseRef**

A **ReferenceLink** is used to show a relationship (calling/referencing) relationship between behavioral model elements of a **KnowledgeModel**. It is contained within a *BKPMNDefinitions*.

- A **ReferenceLink** is line that SHALL be drawn with a thick dashed and dotted single line with a unfilled arrowhead (see figure below).
    - The use of text, color, size, and lines for an **ReferenceLink** SHALL follow the rules defined in the section entitled “Use of Text, Color, Size, and Lines in a Diagram” above.

Figure 63: A ReferenceLink

Generalizations

The **ReferenceLink** element inherits the attributes and/or associations of:

- *ModelElementConnector* (see the section entitled “ModelElementConnector” for more information).

Further, the *Connector* element inherits the attributes and/or associations of:

- *SCEElement* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Further, the *SCEElement* element inherits the attributes and/or associations of:

- *SCERootElement* (see the **SCE** Specification for more information).

Constraints

A **ReferenceLink** is a type of **SCE** *ElementRelationshipType*, through the *ModelElementConnector* element, but is distinguished with this constraint:

- The instance for the element’s *RelationshipKind* SHALL be named “Reference”.

Properties

The **ReferenceLink** element does not have any additional attributes and/or associations.

13.4.14 Model Artifacts

BKPMN provides modelers with the capability of showing additional information about a **KnowledgeModel** that is not directly related to the **KnowledgeModel** elements through the capability provided by the *ModelArtifact* elements that are defined in the **SCE** specification. **BKPMN** utilizes the three standard **SCE** *ModelArtifacts*: **Associations**, **Groups**, and **Text Annotations**. **BKPMN** extends the base **SCE Group** element (see below).

BKPMN does not extend the capabilities of the **Association** and **Text Annotation** *ModelArtifacts* but uses them as-is from the **SCE** specification. The **Group** *ModelArtifact* has been extended for **BKPMN** (see the section entitled "Group", below).

The following figure shows how the **SCE** *ModelArtifact* is included within **BKPMN**. *ModelArtifacts* are contained within a **KnowledgeModel**.

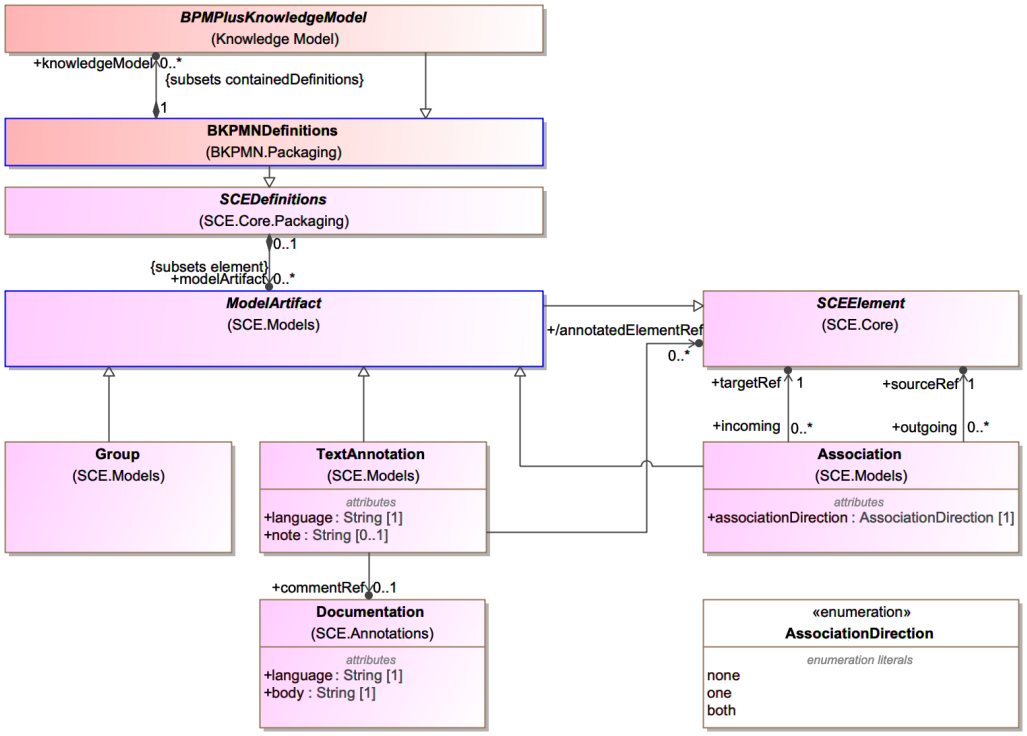


Figure 64: The Use of SCE Model Artifacts in BKPMN

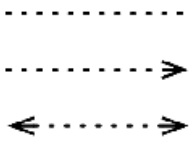
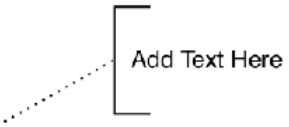
A modeler or modeling tool MAY extend a **KnowledgeModel** and add new types of *ModelArtifacts*. Any new *ModelArtifacts* SHALL follow the *Connector* connection rules (listed below). **Associations** can be used to link *ModelArtifacts* to other diagram elements.

Notation

Full details of *ModelArtifacts* are available in the **SCE** specification, but the notation of the elements is provided here for convenience.

The table below displays the graphical elements of **SCE**'s *ModelArtifacts*:

Table 2: SCE Artifacts Graphical Elements

Element	Description	Notation
Association	An **Association** is used to associate Diagram Artifacts (often **Text Annotations**) or diagram elements to other diagram elements. The connection only specifies that there is some relationship between the two elements, but no model semantics are implied. An **Association** is line that is drawn with a dotted single line. An angle 30° arrowhead may optionally be added to either end of the line.	
Group	The **Group** object is a Diagram Artifact that provides a visual mechanism to group elements of a diagram informally. **Groups** are often used to highlight certain sections of a diagram. The highlighted (grouped) section of the diagram can be separated for reporting and analysis purposes. **BKPMN** also allows a *ParticipantRef* to be associated with a **Group**. A **Group** is a rounded corner rectangle that is drawn with a solid dashed and dotted line (see figure to the right).	
Text Annotation	**Text Annotations** are a mechanism for a modeler to provide additional information for the reader of a **KnowledgeModel**. An **Association** may be used to connect user-defined text (a **Text Annotation**) with a diagram element. A **Text Annotation** is an open rectangle that is drawn with a solid single line (see figure to the right).	

13.4.14.1 Group (BKPMN)

The **Group** object is a *ModelArtifact* that provides a visual mechanism to informally group elements of a diagram. **Groups** are often used to highlight certain sections of a diagram without adding additional constraints or semantics. The highlighted (grouped) section of the diagram can be separated for reporting and analysis purposes. **BKPMN** extends the **SCE Group** element by adding an association to a *ParticipantRef*. This allows provides the capability for **Groups** in a **KnowledgeModel** to separate the behavioral elements into groups related to a particular participant of the *BKPMNDefinitions* behaviors (see the figure in the section entitled "BPM+ Knowledge Packages," above). It is contained within a *BKPMNDefinitions*.

The following figure shows the *Group* metamodel.

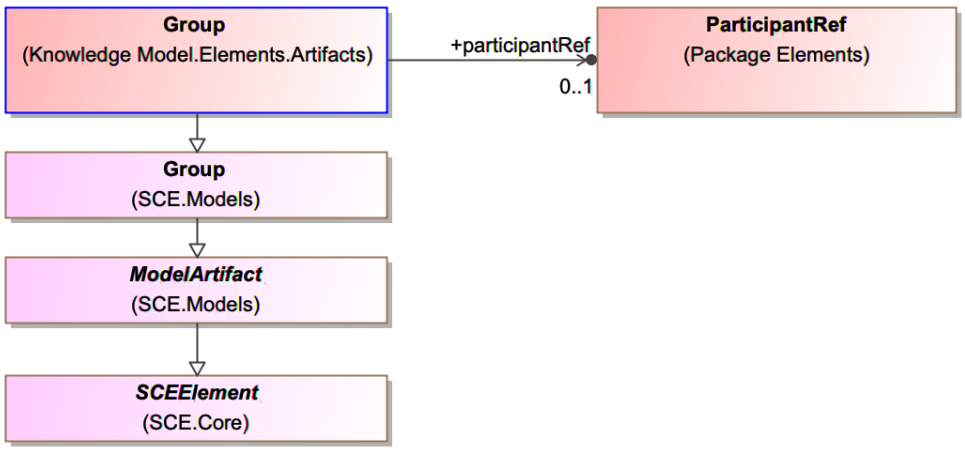


Figure 65: The Group Metamodel

Generalizations

The **Group** element inherits the attributes and/or associations of:

- *Group* (see the **SCE** Specification for more information [OMG doc number bmi-2021-12-09]).

Properties

The following table presents the additional attributes and/or associations for **Group**:

Table 47. Group Attributes and/or Associations

Property/Association	Description
participantRef : ParticipantRef [0..1]	This identifies the Participant within the *BKPMNDefinitions* is associated with the **Group**. The *BPMPlusModelRef* elements that are contained within the graphical boundaries of the **Group** should also be associated with the same *ParticipantRef*.

13.4.14.2 Model Artifact Connection Rules

See the section entitled "**Error! Reference source not found.**" above for *Connector* connection rules.

- A *DiagramArtifact* SHALL NOT be a target for a **Model Link** or a **Reference Link**.
- A *DiagramArtifact* SHALL NOT be a source for a **Model Link** or a **Reference Link**.

