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Case Management Model and Notation (CMMN)

Version 1.0

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Preface

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The type styles shown below are used in this document to distinguish programming statements from ordinary English. However, these conventions are not used in tables or section headings where no distinction is necessary.

Times/Times New Roman - 11 pt.: Standard body text

Helvetica/Arial - 10 pt. Bold: OMG Interface Definition Language (OMG IDL) and syntax elements.

`Courier/Courier New - 11 pt. Bold:` Programming language elements.

Helvetica/Arial - 10 pt: Exceptions

NOTE: Terms that appear in italics are defined in the glossary. Italic text also represents the name of a document, specification, or other publication.

1 Scope

1.1 Project Goals

The goals of this project are to:

1. Create a Case Management specification (referred to herein as CMMN 1.0).
2. Submit the specification as a response to the OMG RFP for Case Management Process Modeling (OMG document: Bmi/2010-09-23)

1.2 In Scope

1. Define Case Management Model, notation, and operational semantics of the model.
2. Leverage a content management model based on properties, documents, folders, and relationships.
3. Leverage a standard expression and query language as the default CMMN expression and query language.
4. Specify how case events and constraints may be applied.
5. Specify interchange format for Case Management Model (XMI and XSD).

1.3 Out of Scope

1. Deployment mechanics
2. Run-time API's.
3. Operational simulation.
4. Definition of an [business] organizational model.
5. Definition of business goals.

2 Conformance

Software can claim compliance or conformance with CMMN 1.0 if and only if the software fully matches the applicable compliance points as stated in the specification. 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. The specification defines four types of compliance points namely Visual Notation Conformance, Case Modeling Conformance, BPMN Compatibility Conformance, and CMMN Complete Conformance. The implementation is said to have CMMN Complete Conformance if it complies with all of the requirements stated in Sections 2.1, 2.4, 5, 6, 7, and 8.

An implementation claiming compliance or conformance to CMMN Complete Conformance or to Case Modeling Conformance is NOT REQUIRED to support BPMN Compatibility Conformance and vice-versa. An implementation claiming compliance or conformance to CMMN Complete Conformance, to Case Modeling Conformance, or to BPMN Compatibility Conformance is REQUIRED to be conformant to the Visual Notation Conformance.

A conforming implementation is NOT REQUIRED to support any element or attribute that is specified herein to be non-normative or informative. In each instance in which this specification defines a feature to be "optional," it specifies whether the option is in:

- How the feature will be displayed

- Whether the feature will be displayed
- Whether the feature will be supported

A conforming implementation is NOT REQUIRED to support any feature whose support is specified to be optional. If an implementation supports an optional feature, it SHALL support it as specified. A conforming implementation SHALL support any “optional” feature for which the option is only in whether or how it SHALL be displayed.

The following table summarizes the conformance types, by listing the sections that each conformance type must implement.

Sections	Visual Notation Conformance	Case Modeling Conformance	BPMN Compatibility Conformance	CMMN Complete Conformance
2.1	√	√	√	√
2.2		√		√
2.3			√	√
2.4				√
5		√		√
6	√	√	√	√
6.7.2.1			√	√
6.7.2.2			√	√
7				√
8		√		√

Table 1: Conformance Matrix

2.1 Visual Notation Conformance

An implementation that creates and displays CMMN models SHALL conform to the specifications and restrictions with respect to diagrammatic relationships between graphical elements, as described in Section 6. A key element of CMMN 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 case modelers will recognize and understand. An implementation that creates and displays CMMN 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,

- CMMN 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.
- 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 MUST NOT conflict with any current CMMN or BPMN defined line style.

The following extensions to a CMMN 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 CMMN element or to represent a new subtype of the corresponding concept.
- A new shape representing a kind of Case File Item or Plan Item MAY be added to a model, but the new Case File Item or Plan Item shape SHALL NOT conflict with the shape specified for any other CMMN or BPMN 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 BPMN.
- 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 CMMN tools.

2.2 Case Modeling Conformance

The implementation claiming conformance to the Case Modeling Conformance SHALL comply with all of the requirements set forth in Sections 5, 6, and 8; and it should be conformant with the Visual Notation Conformance in Section 2.2. A tool claiming Modeling Conformance MUST fully support the underlying metamodel in section 5, and MUST fully support the visual notation in section 6. Conformant implementations MUST fully support and interpret the exchange format specified in Section 7.

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

2.3 BPMN Compatibility Conformance

The implementation claiming conformance to the BPMN Compatibility Conformance SHALL comply with all of the optional BPMN compatibility requirements set forth in Sections 6.7.2.1 and 6.7.3.1, and should be conformant with the Visual Notation Conformance in Section 2.2. The optional BPMN compatibility requirements set forth in Sections 6.7.2.1 and 6.7.3.1, are considered required to claim conformance to the BPMN Compatibility Conformance. A BPMN Compatibility Conformance implementation is NOT REQUIRED to be conformant to the Case Modeling Conformance or to the CMMN Complete Conformance.

This compliance point is intended to be used by tools supporting both BPMN and CMMN.

2.4 CMMN Complete Conformance

The implementation claiming conformance to the CMMN Complete Conformance SHALL comply with all of the requirements set forth in Sections 5, 6, 7 and 8; and it should be conformant with the Visual Notation Conformance in Section 2.2. A tool claiming CMMN Complete Conformance MUST fully support and interpret the underlying metamodel in section 5. Conformant implementations MUST fully support the visual notation in section 6. Conformant implementations MUST fully support and interpret the execution semantics and life-cycle specified in Section 7, and it MUST fully support and interpret the exchange formats in section 8.

This compliance point is intended to be uses by tools supporting CMMN modeling and execution.