14 BKPMN Library

A Library is included in **BKPMN** to provide standard instances that should be implemented by tools supporting **BKPMN**. Currently, **BKPMN** defines the instances for 10 sub-packages (see below).

The following figure presents the 10 instances for the *BKPMNVocabulary* element provided by the **BKPMN** Library:

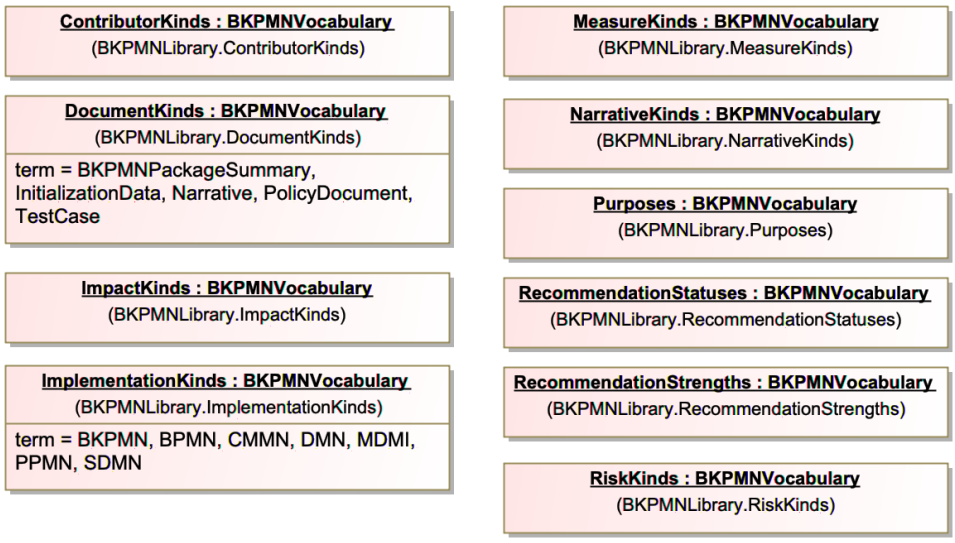


Figure 66: The BKPMN Library Instance Model

The following table presents a description for the included instances for *BKPMNVocabulary*:

Table 48. BKPMNVocabulary Instances

Instance	Description
ContributorKinds	This *BKPMNVocabulary* instance does not have any predefined instances of *SemanticReference* `terms`. These can be added by a modeler or tooling environment. Example *ContributorKind* instances could include: author; editor; endorser; reviewer; subject-matter-expert.
DocumentKinds	This *BKPMNVocabulary* instance has five predefined instances of *SemanticReference* `terms`. See section below. Additional `terms` can be added by a modeler or tooling environment.
ImpactKinds	This *BKPMNVocabulary* instance does not have any predefined instances of *SemanticReference* `terms`. These can be added by a modeler or tooling environment. Example *ImpactKind* instances could include: negative; neutral; positive; and unknown.
ImplementationKinds	This *BKPMNVocabulary* instance has seven predefined instances of *SemanticReference* `terms`. See section below. Additional `terms` can be added by a modeler or tooling environment.
MeasureKinds	This *BKPMNVocabulary* instance does not have any predefined instances of *SemanticReference* `terms`. These can be added by a modeler or tooling environment. Example *MeasureKind* instances could include: quality; process; perception; performance; and input.

NarrativeKinds	This *BKPMNVocabulary* instance does not have any predefined instances of *SemanticReference* `terms`. These can be added by a modeler or tooling environment. Example *NarrativeKind* instances could include: background; discussion; scope.
Purposes	This *BKPMNVocabulary* instance does not have any predefined instances of *SemanticReference* `terms`. These can be added by a modeler or tooling environment. Example *Purpose* instances could include: assessment; education.
RecommendationStatuses	This *BKPMNVocabulary* instance does not have any predefined instances of *SemanticReference* `terms`. These can be added by a modeler or tooling environment. Example *RecommendationStatus* instances could include: amended; deleted; new-added; new-replaced; not-changed.
RecommendationStrengths	This *BKPMNVocabulary* instance does not have any predefined instances of *SemanticReference* `terms`. These can be added by a modeler or tooling environment. Example *RecommendationStrength* instances could include: strong-against; strong-for; weak-against; weak-for.
RiskKinds	This *BKPMNVocabulary* instance does not have any predefined instances of *SemanticReference* `terms`. These can be added by a modeler or tooling environment. Example *RiskKind* instances could include: fraction-of-incidences; hazard-ratio; increases-in-incidences; and relative.

14.1 DocumentKinds

The following figure presents the instances for the *DocumentKind* element that are `terms` for the instance (`DocumentKinds`) of the *BKPMNVocabulary* element:

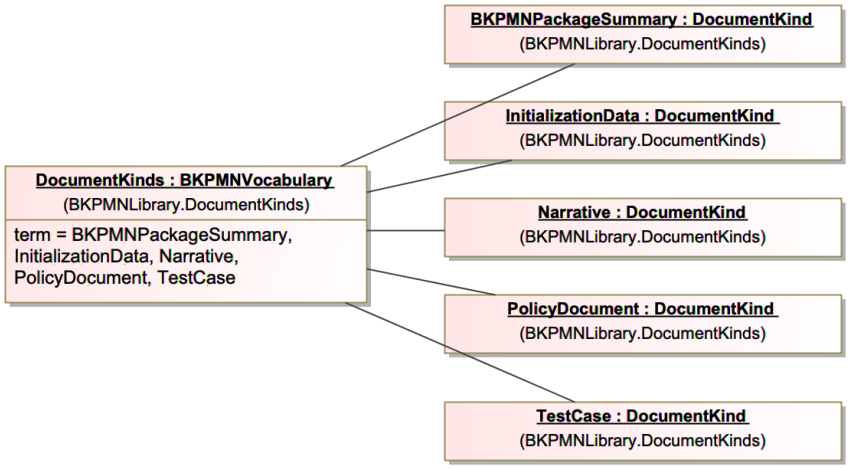


Figure 67: The DocumentKinds Instance Model

The following table presents a description for the included instances for *DocumentKind*:

Table 49. ItemKind Literals

Literal	Description
BKPMNPackageSummary	This *SemanticReference* instance is used for the *DocumentKind* of the *BKPMNPackageSummary* element.
InitializationData	This *SemanticReference* instance is used for the *DocumentKind* of the *InitializationDataRef* element.
Narrative	This *SemanticReference* instance is used for the *DocumentKind* of the *NarrativeRef* element.
PolicyDocument	This *SemanticReference* instance is used for the *DocumentKind* of the *PolicyDocumentRef* element.
TestCase	This *SemanticReference* instance is used for the *DocumentKind* of the *TestCaseRef* element.

14.2 ImplementationKinds

The following figure presents the instances for the *ImplementationKind* element that are `terms` for the instance (`ImplementationKinds`) of the *BKPMNVocabulary* element:

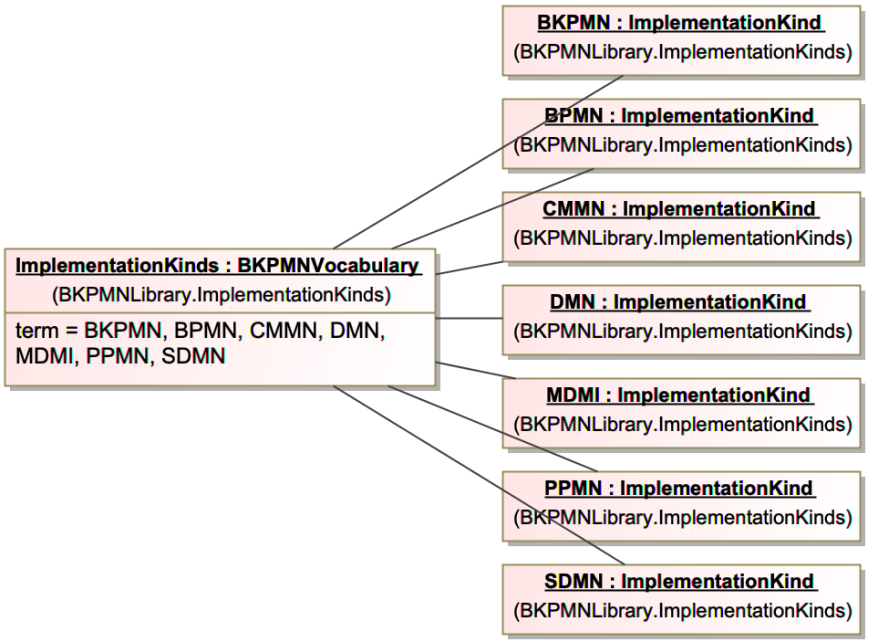


Figure 68: The ImplementationKinds Instance Model

The following table presents a description for the included instances for *ImplementationKind*:

Table 50. ItemKind Literals

Literal	Description
BKPMN	This *SemanticReference* instance is used for the *ImplementationKind* of the *BKPMNDocumentRef* element.
BPMN	This *SemanticReference* instance is used for the *ImplementationKind* of the *BKPMNDocumentRef* element.
CMMN	This *SemanticReference* instance is used for the *ImplementationKind* of the *CMMNDocumentRef* element.
DMN	This *SemanticReference* instance is used for the *ImplementationKind* of the *DMNDocumentRef* element.
MDMI	This *SemanticReference* instance is used for the *ImplementationKind* of the *MDMIDocumentRef* element.
PPMN	This *SemanticReference* instance is used for the *ImplementationKind* of the *PPMNDocumentRef* element.
SDMN	This *SemanticReference* instance is used for the *ImplementationKind* of the *SDMNDocumentRef* element.

15 BPM+ Models Harmonization

A **KnowledgeModel** (see the section entitled “KnowledgeModel”, above) defines relationships between core modeling elements of the BPM+ languages (**BPMN**, **CMMN**, and **DMN**) that are used for a *BPM+ Knowledge Package*. For example, a **CMMN** Decision Task can be associated to a **DMN** Decision Service through the **ModelLink** element. If the **CMMN** Case was configured correctly and the target DMN Decision Service is present in the **DMN** models referenced by the *Manifest*, then a **BKPMN** tool can validate the **ModelLink** between the two objects in the **KnowledgeModel**. All **ModelLinks** in a **KnowledgeModel** should be validated before a *BPM+ Knowledge Package* is considered complete.

However, **BPMN** was developed before **CMMN** and **DMN**, and thus, does not have explicit mechanism to link to **CMMN** or **DMN** elements. Thus, **BPMN** requires additional capabilities to facilitate this validation (see next section). This is the main purpose of the BPM+ Model Harmonization for **BKPMN**.

15.1 BPMN Harmonization

The **BPMN** harmonization overlays onto **BPMN** the infrastructure to enable **BKPMN** to validate **ModelLinks** from a **ProcessRef** to a **CaseRef** or **DecisionServiceRef**.

The following figure shows the metamodel for harmonizing **BPMN** within a BPM+ Knowledge Package.

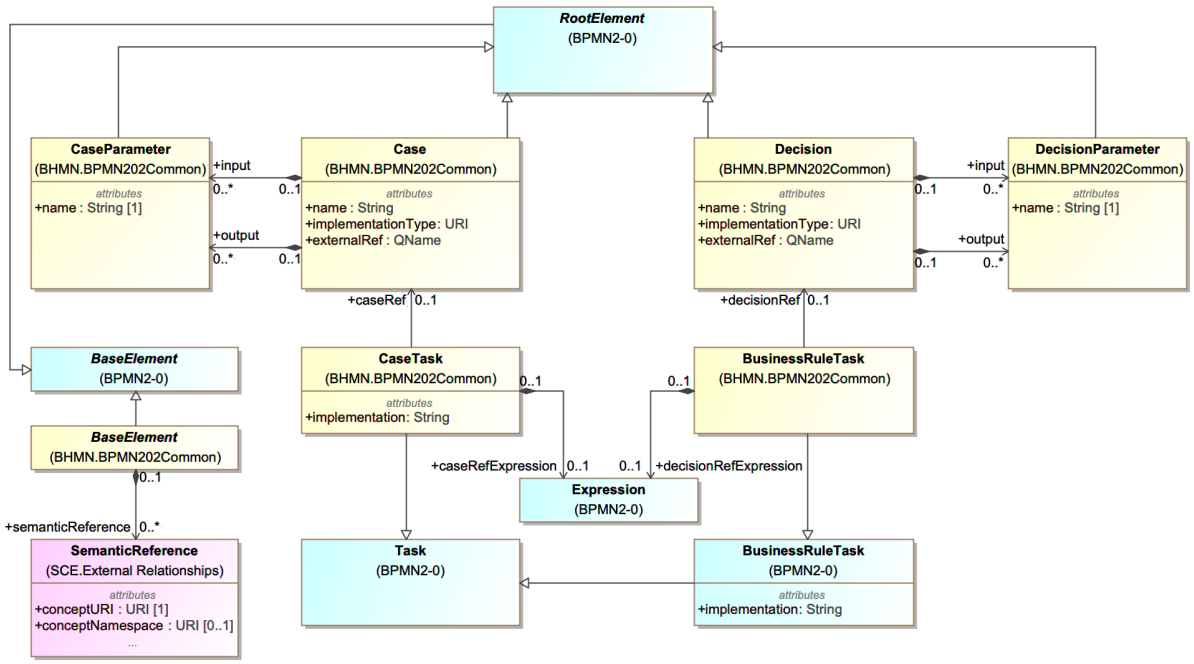


Figure 69: The BPMN Harmonization Metamodel

15.1.1 BaseElement

Generalizations

The *BaseElement* element inherits the attributes and/or associations of:

- **BPMN** *BaseElement* (see the **BPMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *BaseElement*:

Table 51. BaseElement Attributes and/or Associations

Property/Association	Description
semanticReference : (SCE) SemanticReference [0..*]	A concrete *BaseElement* can include multiple **SCE** *SemanticReference* elements.

15.1.2 BusinessRuleTask

Generalizations

The *BusinessRuleTask* element inherits the attributes and/or associations of:

- **BPMN** *BusinessRuleTask* (see the **BPMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *BusinessRuleTask*:

Table 52. BusinessRuleTask Attributes and/or Associations

Property/Association	Description
decisionRef : Decision [0..1]	A reference to a *Decision* (see below). If `decisionRef` is not specified, then `decisionRefExpression` MUST be specified. Only one of the attributes, `decisionRefExpression` or `decisionRef` MUST be specified.
decisionRefExpression : (BPMN) Expression [0..1]	This association defines the details of how a *BusinessRuleTask*, which is in a *Process* that is contained in a **BPMN** file that is referenced in the *Manifest*, is connected to a **DMN** *DecisionService*, which is contained in a **DMN** file that is referenced in the *Manifest*. Note that the link may be to a **DMN** *Decision*.

15.1.3 CaseTask

Generalizations

The *CaseTask* element inherits the attributes and/or associations of:

- **BPMN** *Task* (see the **BPMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *CaseTask*:

Table 53. CaseTask Attributes and/or Associations

Property/Association	Description
caseRef : Case [0..1]	A reference to a *Case* (see below). If `caseRef` is not specified, then `caseRefExpression` MUST be specified. Only one of the attributes, `caseRefExpression` or `caseRef` MUST be specified.
caseRefExpression: (BPMN) Expression [0..1]	If `caseRefExpression` is specified, it is assumed that the expression evaluates to a `QName` which is a valid `QName` of an existing `Process`. The process referred to by this `QName` MUST have compatible `Input` and `Output` parameters. The `processRefExpression` can be used to determine the concrete `Process` to be invoked by the `ProcessTask` at runtime. If that attribute is not specified, then `processRef` MUST refer to a valid `Process`. Only one of the attributes, `processRefExpression` or `processRef` MUST be specified.
implementation : String [0..1]	This attribute specifies the technology that will be used to link to a **CMMN** Case Model.

15.1.4 Case

A *Case* in this context is an abstraction of *Cases* as they are specified in various *Case* modeling specifications. By default, a version of the **CMMN** specification is assumed.

Generalizations

The *Case* element inherits the attributes and/or associations of:

- **BPMN** *RootElement* (see the **BPMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *Case*:

Table 54. Case Attributes and/or Associations

Property/Association	Description
externalRef : QName [0..1]	The concrete *Case* to be used.
implementationType : URI	The implementation type of the *Case*. It MUST be provided in URI format.
input : CaseParameter [0..*]	Zero or more `inputs` of the *Case*.
name : String [1]	The name of the *Case*.
output : CaseParameter [0..*]	Zero or more `outputs` of the *Case*.

15.1.5 CaseParameter

Generalizations

The *CaseParameter* element inherits the attributes and/or associations of:

- **BPMN** *RootElement* (see the **BPMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *CaseParameter*:

Table 55. CaseParameter Attributes and/or Associations

Property/Association	Description
name : String [0..1]	The `name` of the *CaseParameter*.

15.1.6 Decision

A *Decision* in this context is an abstraction of *Decisions or Decision Services* as they are specified in various *Decision* modeling specifications. By default, a version of the **DMN** specification is assumed.

Generalizations

The *Decision* element inherits the attributes and/or associations of:

- **BPMN** *RootElement* (see the **BPMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *Decision*:

Table 56. Decision Attributes and/or Associations

Property/Association	Description
externalRef : QName [0..1]	The concrete *Decision* to be used.
implementationType : URI	The implementation type of the *Decision*. It MUST be provided in URI format.
input : DecisionParameter [0..*]	Zero or more `inputs` of the *Decision*.
name : String [1]	The name of the *Decision*.
output : CaseParameter [0..*]	Zero or more `outputs` of the *Decision*.

15.1.7 DecisionParameter

Generalizations

The *DecisionParameter* element inherits the attributes and/or associations of:

- **BPMN** *RootElement* (see the **BPMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *DecisionParameter*:

Table 57. DecisionParameter Attributes and/or Associations

Property/Association	Description
name : String [0..1]	The `name` of the *DecisionParameter*.

15.2 CMMN Harmonization

The harmonization of **CMMN** to a BPM+ Knowledge Package is limited to the inclusion of an **SCE** *SemanticReference* to any **CMMN** element.

The following figure shows the metamodel for harmonizing **CMMN** within a BPM+ Knowledge Package.