3 References

3.1 Normative

RFC-2119

- Key words for use in RFCs to Indicate Requirement Levels, S. Bradner, IETF RFC 2119, March 1997 http://www.ietf.org/rfc/rfc2119.txt

3.2 Non-Normative

Aalst, W.M.P. van der, Weske, M.: *Case Handling: a new paradigm for business process support*. Data & Knowledge Engineering. 53(2). 129-162, 2005

Business Process Model and Notation (BPMN) Version 2.0, OMG, January 2011, http://www.omg.org/spec/BPMN/2.0/PDF/

Davenport, Th. H. and Nohria, N., *Case Management and the Integration of Labor*, Sloan Management Review, 1994.

Davenport, Th. H, *Thinking for a Living: How to Get Better Performance and Results from Knowledge Workers*, HarvardBusinessSchool Press, 2005.

Hull, R., Damaggio, E., Fournier, F., Gupta, M., Heath III, F.T., Hobson, S., Linehan, M., Maradugu, S., Nigam, A., Sukaviriya, P., and Vaculin, R., *Introducing the Guard-Stage-Milestone Approach for Specifying Business Entity Lifecycles*. Proceedings of the 7th International conference on Web Services and Formal Methods (WS-FM 2010). Bravetti, M., and Bultan, T. (eds.). Springer-Verlag, Berling, Heidelberg, 1-24. 2010.

Hull, R. et. al., *Business artifacts with guard-stage-milestone lifecycles: Managing artifact interactions with conditions and events*. Proceedings of the 5th ACM Intl. Conf. on Distributed Event-based Systems (DEBS), pages 51–62, New York, NY, USA, 2011.

Man, H. de, *Case Management: A Review of Modeling Approaches*, BPTrends, January 2009. [http://www.bptrends.com/publicationfiles/01-09-ART-%20Case%20Management-1-DeMan.%20doc--final.pdf]

4 Additional Information

4.1 Background

This specification defines a common meta-model and notation for modeling and graphically expressing a `Case`, as well as an interchange format for exchanging `Case` models among different tools. The specification is intended to capture the common elements that `Case` management products use, while also taking into account

current research contributions on Case management. It is to Case management products what the OMG Business Process Model and Notation (BPMN) specification is to business process management products.

BPMN has been adopted as a business process modeling standard. It addresses capabilities incorporated in a number of other business process modeling languages, where processes are described as the predefined sequences of activities with decisions (gateways) to direct the sequence along alternative paths or for iterations. These models are effective for predefined, fully specified, repeatable business processes.

For some time, there has been discussion of the need to model activities that are not so predefined and repeatable, but instead depend on evolving circumstances and ad hoc decisions by knowledge workers regarding a particular situation, a *case* (see Davenport 1994 and 2005; and Van der Aalst 2005). Applications of Case management include licensing and permitting in government, application and claim processing in insurance, patient care and medical diagnosis in healthcare, mortgage processing in banking, problem resolution in call centers, sales and operations planning, invoice discrepancy handling, maintenance and repair of machines and equipment, and engineering of made-to-order products.

4.2 General concept

A Case is a proceeding that involves actions taken regarding a subject in a particular situation to achieve a desired outcome. Traditional examples come from the legal and medical worlds, where a legal Case involves the application of the law to a subject in a certain fact situation, and a medical Case involves the care of a patient in the context of a medical history and current medical problems. The subject of a Case may be a person, a legal action, a business transaction, or some other focal point around which actions are taken to achieve an objective. The situation commonly includes data that inform and drive the actions taken in a Case.

Any individual Case may be resolved in a completely ad-hoc manner, but as experience grows in resolving similar Cases over time, a set of common practices and responses can be defined for managing Cases in a more rigorous and repeatable manner. This becomes the practice of Case management, around which software products have emerged to assist Case Workers whose job is to process and resolve Cases.

Case management is often directed by a human—a Case manager or a team of Case workers—with minimal predefined encoding of the work to be performed. A Case may not have a single, designated Case manager, but may collaboratively engage different participants as required to make decisions or perform certain Tasks.

Planning at run-time is a fundamental characteristic of Case management. Case management requires modeling and notation which can express the essential flexibility that human Case workers, especially knowledge workers, require for run-time planning for the selection of Tasks for a Case, run-time ordering of the sequence in which the Tasks are executed, and ad-hoc collaboration with other knowledge workers on the Tasks (see De Man, January 2009).

Case management planning is typically concerned with determination of which Tasks are applicable, or which follow-up Tasks are required, given the state of the Case. Decisions may be triggered by events or new facts that continuously emerge during the course of the Case, such as the receipt of new documents, completion of certain Tasks, or achieving certain Milestones. Individual Tasks that are planned and executed in the context of the Case might be predefined procedural Processes in themselves, but the overall Case cannot be orchestrated by a predefined sequence of Tasks.

Representation of the circumstances and the decision factors in a Case model requires references to data about the subject of the Case. The collection of data about the Case is often described as a CaseFile. Documents and other unstructured or structured data about a Case are captured and referenced in the CaseFile for decision-making by Case workers.

Modeling of constraints and guidance on the actions to be taken in a Case requires the specification of rules that reference the data in the CaseFile. A Case model may specify constraints on run-time state transitions as

well as constraints on actions, and recommendations for actions, that are dependent on the run-time state of the Case. Even though this specification is focused on modeling and notation, not run-time Case management per se, execution semantics is important for modeling of constraints and rules that depend on run-time state. To that end, execution semantics defined in this specification -- describing how EventListeners, Stages, Tasks, and Milestones affect each other and the state of the Case during the run-time management of a Case -- have been influenced by recent research into business artifacts and the guard-stage-milestone formalism (see Hull 2010).

Cases are directed not just by explicit knowledge about the particular Case and its context represented in the CaseFile, but also by explicit knowledge encoded as rules by business analysts, the tacit knowledge of human participants, and tacit knowledge from the organization or community in which participants are members.