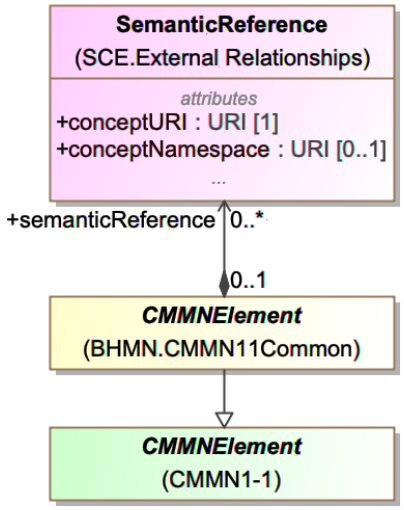


Figure 70: The CMMN Harmonization Metamodel

15.2.1 CMMNElement

Generalizations

The *CMMNElement* element inherits the attributes and/or associations of:

- **CMMN** *CMMNElement* (see the **CMMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *CMMNElement*:

Table 58. CMMNElement Attributes and/or Associations

Property/Association	Description
semanticReference : (SCE) SemanticReference [0..*]	A concrete *CMMNElement* can include multiple **SCE** *SemanticReference* elements.

15.3 DMN Harmonization

The harmonization of **DMN** to a BPM+ Knowledge Package is limited to the inclusion of an **SCE** *SemanticReference* to any **DMN** element.

The following figure shows the metamodel for harmonizing **DMN** within a BPM+ Knowledge Package.

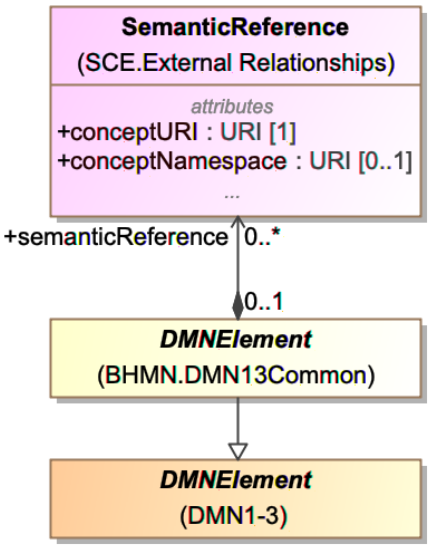


Figure 71: The DMN Harmonization Metamodel

15.3.1 DMNElement

Generalizations

The *DMNElement* element inherits the attributes and/or associations of:

- **DMN** *DMNElement* (see the **DMN** specification for more information).

Properties

The following table presents the additional attributes and/or associations for *DMNElement*:

Table 59. DMNElement Attributes and/or Associations

Property/Association	Description
semanticReference : (SCE) SemanticReference [0..*]	A concrete *DMNElement* can include multiple **SCE** *SemanticReference* elements.

16 BKPMN Examples (Informative)

16.1 Use Case: Hello Patient

The BPM+ Health community has been defining Shareable Clinical Pathways by using the current BPM+ standards to define formal and executable versions of current clinical guidelines (e.g., for hypertension, chronic kidney disease, etc.). Current clinical guidelines are usually found in printed or PDF documents and they contain vague and often confusing semantics leading to a great variability in how the guidelines are understood and performed.

This section describes a simple use case that was developed by the BPM+ Health community. At that time there was no concepts of BPM+ Knowledge Packages or Shared Data. The work on this and other use cases was instrumental

in identifying the need and requirements for a BPM+ Knowledge Package and for Shared Data.

16.1.1 Organizing BPM+ Models (A BPM+ Knowledge Package)

The use case defined the Processes, Cases, and Decision Services that are involved in managing a visit to a Doctor's office. Note that these models were intended to be illustrative rather than an official, comprehensive healthcare guideline.

The following table lists the major BPM+ model elements that made up the use case.

Table 60. List of BPM+ Models for the Hello Patient Use Case

Cases	Decision Services	Processes
1. *Hello Patient* 2. *Perform Examination* 3. *Perform Additional Test for Physical*	1. *What is Treatment Plan?* 2. *What is Patient's BMI Category?* 3. *Weight Counseling Suggested?* 4. *What is Blood Pressure Rating?* 5. *Physical Required?*	1. *Manage Hello Patient Triggers…* 2. *Evaluate Applicability* 3. *Manage Patient Visit* 4. *Check In Patient* 5. *Take Vital Signs* 6. *Check Out Patient* 7. *Update Appointment Information* 8. *Ask Screening Questions* 9. *Manage Counseling Referral*

A larger use case for "Antenatal Care" was developed and contained more models than listed above. For that use case there were 9 Cases, 15 Decision Services, and 28 Processes.

Reviewing one of the models listed in the table above does not provide the overall scope and context of the set of models in the use case. While it may be possible to trace through the connections between the BPM+ models, that tracing still does provide the proper context.

This lack of perspective resulted in a new type of diagram included with the use case. It is referred to as a Knowledge Diagram. The diagram provides graphical representations of the BPM+ models and draws connectors to represent how the models can be traced through their connections. The following figure displays the Knowledge Diagram for the Hello Patient use case. Note that all the items listed in the table above have diagram elements associated with them. There are different notations for Processes, Cases, and Decision Services.

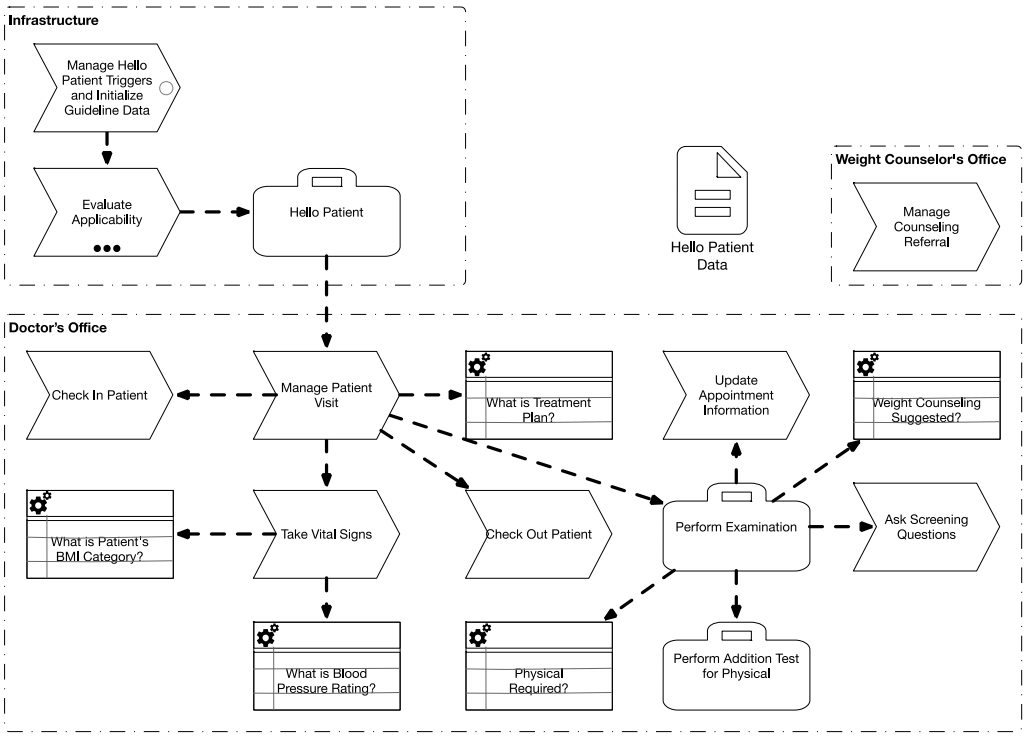


Figure 72: Example of a BPM+ Knowledge Diagram

Note that the development of the Knowledge Diagram for the use cases was an indication that something else was needed to fully document the contexts of a set of BPM+ created for a specific topic. This and other factors led to the requirements for a BPM+ Knowledge Package.

16.1.2 Organizing BPM+ Data Elements (A Shared Data Model)

Several elements in BPM+ Models are intended to store or convey data required for the execution of those Models. **BPMN** has Data Objects, Data Inputs, Data Outputs, Data Stores, and Properties. **CMMN** has Case File Items. **DMN** has Information Items that are used for Data Inputs and Decisions. The Hello Patient use case employed many of these types of data elements within its BPM+ models. The following table lists those data elements used within the set of BPM+ models for the Hello Patient use case.

Table 61. List of Data Elements used by the BPM+ Models in the Hello Patient Use Case

Case Data	Decision Service Data	Process Data
1. Blood Pressure	***1. Blood Pressure***	***1. Blood Pressure***
2. Blood Pressure Goal	***2. Blood Pressure Goal***	***2. Blood Pressure Goal***
3. BMI Category	*3. Blood Pressure Rating*	*3. Blood Pressure Rating*
4. Encounter	***4. BMI Category***	***4. BMI Category***
5. Exam Data	*5. Demographics*	*5. Demographics*
6. Guideline Info	***6. Exam Data***	*6. Encounter*
7. Health Conditions	***7. Health Conditions***	***7. Exam Data***
8. Medication	***8. Medication***	***8. Health Conditions***
9. Medication Tolerances	***9. Medication Tolerances***	*9. Loop Counter*
10. Pathway Goals	*10. Pathway Goals*	***10. Medication***
11. Patient Health Record	*11. Patient Complaints*	***11. Medication Tolerances***
12. Referral	***12. Patient Health Record***	*12. Pathway Goals*
13. Treatment Plan	***13. Referral***	*13. Patient Complaints*
14. Vital Signs and Measurements	***14. Treatment Plan***	***14. Patient Health Record***
15. Weight Counseling Referral	*15. Treatment Choice*	***15. Referral***
16. Weight Counseling Referral Choice	***16. Vital Signs and Measurements***	***16. Treatment Plan***
	17. Weight Counseling Referral	*17. Treatment Choice*
	18. Weight Counseling Referral Choice	***18. Vital Signs and Measurements***
		19. Weight Counseling Referral

Note that the data elements listed in **bold** in the table are those that appear in all three types of BPM+ models. The other data elements appear in at least two of the model types.

The set of data elements listed in the above table reflect those data elements that are necessary for only the context of this use case (Hello Patient). They do not represent all the data elements that a Doctor's Office may require for all of its operations – let alone all the data elements required for the healthcare domain. The use case only specified the data elements required for its particular situation. Hence, we refer to sets of data elements used in such a context as "Shared Data".

Since the use case employed all three different types of BPM+ models (Process, Case, and Decision Service), the Shared Data of the use case is shared and distributed across the three types of models. While there are some technical differences between how data is structured and used across the BPM+ specifications, at the logical level, they all play the same role within the respective languages. This is evident when a specific conceptual data element (e.g., "Vital Signs and Measures") can be included in all three BPM+ modeling languages (see figure below). That is, the same data element (and its values during runtime) can be, for example, passed from a **CMMN** Case to a **BPMN** Process and then used in a **DMN** Decision.

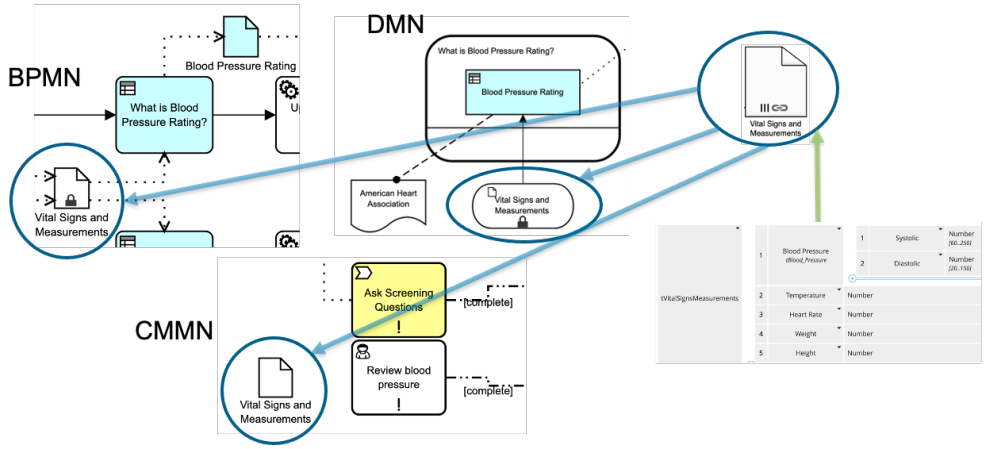


Figure 73: Illustration of How Data Elements are Share Across BPM+ Models

Without a **Shared Data Model** tool, the same data element has to be defined separately in the tools dedicated to each modeling language. There are no standard mechanisms for sharing data elements across the three types BPM+ models.

If there are a lot of data elements that are shared between the models of a BPM+ Knowledge Package, the development and maintenance burden for synchronizing the properties of the data elements will problematic. All of the Hello Patient use date elements were used in at least two types of models. Each time any of the data elements were modified, which can happen multiple times during the BPM+ Knowledge Package development cycle, there would be one or more modifications in the other types of BPM+ models. It would be up to the modeler to ensure that the modifications were made and were consistent.

This maintenance burden was the driver for defining a **Shared Data Model**, which would be a library of data elements that would readily be available for synchronization with the other BPM+ Models. That is, the Data Items of the **Shared Data Model** should share the same characteristics as the data elements of the three BPM+ data elements. Further, the modeling experience should be very similar across all four models to ease burdens on the modeler.

The **Shared Data Model** would provide an environment where data elements can be defined and modified in a single location and the changes could be distributed to the other BPM+ models without additional work and vigilance by the modeler.

17 Exchange Formats

17.1 Interchanging Incomplete Models

In practice, it is common for models to be interchanged before they are complete. This occurs frequently when doing iterative modeling, where one user (such as a subject matter expert or business person) first defines a high-level model, and then passes it on to another user to be completed and refined.

Such “incomplete” models are ones in which all of the mandatory attributes have not yet been filled in, or the cardinality lowerbound of attributes and associations has not been satisfied.

XMI allows for the interchange of such incomplete models. In **BKPMN**, we extend this capability to interchange of XML files based on the **BKPMN XSD**. In such XML files, implementers are expected to support this interchange by:

- Disregarding missing attributes that are marked as ‘required’ in the XSD.
- Reducing the lower bound of elements with ‘minOccurs’ greater than 0.

17.2 XSD

17.2.1 Document Structure

A domain-specific set of model elements is interchanged in one or more **BKPMN** files. The root element of each file SHALL be `<DMN:Definitions>`. The set of files SHALL be self-contained, i.e., all definitions that are used in a file SHALL be imported directly or indirectly using the `<DMN:Import>` element.

Each file SHALL declare a "`namespace`" that MAY differ between multiple files of one model.

BKPMN files MAY import non-**BKPMN** files (such as XSDs and PMMLs) if the contained elements use external definitions.

17.2.2 References within the BKPMN XSD

Many **BKPMN** elements that may need to be referenced contain IDs and within the **BKPMN XSD**, references to elements are expressed via these IDs. The XSD IDREF type is the traditional mechanism for referencing by IDs, however it can only reference an element within the same file. **BKPMN** elements of that inherit from **SCE** *RootElement* support referencing by ID, across files, by utilizing an href attribute whose value must be a valid URI reference [RFC 3986] where the path components may be absolute or relative, the reference has no query component, and the fragment consists of the value of the id of the referenced **BKPMN** element.

For example, consider the following Decision:

```
<decision name="Pre-Bureau Risk Category"
id="prebureauriskDec01">…</decision>
```

When this Decision is referenced, e.g. by an InformationRequirement in a Decision that is defined in another file, the reference could take the following form:

```
<requiredDecision
href="http://www.example.org/Definitions01.xml#prebureauriskDec01"/>
```

where "`http://www.example.org/Definitions01.xml`" is an URI reference to the XML document in which the "Pre-Bureau Risk Category" Decision is defined (e.g. the value of the locationURI attribute in the corresponding Import element), and "prebureauriskDec01" is the value of the id attribute for the Decision.

If the path component in the URI reference is relative, the base URI against which the relative reference is applied is determined as specified in [RFC 3986]. According to that specification, "if no base URI is embedded and the representation is not encapsulated within some other entity, then, if a URI was used to retrieve the representation, that URI shall be considered the base URI" ([RFC 3986], section 5.1.3). That is, if the reference is not in the scope of an xml:base attribute [XBASE], a value of the href attribute that contains only a fragment and no path component references a **BKPMN** element that is defined in the same instance of XML file as the referencing element. In the example below, assuming that the requiredDecision element is not in the scope of an xml:base attribute, the **BKPMN** element whose id is "prebureauriskDec01" must be defined in the same XML document:

```
<requiredDecision href="#prebureauriskDec01" />
```

Attribute typeRef references ItemDefinitions and built-in types by name not ID. In order to support imported types, typeRef uses the namespace-qualified name syntax [qualifer].[local-name], where qualifier is specified by the name attribute of the Import element for the imported type. If the referenced type is not imported, the prefix SHALL be omitted.

18 BKPMN Diagram Interchange

18.1 Scope

This chapter specifies the meta-model and schema for **BKPMN** 1.0 Diagram Interchange (**BKPMN DI**). The

BKPMN DI is meant to facilitate the interchange of **BKPMN** diagrams between tools rather than being used for internal diagram representation by the tools. The simplest interchange approach to ensure the unambiguous rendering of a KPMN diagram was chosen for **BKPMN DI**. As such, **BKPMN DI** does not aim to preserve or interchange any "tool smarts" between the source and target tools (e.g., layout smarts, efficient styling, etc.).

BKPMN DI does not ascertain that the **BKPMN** diagram is syntactically or semantically correct.

18.2 Measurement Unit

As per OMG DD, all coordinates and lengths defined by **BKPMN DI** are assumed to be in user units, except when specified otherwise. A user unit is a value in the user coordinate system, which initially (before any transformation is applied) aligns with the device's coordinate system (for example, a pixel grid of a display). A user unit, therefore, represents a logical rather than physical measurement unit. Since some applications might specify a physical dimension for a diagram as well (mainly for printing purposes), a mapping from a user unit to a physical unit can be specified as a diagram's resolution. Inch is chosen in this specification to avoid variability, but tools can easily convert from/to other preferred physical units. Resolution specifies how many user units fit within one physical unit (for example, a resolution of 300 specifies that 300 user units fit within 1 inch on the device).

18.3 Diagram Definition and Interchange

The **BKPMN DI** meta-model, similar to the **BKPMN** abstract syntax meta-model, is defined as a MOF-based meta-model. As such, its instances can be serialized and interchanged using XMI. **BKPMN DI** is also defined by an XML schema. Thus its instances can also be serialized and interchanged using XML.

Both **BKPMN DI** meta-model and schema is layered upon the **SCE DI** (see the **SCE 1.0** specification [OMG doc number bmi-2021-12-09]), which is harmonized with the OMG Diagram Definition (DD) standard version 1.1. The referenced DD contains two main parts: the Diagram Commons (DC) and the Diagram Interchange (DI). The DC defines common types like bounds and points, while the DI provides a framework for defining domain-specific diagram models. As a domain-specific DI, **BKPMN DI** defines a few new meta-model classes that derive from the abstract classes from **SCE DI** and DI.