A Case has two distinct phases, the design-time phase and the run-time phase. During the design-time phase, business analysts engage in modeling, which includes defining Tasks that are always part of pre-defined segments in the Case model, and "discretionary" Tasks that are available to the Case worker, to be applied in addition, to his/her discretion. In the run-time phase, Case workers execute the plan, particularly by performing Tasks as planned, while the plan may continuously evolve, due to the same or other Case workers being engaged in planning, i.e. adding discretionary Tasks to the plan of the Case instance in run-time. The following figure describes these concepts.

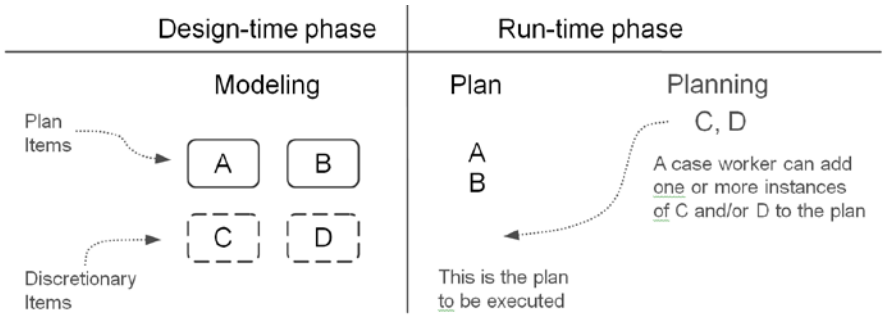


Figure 1: Design-time phase modeling and run-time phase planning

4.3 Target users

Business analysts are the anticipated users of Case management tools for capturing and formalizing repeatable patterns of common Tasks, EventListeners, and Milestones into a Case model. A new Case model may be defined as entirely at the discretion of human participants initially, but it should be expected to evolve as repeatable patterns and best practices emerge. Patterns and outcomes from execution of the Case model can be incorporated iteratively by business analysts into the Case model, in the form of improved rules and more predictable patterns of Tasks, in order to make Case management more repeatable and improve outcomes over time.

4.4 Interoperability

In the context of Case management, this specification defines a meta-model (that is, a model for defining models), a notation for expressing Case models, and an XML Model for Interchange (XMI) and XML-Schema for exchanging Case models among different Case management vendors' environments and tools. The meta-model can be used by Case management definition tools to define functions and features that a business analyst could use to define a Case model for a particular type of Case, such as invoice discrepancy handling. The notation is intended for use by those tools to express the model graphically.

This specification enables portability of Case models, so that users can take a model defined in one vendor's environment and use it in another vendor's environment. The CMMN XMI and/or XML-Schema are intended for importing and exporting Case models among different Case management vendors' environments and tools.

A Case model is intended to be used by a run-time Case management product to guide and assist a knowledge worker in the handling of a particular instance of a Case, for example a particular invoice discrepancy. The meta-model and notation are used to express a case model in a common notation for a particular type of Case, and the resulting model can subsequently be instantiated for the handling of a particular instance of a Case.

4.5 Submitting and Supporting Organizations

The following companies are formal submitting members of OMG:

- BizAgi Limited
- Cordys Nederland BV
- International Business Machines Corporation
- Oracle Incorporated
- SAP AG
- Kofax plc

The following organizations have contributed to the development of this specification but are not formal submitters:

- Agile Enterprise Design, LLC
- Stiftelsen SINTEF
- TIBCO Software
- Trisotech

The following persons were members of the core teams that contributed to the content specification: Alan Babich, Henk de Man, Heidi Buelow, Bill Carpenter, Martin Chapman, Fred Cummins, Brian Elvesæter, Denis Gagne, Rick Hull, Dave Ings, Oliver Kieselbach, Matthias Kloppmann, Mike Marin, Greg Melahn, Paul O'Neill, Ralf Mueller, Ravi Rangaswamy, Jesus Sanchez, Arvind Srinivasan, Allen Takatsuka, Ivana Trickovic, Ganesh Vaideeswaran, Paul Vincent.

In addition, the following persons contributed valuable ideas and feedback that improved the content and the quality of this specification: Thomas Hildebrandt, Knut Hinkelmann, Jana Koehler, Matthias Kurz, Robert Lario, Paul Winsberg

4.6 IPR and Patents

The authors intend to contribute this work to OMG on a RF on RAND basis.

4.7 Guide to the Specification

This specification is organized into sections. Those sections that are normative are indicated as such.

5 Case Management Elements

5.1 Core Infrastructure

5.1.1 CMMNElement

`CMMNElement` is the abstract base class for all other classes in the `Case` metamodel.

Attribute	Description
id : String	The ID of a `Case` metamodel object.
description : String	The description of a `Case` metamodel object

Table 2: CMMNElement attributes

All reference associations between `CMMNElements` that are directly or indirectly contained in a `Case` MUST be resolvable within that `Case`, unless stated differently in the remainder of this specification.

5.1.2 Definitions

The `Definitions` class is the outermost containing object for all `CMMNElements`. It defines the scope of visibility and the namespace for all contained elements. The interchange of CMMN files will always be through one or more `Definitions`.

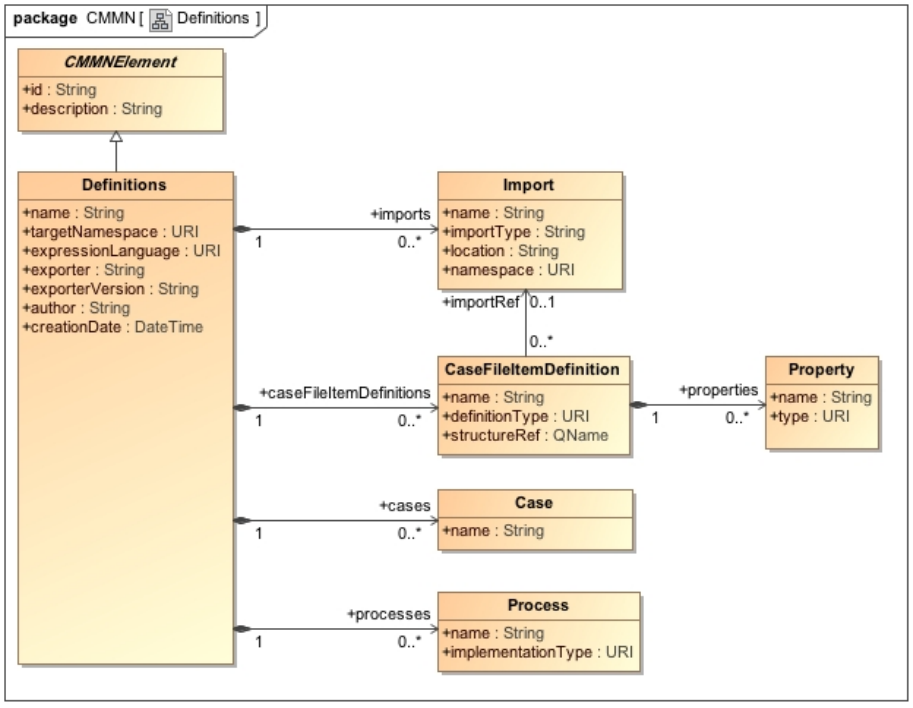


Figure 2: Definitions class diagram

Table 3 defines the attributes of `Definitions`. It refers to concepts that are specified later on in the document, such as `Case` (5.2), `CaseFile` (5.3.1), `CaseFileItem` (5.3.2) and `Process` (5.4.8).

Attribute	Description

name : String	The name of the `Definitions` object.
targetNamespace : URI	This attribute identifies the namespace associated with the `Definitions` objects and follows the convention established by XML Schema.
expressionLanguage : URI	The expression language used for this `Definitions` object. The default is "http://www.w3.org/1999/XPath". This value MAY be overridden on each individual `Expression`. The language MUST be specified in a URI format
exporter : String	This attribute identifies the tool that is exporting the CMMN model file.
exporterVersion : String	This attribute identifies the version of the tool that is exporting the CMMN model file
author : String	This attribute identifies the author of the CMMN model file
creationDate : DateTime	This attribute identifies the creation date of the CMMN model file
imports : Import[0..*]	This attribute is used to import externally defined elements and make them available for use by elements within this `Definitions.` A `Definitions` object that contains a `Case` MUST contain the `Imports` that are referenced by the `CaseFileItemDefinitions` of the `CaseFileItems` in the `CaseFile` of that `Case`.
caseFileItemDefinitions : CaseFileItemDefinition[0..*]	This attribute is used for the definition of `CaseFileItem` elements and makes those definitions available to use by elements within this `Definitions`. A `Definitions` object that contains a `Case` MUST contain the `CaseFileItemDefinitions` of the `CaseFileItems` in the `CaseFile` of that `Case`.
cases : Case[0..*]	This attribute is used to define `Cases` and make them available for use by elements within this `Definitions`.
processes: Process[0..*]	This attribute is used to define `Processes` and makes them available to use by elements within this `Definitions`. `ProcessTasks` of a `Case` MUST refer to `Processes` that are contained by the `Definitions` object that also contains the `Case`. `ProcessTask` and integration with

	`Process` is specified in 5.4.10.5.1.

Table 3: Definitions attributes

5.1.3 Import

Type definitions that are externally defined can be imported into the `CaseFile`. This enables `CaseFileItemDefinitions` to refer to those externally defined types. The `Import` class has the following attributes:

Attribute	Description
importType : String	The type of the import. For example, for XML-Schema, the import type is XSD.
location : String	The location URL of the import
namespace : URI	The namespace of the imported elements

Table 4: Import attributes

For `CaseFileItemDefinitions` of definition type XSDElement, XSDComplexType, XSDSimpleType and XSDElement, the `Import` class SHOULD be used to import an XML Schema definition into the `Case` model. For other definition types, the use of `Import` is not further specified.

5.1.4 CaseFileItemDefinition

`CaseFileItemDefinition` elements specify the structure of a `CaseFileItem`. `CaseFileItem` is specified in 5.3.2.

Attribute	Description
definitionType : URI	The URI specifying the definition type of the `CaseFileItem`. Table 6 specifies definition types.
structureRef : QName	A qualified name referring to the concrete structure of the definition entity. For XML-Schema typed case file definition elements, the `structureRef` refers to a XML complex type, element or simple type in a XML-Schema.
importRef : Import[0..1]	A (optional) reference to an `Import`. External structure definitions such as XML-Schema might be imported into the `CaseFile` and then referred from `CaseFileItemDefinition`
properties : Property[0..*]	Zero or more `Property` objects

Table 5: CaseFileItemDefinition attributes

The following definition types are specified for the `CaseFileItemDefinition:`

Definition Type	URI
Folder in CMIS	http://www.omg.org/spec/CMMN/DefinitionType/CMISFolder
Document in CMIS	http://www.omg.org/spec/CMMN/DefinitionType/CMISDocument

Relationship in CMIS	http://www.omg.org/spec/CMMN/DefinitionType/CMISRelationship
XML-Schema Element	http://www.omg.org/spec/CMMN/DefinitionType/XSDElement
XML Schema Complex Type	http://www.omg.org/spec/CMMN/DefinitionType/XSDComplexType
XML Schema Simple Type	http://www.omg.org/spec/CMMN/DefinitionType/XSDSimpleType
Unknown	http://www.omg.org/spec/CMMN/DefinitionType/Unknown
Unspecified	http://www.omg.org/spec/CMMN/DefinitionType/Unspecified

Table 6: DefinitionTypes and their URIs

5.1.4.1 Property

`Property` MAY complement `CaseFileItemDefinitions`. The following table gives an overview of the `Property` attributes:

Attribute	Description
name : String	The name of the attribute
type : URI	The type of the attribute. The type MUST be a URI. Table 8 specifies these types.