The focus of **BKPMN DI** is the interchange of laid out shapes and edges that constitute a **BKPMN** diagram. Each shape and edge references a particular **BKPMN** model element. The referenced **SDMN** model elements are all part of the actual **BKPMN** model. As such, **BKPMN DI** is meant to only contain information that is neither present nor derivable, from the **BKPMN** model whenever possible. Simply put, to render a **BKPMN** diagram both the **BKPMN DI** instance(s) and the referenced **BKPMN** model are REQUIRED.

From the **BKPMN DI** perspective, a **BKPMN** diagram is a particular snapshot of a **BKPMN** model at a certain point in time. Multiple **BKPMN** diagrams can be exchanged referencing model elements from the same **BKPMN** model. Each diagram may provide an incomplete or partial depiction of the content of the **BKPMN** model. As described in Clause 13, a **BKPMN** model package consists of one or more files. Each file may contain any number of **BKPMN** diagrams. The exporting tool is free to decide how many diagrams are exported and the importing tool is free to decide if and how to present the contained diagrams to the user.

18.4 BKPMN Diagram Interchange Meta-Model

18.4.1 How to read this Chapter

Clause 18.5.3 describes in detail the meta-model used to keep the layout and the look of **BKPMN** Diagrams. Clause 18.5.4 presents in tables a library of the **BKPMN** element depictions and an unambiguous resolution between a referenced **BKPMN** model element and its depiction.

18.4.2 Overview

The **BKPMN DI**, which extends the **SCE DI**, is an instance of the OMG **DI** meta-model. The basic concept of **BKPMN DI**, as with diagram interchange in general, is that serializing a diagram [*BKPMNDiagram*] for interchange requires the specification of a collection of shapes [*BKPMNShape*] and edges [*BKPMNEdge*].

The **BKPMN DI** classes only define the visual properties used for depiction. All other properties that are REQUIRED for the unambiguous depiction of the **BKPMN** element are derived from the referenced **BKPMN** element [*BKPMNElementRef*].

BKPMN diagrams may be an incomplete or partial depiction of the content of the **BKPMN** model. Some **BKPMN** elements from a **BKPMN** model may not be present in any of the diagram instances being interchanged.

BKPMN DI does not directly provide for any containment concept. The *BKPMNDiagram* is an ordered collection of mixed *BKPMNShape*(s) and *BKPMNEdge*(s). The order of the *BKPMNShape*(s) and *BKPMNEdge*(s) inside a *BKPMNDiagram* determines their Z-order (i.e., what is in front of what). *BKPMNShape*(s) and *BKPMNEdge*(s) that are *BKPMNEdge*(s) MUST appear after them in the *BKPMNDiagram*. Thus, the exporting tool MUST order all *BKPMNShape*(s) and *BKPMNEdge*(s) such that the desired depiction can be rendered.

18.4.3 Measurement Unit

As per OMG DD, all coordinates and lengths defined by **BKPMN DI** are assumed to be in user units, except when specified otherwise. A user unit is a value in the user coordinate system, which initially (before any transformation is applied) aligns with the device's coordinate system (for example, a pixel grid of a display). A user unit, therefore, represents a logical rather than physical measurement unit. Since some applications might specify a physical dimension for a diagram as well (mainly for printing purposes), a mapping from a user unit to a physical unit can be specified as a diagram's resolution. Inch is chosen in this specification to avoid variability, but tools can easily convert from/to other preferred physical units. Resolution specifies how many user units fit within one physical unit (for example, a resolution of 300 specifies that 300 user units fit within 1 inch on the device).

18.4.4 Elements

The following sections define the elements necessary for exchanging the diagrams from an **BKPMN** modeling tool.

18.4.4.1 BKPMNDI

The class *BKPMNDI* is a container for the shared **SCE** *SCEStyle* and all the *BKPMNDIDiagrams* defined in a *BKPMNDefinitions*.

The following figure shows the *BKPMNDI* metamodel.

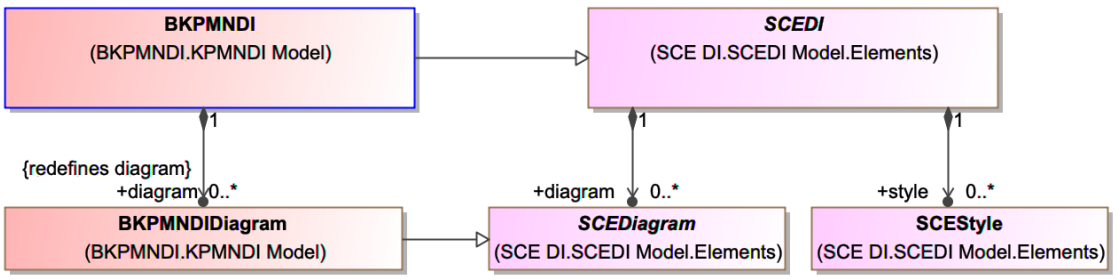


Figure 74: BKPMNDI

Generalizations

The *BKPMNDI* element inherits the attributes and/or associations of:

- **SCE** *SCEDI* (see the **SCE** specification [OMG doc number bmi-2021-12-09] for more information).

Properties

The following table presents the additional attributes and/or associations for *BKPMNDI*:

Table 62. BKPMNDI Attributes and/or Associations

Property/Association	Description
diagram : BKPMNDIDiagram [0..*]	A list of *BKPMNDIDiagrams*. This redefines the `diagram` association inherited from the **SCE** *SCEDI* element.

18.4.4.2 BKPMNDIDiagram

The class *BKPMNDIDiagram* specializes **SCE** *SCEDiagram*. It is a kind of diagram that represents a depiction of all or part of a **BKPMN** model. It is contained within the *BKPMNDI* element (see above).

BKPMNDIDiagram is the container of *BKPMNDIDiagramElement* (*BKPMNShape*(s) and *BKPMNEdge*(s)). *BKPMNDIDiagram* cannot include other *BKPMNDIDiagram*.

A *BKPMNDIDiagram* can define an **SCE** *SCEStyle* locally and/or it can refer to a shared one defined in the BKPMDI. Properties defined in the local style overrides the one in the referenced shared style. That combined style (shared and local) is the default style for all the *BKPMNDIDiagramElement* contained in this *BKPMNDIDiagram* diagram.

The *BKPMNDIDiagram* class represents a two-dimensional surface with an origin of (0, 0) at the top left corner. This means that the x and y axes have increasing coordinates to the right and bottom. Only positive coordinates are allowed for diagram elements that are nested in a *BKPMNDIDiagram*.

The following figure shows the *BKPMNDIDiagram* metamodel.

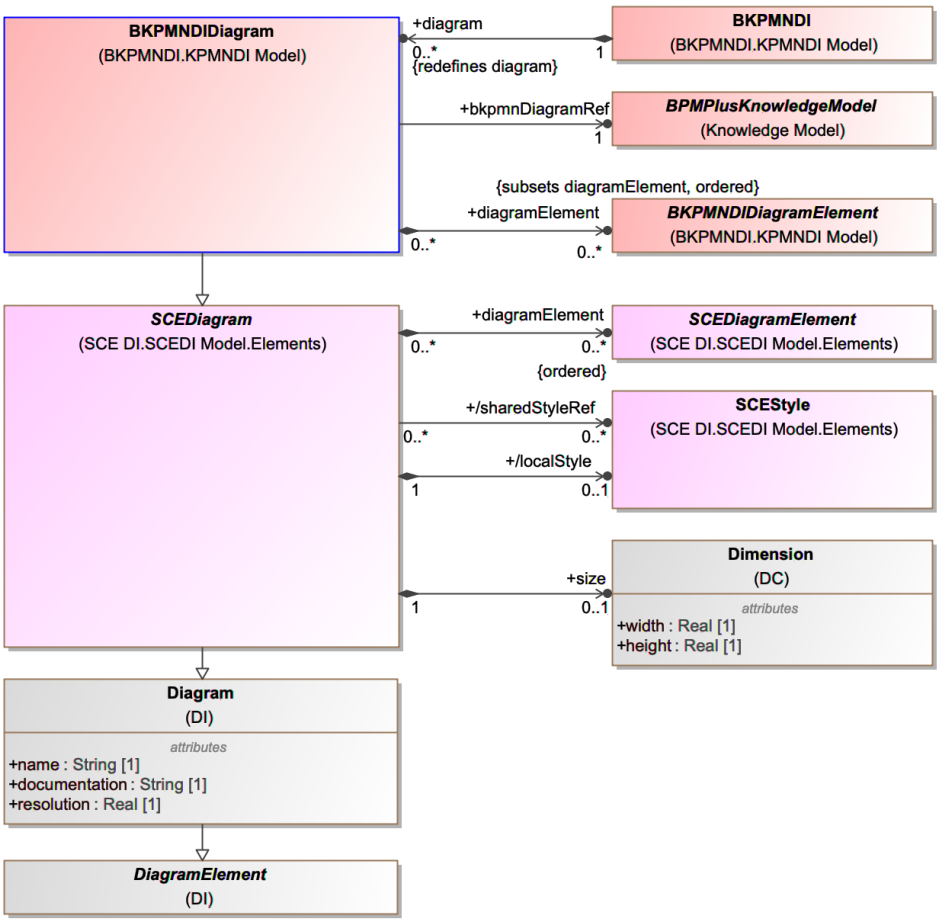


Figure 75: BKPMNDI Diagrams

Generalizations

The *BKPMNDIDiagram* element inherits the attributes and/or associations of:

- **SCE** *SCEDIDiagram* (see the **SCE** specification [OMG doc number bmi-2021-12-09] for more information).