Table 7: Property attributes

`Property types` are derived from the top-level built-in primitive types of XML Schema and include the following, see the description of the individual types in the XML Schema specification for an exact definition of the value space.

Type	URI
string	http://www.omg.org/spec/CMMN/PropertyType/string
boolean	http://www.omg.org/spec/CMMN/PropertyType/boolean
integer	http://www.omg.org/spec/CMMN/PropertyType/integer
float	http://www.omg.org/spec/CMMN/PropertyType/float
double	http://www.omg.org/spec/CMMN/PropertyType/double
duration	http://www.omg.org/spec/CMMN/PropertyType/duration
dateTime	http://www.omg.org/spec/CMMN/PropertyType/dateTime
time	http://www.omg.org/spec/CMMN/PropertyType/time
date	http://www.omg.org/spec/CMMN/PropertyType/date
gYearMonth	http://www.omg.org/spec/CMMN/PropertyType/gYearMonth

gYear	http://www.omg.org/spec/CMMN/PropertyType/gYear
gMonthDay	http://www.omg.org/spec/CMMN/PropertyType/gMonthDay
gDay	http://www.omg.org/spec/CMMN/PropertyType/gDay
gMonth	http://www.omg.org/spec/CMMN/PropertyType/gMonth
hexBinary	http://www.omg.org/spec/CMMN/PropertyType/hexBinary
base64Binary	http://www.omg.org/spec/CMMN/PropertyType/base64Binary
anyURI	http://www.omg.org/spec/CMMN/PropertyType/anyURI
QName	http://www.omg.org/spec/CMMN/PropertyType/QName

Table 8: Property Types and their URIs

5.2 Case Model Elements

`Case` is a top-level concept that combines all elements that constitute a `Case` model. The following diagram illustrates the metamodel of the `Case` and its associated classes.

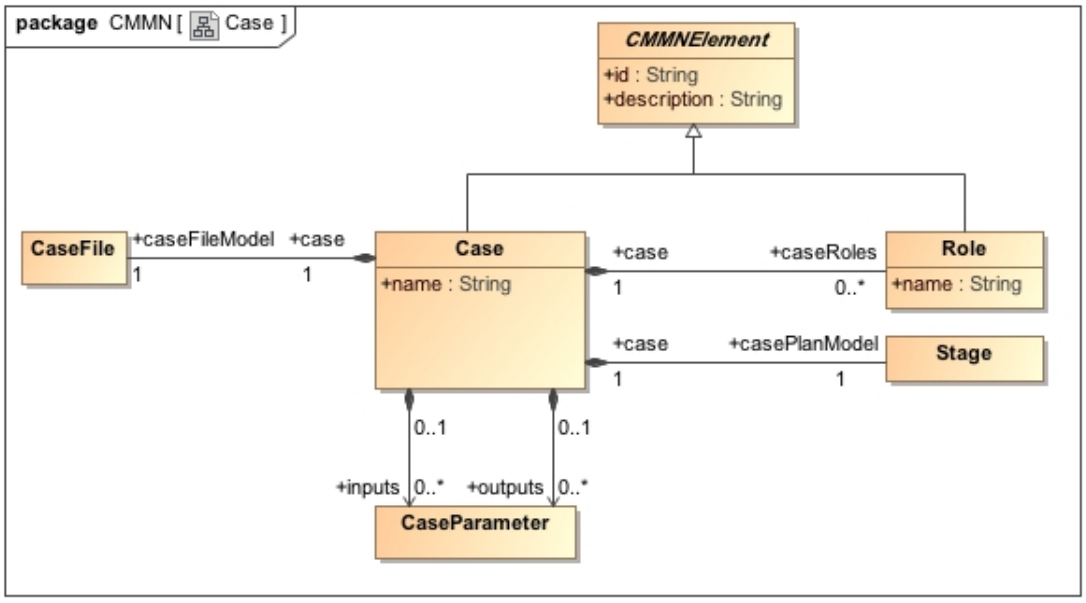


Figure 3: Case class diagram

A `Case` consists of a `caseFileModel`, a `casePlanModel` and a set of `caseRoles`. It also contains `inputs` and `outputs`, to enable interaction of the `Case` with its environment.

In this section we will regularly refer to aspects of CMMN execution semantics, in particular to elements of CMMN-defined lifecycles. Chapter 7 provides a complete specification of CMMN execution semantics and related lifecycles.

5.2.1 Case

The `Case` class inherits from the `CMMNElement` class and comprises of the following additional attributes:

Attribute	Description
name : String	The name of the Case
caseRoles : Role[0..*]	This attribute lists the Role objects associated with the Case. These Roles are specific to the Case, and are not known outside the context of the Case.
caseFileModel : CaseFile[1]	One CaseFile object. Every Case MUST be associated with exactly one CaseFile. CaseFile is specified in 5.3.1.
casePlanModel : Stage[1]	The plan model of the Case. Every Case MUST be associated with exactly one plan model. It is defined by association to Stage. Stage is specified in 5.4.8. As it will appear in that section, Stage represents a recursive concept (Stages can be nested within other Stages), used as container of elements from which the plan of the case is constructed and can further evolve, and having a lifecycle that can be tracked in run-time. The "most outer" Stage is associated to the Case as its casePlanModel.
inputs : CaseParameter[0..*]	Input Parameters of the Case. A Case might have input Parameters so that it can be called from outside, e.g. by other Cases.CaseParameters are specified in 5.4.10.3.
outputs : CaseParameter[0..*]	Output Parameters of the Case. A Case might have output parameters so that it can return a result to e.g. a calling Case.

Table 9: Case attributes

5.2.2 Role

CaseRoles authorize case workers or teams of case workers to perform HumanTasks (specified in 5.4.10.4), plan based on DiscretionaryItems (specified in 5.4.9.2), and raise user events (by triggering UserEventListeners, as specified in 5.4.2.2).

Example Roles of a case might be:

- Doctor. A doctor Role may contain one or more participants that are allowed to perform HumanTasks, trigger UserEventListeners, or do planning that requires doctor skills.
- Patient. A Case may provide an interface for patients to do planning that may correspond to scheduling appointments, complete HumanTasks that may correspond to providing information about their health, etc. In a typical application, a Case may limit the patient Role to contain a single participant.
- Nurse. A nurse Role may represent one or more participants with the skills of a nurse care provider

Assignment of Roles to participants, such as to individuals or teams, is not included in the scope of CMMN.

The Role class inherits from the CMMNElement class and comprises of the following additional attributes:

Attribute	Description
name : String	The name of the Role
case : Case[1]	The Case that contains the caseRoles.

Table 10: Role attributes and model associations

5.3 Information Model Elements

The information model of a Case comprises of classes for the management of the information (data) aspects of a Case. All information, or references to information, that is required as context for managing a Case, is defined by a CaseFile. The metamodel of CaseFile is represented in Figure 4.

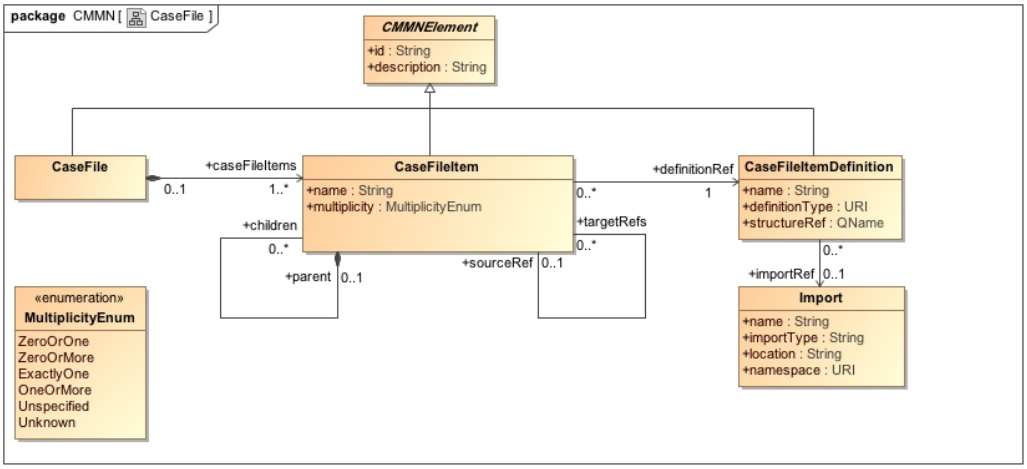


Figure 4: CaseFile class diagram

This model supports, amongst others, the information structure of the CMIS standard for content management systems, standards known from Service Oriented Architectures (SOA) like XML Schema and Object Oriented models based on UML.

5.3.1 CaseFile

Information in the `CaseFile` serves as context for raising events and evaluating `Expressions` as well as point of reference for `CaseParameters`, such as `inputs` and `outputs` of `Tasks`. `CaseFile` also serves as container for data that is accessible by other systems and people outside of the `Case`, through `CaseParameters`. `CaseFile` is meant as logical model. It does not imply any assumptions about physical storage of information.

Every `Case` is associated with exactly one `CaseFile`. The `Case` information is represented by the `CaseFile`. It contains `CaseFileItems` that can be any type of data structure. In particular containment hierarchies and other content objects can be represented. The `Case File` is represented in the metamodel by the class `CaseFile`, which has the following attributes:

Attribute	Description
caseFileItems : CaseFileItem[1..*]	This attribute lists the `CaseFileItems` of a `CaseFile`. A `CaseFile` MUST contain at least one `CaseFileItem`

Table 11: CaseFile attributes and model associations

5.3.2 CaseFileItem

A `CaseFile` consists of `CaseFileItems`. A `CaseFileItem` may represent a piece of information of any nature, ranging from unstructured to structured, and from simple to complex, which information can be defined based on any information modeling "language". A `CaseFileItem` can be anything from a folder or document stored in CMIS, an entire folder hierarchy referring or containing other `CaseFileItems` or simply an XML document with a given structure. The structure, as well as the "language" (or format) to define the structure, is defined by the associated `CaseFileItemDefinition` (see 5.1.4). This may include the definition of properties ("metadata") of a `CaseFileItem`. If the internal content of the `CaseFileItem` is known, an XML Schema, describing the `CaseFileItem`, may be imported.

`CaseFileItems` can be used to represent containment structures organized into arbitrary hierarchies by using the parent/children containment association. For example, a folder hierarchy can be implemented by using a

`CaseFileItemDefinition.definitionType` of CMISFolder, and using children and parent `CaseFileItems` as the folder structure. The resulting hierarchy can include metadata for each folder represented by the properties as defined by the associated `CaseFileItemDefinition`.

Case file items can be used to represent arbitrary content. For example, documents can be implemented by using `CaseFileItemDefinition.definitionType` of CMISDocument. There is no need to know the internals of those content objects, but if the internals of the object are known, the XML Schema can be defined by the `Import` class (see 5.1.3) of the `CaseFileItemDefinition`. The document or content object can include metadata as well, as represented by the properties as defined by the associated `CaseFileItemDefinition`.