Further, the *SCEDIDiagram* element inherits the attributes and/or associations of:

- **DD** *Diagram* (see the **DD** specification [OMG formal-15-06-01] for more information).

Properties

The following table presents the additional attributes and/or associations for *BKPMNDIDiagram*:

Table 63. BKPMNDIDiagram Attributes and/or Associations

Property/Association	Description
bkpmnDiagramRef : BKPMNDiagram [1]	The diagram that the DI is representing. In the current version, this will be a **KnowledgeDiagram**.

diagramElement : BKPMNDIDiagramElement [0..*]	A list of *BKPMNDIDiagramElement* (*BKPMNShape* and *BKPMNEdge*) that are depicted in this diagram. This redefines the `diagramElement` association inherited from the **SCE** *SCEDIDiagram* element.

18.4.4.3 BKPMNDIDiagramElement

The *BKPMNDIDiagramElement* class is contained by the *BKPMNDIDiagram* and is the base class for *BKPMNShape* and *BKPMNEdge*.

BKPMNDIDiagramElement inherits its styling from its parent *BKPMNDIDiagram*. In addition, it can refer to one of the shared **SCE** *SCEStyle* defined in the *BKPMNDI* and/or it can define a local style. See the **SCE** specification [OMG doc number bmi-2021-12-09] for more details on styling.

BKPMNDIDiagramElement MAY also contain a **SCE** *SCELabel* when it has a visible text label. If no **SCE** *SCELabel* is defined, the *BKPMNDIDiagramElement* should be depicted without a label.

The following figure shows the *BKPMNDIDiagramElement* metamodel.

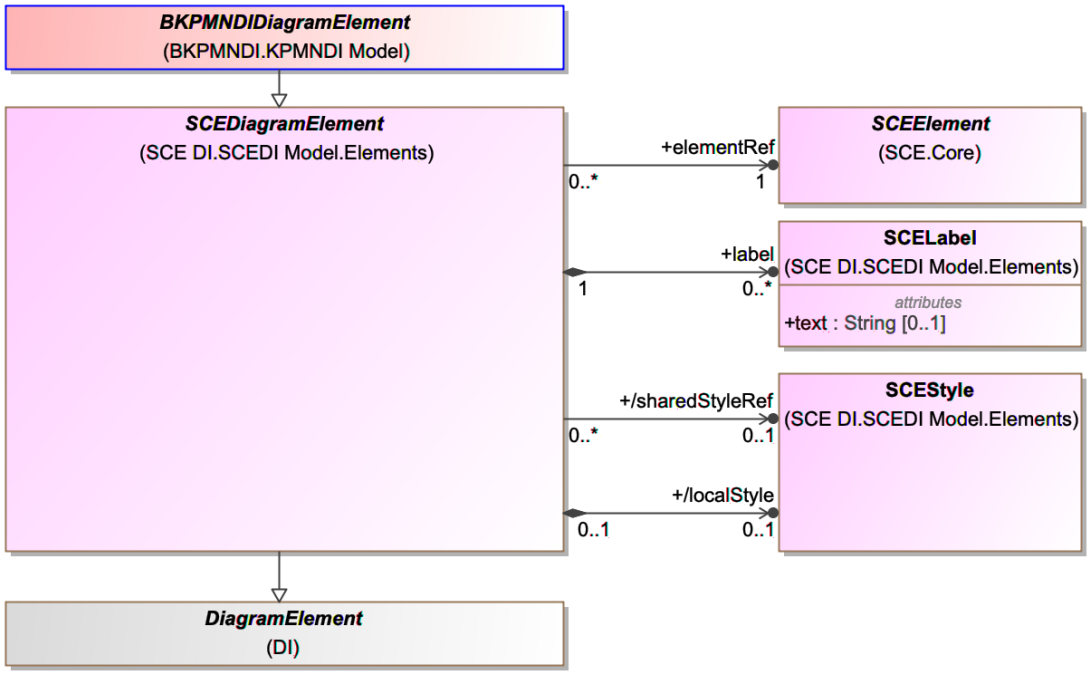


Figure 76: BKPMNDI Diagram Element

Generalizations

The *BKPMNDIDiagramElement* element inherits the attributes and/or associations of:

- **SCE** *SCEDiagramElement* (see the **SCE** specification [OMG doc number bmi-2021-12-09] for more information).

Further, the *SCEDIDiagram* element inherits the attributes and/or associations of:

- **DD** *DiagramElement* (see the **DD** specification [OMG formal-15-06-01] for more information).

Properties

The *BKPMNDIDiagramElement* element does not have any additional attributes and/or associations.

18.4.4.4 BKPMNShape

The *BKPMNShape* class specializes **SCE** *SCEShape* and *BKPMNDIDiagramElement*. It is a kind of shape that depicts a concrete specialization of **SCE** *SCEElement* from the **BKPMN** model.

BKPMNShape represents a BKPMNPackageRef, CaseRef, ChoreographyRef, CollaborationRef, Development Method, DecisionServiceRef, QuestionnaireHandlerRef, OperationalModelRef, OrderSetHandlerRef, PedigreeAndProvenanceRef, ProcessRef, SharedDataModelRef, Undefined Behavior, Group, or a Text Annotation that is depicted on the diagram.

BKPMNShape has one additional property (isCollapsed) that are used to further specify the appearance of some shapes that cannot be deduced from the **BKPMN** model.

The following figure shows the *BKPMNShape* metamodel.

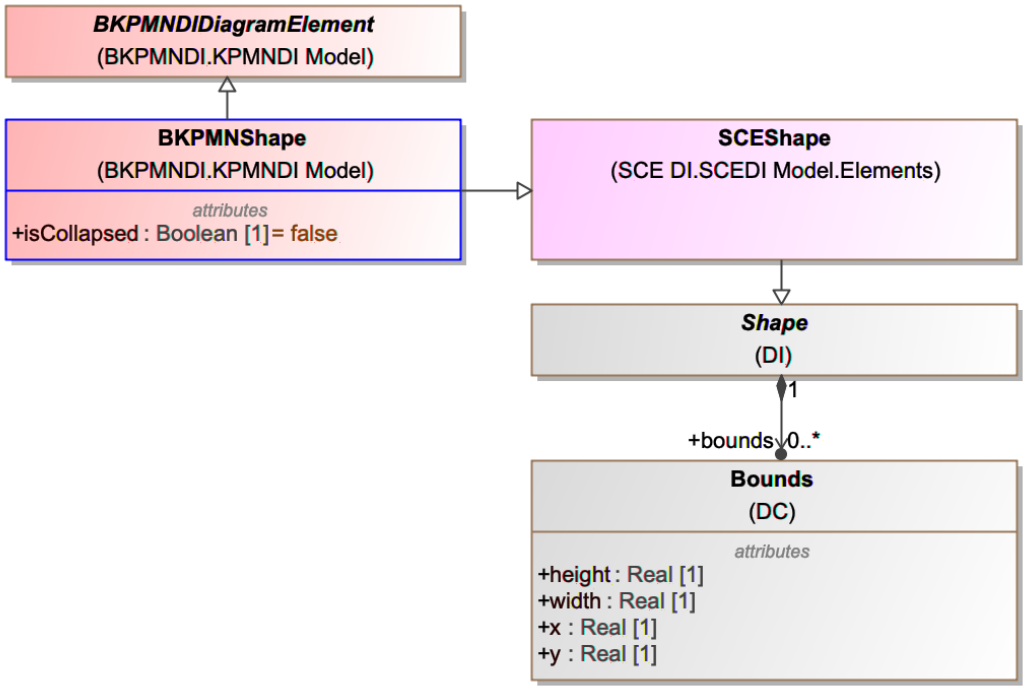


Figure 77: BKPMNDI Shape

Generalizations

The *BKPMNShape* element inherits the attributes and/or associations of:

- *BKPMNDIDiagramElement* (see the section entitled "BKPMNDIDiagramElement" for more information).

Further, the *BKPMNDIDiagramElement* element inherits the attributes and/or associations of:

- *DI::DiagramElement* (see the **DD** specification (OMG formal-15-06-01) for more information).

In addition, the *BKPMNShape* element inherits the attributes and/or associations of:

- *DI::Shape* (see the **DD** specification (OMG formal-15-06-01) for more information).

Properties

The following table presents the additional attributes and/or associations for *BKPMNShape*:

Table 64. BKPMNShape Attributes and/or Associations

Property/Association	Description
isCollapsed : Boolean [1] default: false	

18.4.4.5 BKPMNEdge

The *BKPMNEdge* class specializes DI::Edge and *BKPMNDIDiagramElement*. It is a kind of edge that can depict a relationship between two **BKPMN** model elements.

BKPMNEdge are used to depict **RelationshipConnectors** or **Associations** in the **BKPMN** model. Since *BKPMNDIDiagramElement* might be depicted more than once, `sourceElementRef` and `targetElementRef` attributes allow to determine to which depiction a *BKPMNEdge* is connected. When *BKPMNEdge* has a source, its `sourceElementRef` MUST refer to the *BKPMNDIDiagramElement* it starts from. That *BKPMNDIDiagramElement* MUST resolved to the concrete specialization of the **SCE** *SCEElement* that is the actual source of the *BKPMNDIDiagramElement* where it ends. When it has a target, its `targetElementRef` MUST refer to the *BKPMNDIDiagramElement* where it ends. That *BKPMNDIDiagramElement* MUST resolved to the concrete specialization of the **SCE** *SCEElement* that is the actual target of the edge.