The following attributes are defined for `CaseFileItem`:

Attribute	**Description**
name : String	The name of the `CaseFileItem`
multiplicity : MultiplicityEnum	The multiplicity of the `CaseFileItem`. The multiplicity specifies the number of potential instances of this `CaseFileItem` in the context of a particular `Case` instance. For example: An auto-damage claim might require “4” photographs of tire profiles. An antecedent investigation might involve “zero or more” police reports.
definitionRef : CaseFileItemDefinition[1]	A reference to the `CaseFileItemDefinition`. Every `CaseFileItem` MUST be associated to exactly one `CaseFileItemDefinition`.
children : CaseFileItem[0..*]	Zero or more children of the `CaseFileItem`. The children objects are contained by the `CaseFileItem`. A `CaseFileItem` is said to be “nested” in another `CaseFileItem`, when the `CaseFileItem` is a one the `children` of another `CaseFileItem`, either directly, or recursively through even other `CaseFileItems`. The set of `children` of a `CaseFileItem` MUST NOT include that `CaseFileItem` or any `CaseFileItem` in which that `CaseFileItem` is nested.
parent : CaseFileItem[0..1]	Zero or one parent of the `CaseFileItem`.
targetRefs : CaseFileItem[0..*]	Zero or more references to target `CaseFileItems`.
sourceRef : CaseFileItem[0..1]	Zero or one source `CaseFileItem`.

Table 12: CaseFileItem attributes

5.3.2.1 Versioning

This specification does not define versioning of `CaseFileItem` instances. It is recognized that any information element may have various versions, but a version control mechanism is outside the scope of this

specification. It is also recognized that vendors may use version control mechanisms in their products, and such extensions may not be interchangeable. However, to guarantee basic interchangeability, when no extensions are used, it is assumed that whenever a case model, or expression, references an information element, that reference MUST refer to the latest, most current, version of that information element.

5.4 Plan Model Elements

This section specifies `casePlanModel` (see Figure 3). For a particular `Case` model, `casePlanModel` comprises both all elements that represent the initial plan of the case, and all elements that support the further evolution of the plan through run-time planning by case workers. As Figure 3 indicates, `casePlanModel` is defined by association to `Stage`. As it will appear in this section, `Stage` represents a recursive concept - `Stages` can be nested within other `Stages` - that serves as container of any element required to construct and further evolve `Case` plans. The “most outer” `Stage` is associated to the `Case` as its `casePlanModel`.

5.4.1 PlanItemDefinition

`PlanItemDefinition` elements define the building blocks from which `Case` (instance) plans are constructed. `PlanItemDefinition` is an abstract class that inherits from `CMMNElement`.

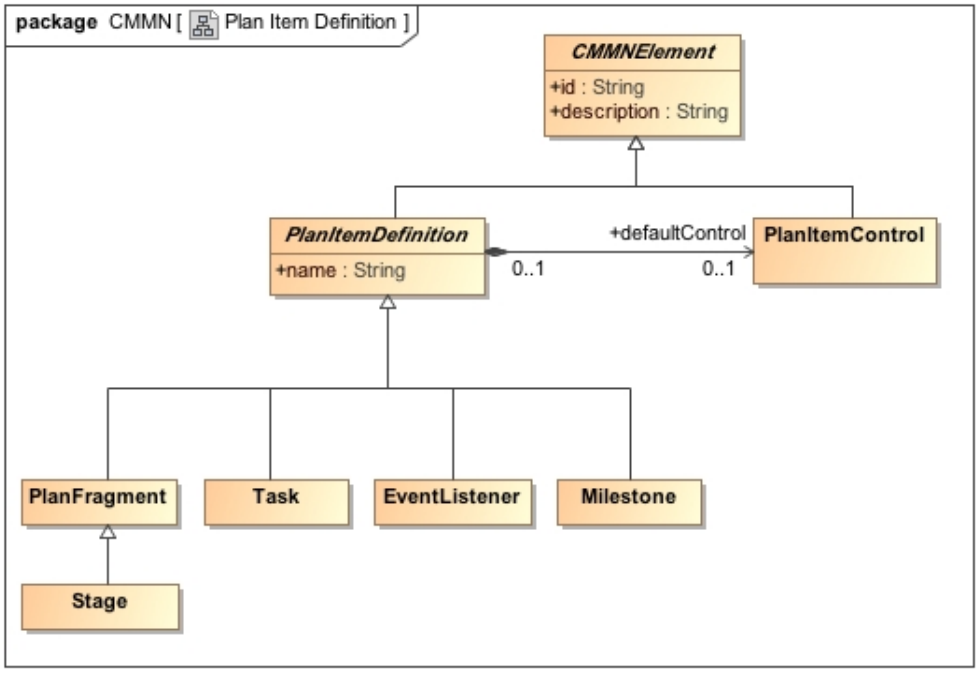


Figure 5: PlanItemDefinition class diagram

`PlanItemDefinition` is specialized into several concepts that are specified subsequent sections in this document: `EventListener`, `Milestone`, `PlanFragment` (and `Stage`) and `Task`.

The class `PlanItemControl` specifies defaults for aspects of control of `PlanItemDefinitions`, such as whether these instances have to be completed before the `Case` or a `Stage` of the `Case`, that contains the instances, can complete. `PlanItemControl` and these aspects will be specified in 5.4.11. As it will appear later, unlike `Stages` and the other sub-types of `PlanItemDefinition`, `PlanFragments` (that are not `Stages`) will not be instantiated in run-time.

`PlanItemDefinition` has the following attributes:

Attribute	Description
name : String	The name of the `PlanItemDefinition`
defaultControl : PlanItemControl[0..1]	Element that specifies the default for aspects of control of `PlanItemDefinitions`. `DefaultControl` MUST NOT be specified for the `Stage` that is referenced by the `Case` as its `casePlanModel`.

Table 13: PlanItemDefinition attributes

5.4.2 EventListener

In CMMN an event is something that "happens" during the course of a `Case`. Events may trigger, for example, the enabling, activation and termination of `Stages` and `Tasks`, or the achievement of `Milestones`. Any event has a cause. CMMN predefines many events, and their causes, such as:

- Anything that can happen to information in the `CaseFile`. This is defined by "standard events" that denote transitions in the CMMN-defined lifecycle of `CaseFileItems`.
- Anything that can happen to `Stages`, `Tasks` and `Milestones`. This is defined by "standard events" that denote transitions in the CMMN-defined lifecycle of these.