The following figure shows the *BKPMNEdge* metamodel.

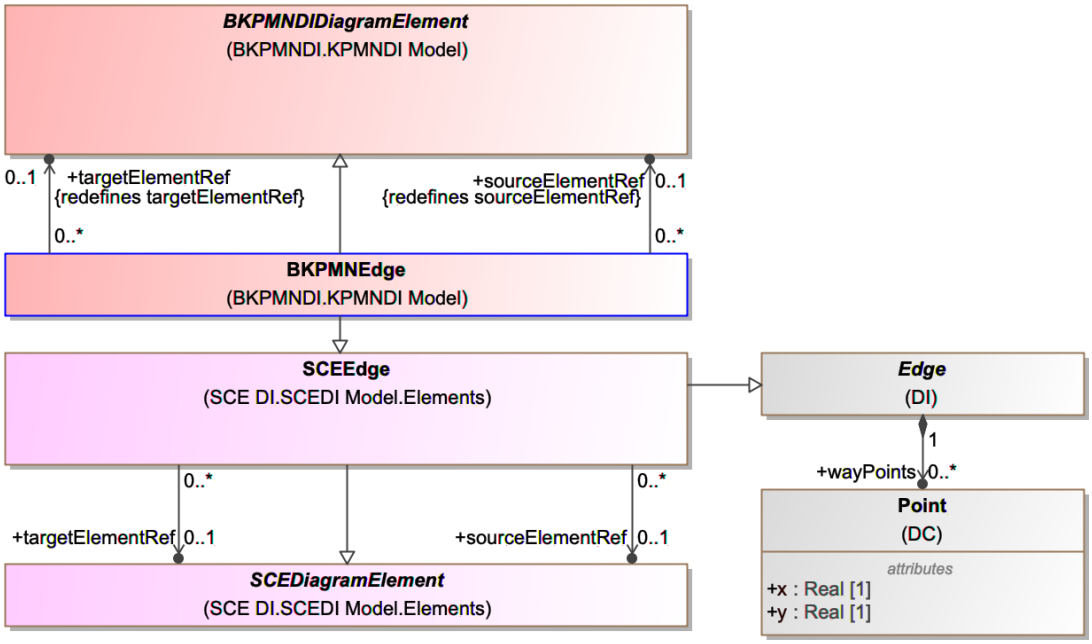


Figure 78: BKPMNDI Edge

Generalizations

The *BKPMNEdge* element inherits the attributes and/or associations of:

- *BKPMNDIDiagramElement* (see the section entitled "BKPMNDIDiagramElement" for more information).

Further, the *BKPMNDIDiagramElement* element inherits the attributes and/or associations of:

- *DI::DiagramElement* (see the **DD** specification (OMG formal-15-06-01) for more information).

In addition, the *BKPMNEdge* element inherits the attributes and/or associations of:

- *DI::Edge* (see the **DD** specification (OMG formal-15-06-01) for more information).

Properties

The *BKPMNEdge* element does not have any additional attributes and/or associations.

The following table presents the additional attributes and/or associations for *DI::Edge*:

Table 65. DI::Edge Attributes and/or Associations

Property/Association	Description
wayPoints : DC::Point [0..*]	A list of points relative to the origin of its parent *BKPMNDIDiagram* that specifies the connected line segments of the edge. At least two (2) waypoints MUST be specified.

18.4.5 Notation

As a specification that contains notation, **BKPMN** specifies the depiction for **BKPMN** diagram elements, including **SCE** *DiagramArtifact* elements.

Serializing a **BKPMN** diagram for interchange requires the specification of a collection of *BKPMNShape*(s) and *BKPMNEdge*(s) in the *BKPMNDIDiagram* (see sections above). The *BKPMNShape*(s) and *BKPMNEdge*(s) attributes must be populated in such a way as to allow the unambiguous rendering of the **BKPMN** diagram by the receiving party. More specifically, the *BKPMNShape*(s) and *BKPMNEdge*(s) MUST reference **BKPMN** model elements. If no *SCEElement* is referenced or if the reference is invalid, it is expected that this shape or edge should not be depicted.

When rendering a **BKPMN** diagram, the correct depiction of a *BKPMNShape* or *BKPMNEdge* depends mainly on the referenced **BKPMN** model element and its particular attributes and/or references. The purpose of this clause is to: provide a library of the **BKPMN** element depictions, and to provide an unambiguous resolution between the referenced **BKPMN** model element [*SCEElement*] and their depiction. Depiction resolution tables are provided below for both *BKPMNShape* and *BKPMNEdge*.

18.4.5.1 Labels

Both *BKPMNShape* and *BKPMNEdge* may have labels (its name attribute) placed on the shape/edge, or above or below the shape/edge, in any direction or location, depending on the preference of the modeler or modeling tool vendor.

Labels are optional for *BKPMNShape* and *BKPMNEdge*. When there is a label, the position of the label is specified by the bounds of the *BKPMNLabel* of the *BKPMNShape* or *BKPMNEdge*. Simply put, label visibility is defined by the presence of the *BKPMNLabel* element.

The bounds of the *BKPMNLabel* are optional and always relative to the containing *BKPMNDIDiagram's* origin point. The depiction resolution tables provided below exemplify default label positions if no bounds are provided for the *BKPMNLabel* (for *BKPMNShape* kinds and *BKPMNEdge* kinds (see sections above)).

When the *BKPMNLabel* is contained in a *BKPMNShape*, the text to display is the name of the *SCEElement*.

18.4.5.2 BKPMNShape Resolution

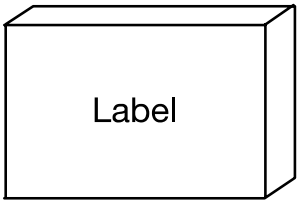
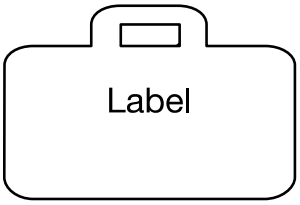
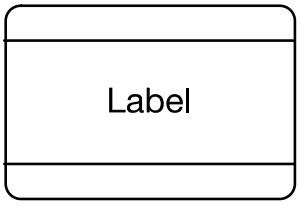
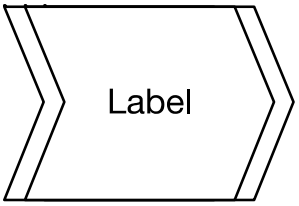
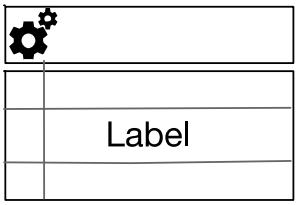
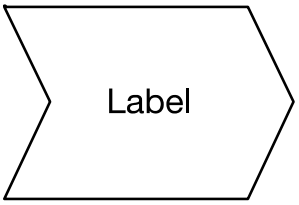
BKPMNShape can be used to represent a **Text Annotation** or a **Group**.

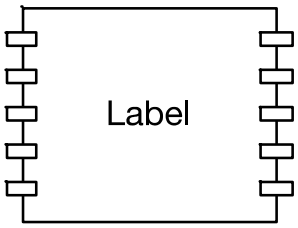
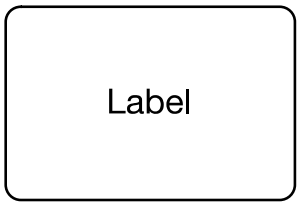
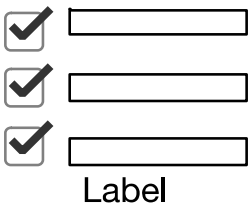
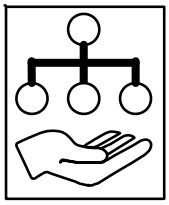
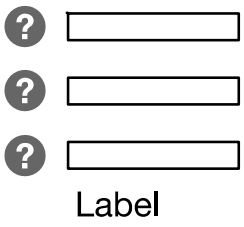
Dipiction for BPMPlusDiagramElements

When a *BKPMNShape* is used to depict a *BPMPlusDiagramElement* the actual shape is determined by: the referred *BPMPlusDiagramElement*.

The following table presents the depiction resolutions for **DataItems**:

Table 66. Depiction Resolution of DataItems

BKPMNElement	BKPMNShape Attributes	Depiction
BKPMNPackageRef		
CaseRef		
ChoreographyRef		
CollaborationRef		
DecisionServiceRef		
OperationalModelRef		
ProcessRef		

ServiceRef		
SharedDataModelRef		
UndefinedBehavior		
OrderSetHandlerRef		
PedigreeAndProvinanceRef		
QuestionaireHandlerRef		

Starting Point Decorator

The following table presents the depiction resolutions for the Multiplicity Decorator:

Table 67. Multiplicity Decorator Depiction

DataItem Attribute	Depiction
Multiplicity = ZeroOrMore or OneOrMore	

Semantic Reference Decorator

The following table presents the depiction resolutions for the Semantic Reference Decorator:

Table 68. Semantic Reference Decorator Depiction

DataItem Attribute	Depiction
If the **DataItem** or any component of its associated *ItemDefinition* has an defined *SemanticReference*.	

18.4.5.3 BKPMNEdge Resolution

BKPMNEdge can be used to represent an **Ownership Connector**, **Parent-Child Connector**, **Relationship Connector**, or a **Data Association**.

Relationship Connector

The following table presents the depiction resolutions for an **Association**:

Table 69. Depiction Resolution of the Relationship Connector

BKPMN Element	Depiction
Relationship Connector