However, elapse of time cannot be captured via these "standard events". Also it will often lead to very indirect modeling, when any user event, such as the approval or rejection of something, has to be captured through impact on data in the `CaseFile` or through transitions in lifecyles of e.g. `Tasks` or `Milestones`.

For this reason, additional class is introduced, called `EventListener`, which is specialized into `TimerEventListener` and `UserEventListener`. `EventListener` has its own CMMN-predefined lifecycle, so that also any elapse of time as well as any user event, can still be captured as "standard events", denoting transitions in the CMMN-defined lifecycle of `EventListener`.

EventListener inherits from `PlanItemDefinition`, so that instances of `EventListeners` can be elements of `Case` plans as well.

This will enable CMMN, to handle any event in a uniform way, namely as "standard events" that denote transitions in CMMN-defined lifecycles. These standard events are handled via `Sentries`. `Sentries` and these "standard events" are specified in section 5.4.6.

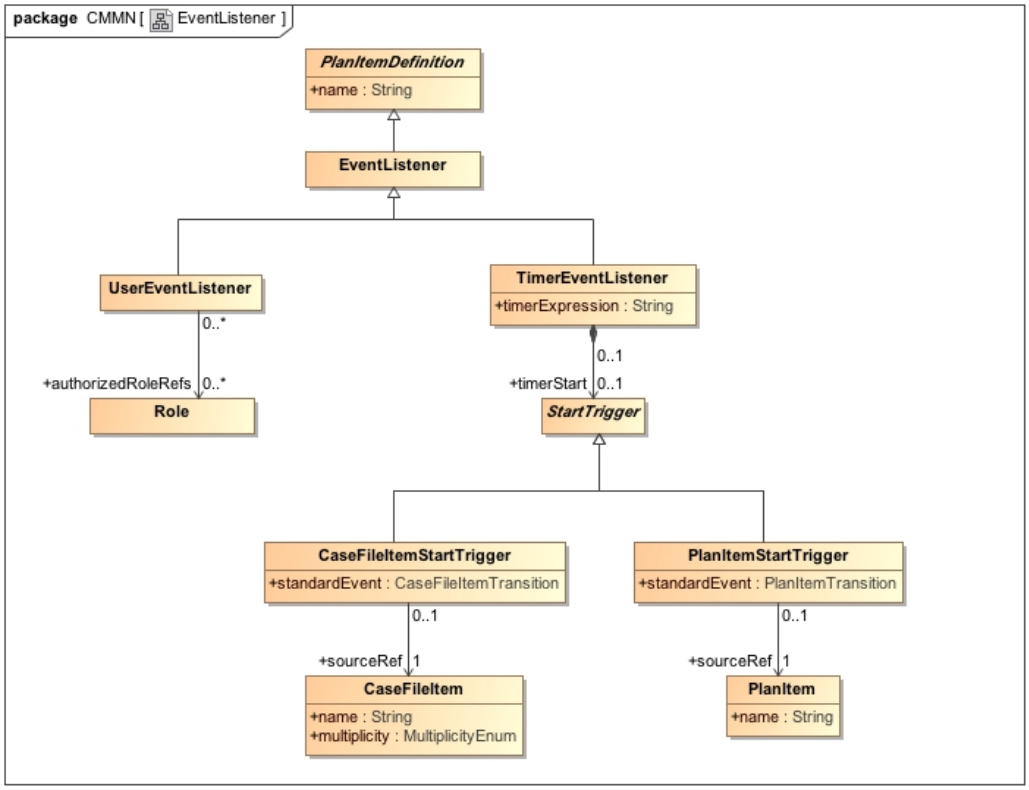


Figure 6: EventListener class diagram

5.4.2.1 TimerEventListener

A `TimerEventListener` is a `PlanItemDefinition`, which instances are used to catch predefined elapses of time. It inherits from `EventListener`. The following table lists the attributes of class `TimerEventListener`:

Attribute	Description
timerExpression : String	An expression string that is conforming to the ISO-8601 format for date and time, duration or interval representations.
timerStart : StartTrigger[0..1]	The starting trigger of the `TimerEventListener`. This attribute is optional. If `timerStart` is specified, then at runtime, if the trigger occurs the time of occurrence of the trigger is captured and the `timerExpression` SHOULD be relative to the timestamp captured when the `timerStart` trigger occurs.

Table 14: TimerEventListener attributes

5.4.2.1.1 StartTrigger

The `TimerEventListener` `StartTrigger` addresses the event of a lifecycle state change that triggers the starting point of `TimerEventListener`. `StartTrigger` is an abstract class that inherits from `CMMNElement` and has two sub-classes, `CaseFileItemStartTrigger` and `PlanItemStartTrigger`.

5.4.2.1.2 CaseFileItemStartTrigger

The class `CaseFileItemStartTrigger` inherits from `StartTrigger` and has the following attributes

Attribute	Description
standardEvent : CaseFileItemTransition	Reference to a state transition in the `CaseFileItem` lifecyle (see 7.2). The enumeration `CaseFileItemTransition` is specified in 5.4.6.2.1.
sourceRef : CaseFileItem[1]	Reference to a `CaseFileItem`. If the associated `CaseFileItem` is undergoing the state transition as specified by attribute `standardEvent`, the `StartTrigger` MUST occur (in run-time).

Table 15: CaseFileItemStartTrigger attributes

5.4.2.1.3 PlanItemStartTrigger

The class `PlanItemStartTrigger` inherits from `StartTrigger` and has the following attributes

Attribute	Description
standardEvent : PlanItemTransition	Reference to a state transition in the lifecycle of a `Stage`, `Task`, `EventListener` or `Milestone` (see 7.3). The enumeration `PlanItemTransition` is specified in 5.4.6.3.1. If `definitionRef` of the `PlanItem`, that is referenced by the `StartTrigger` as `sourceRef`, represents a `Stage` or `Task`, the value of `standardEvent` of the `StartTrigger` MUST denote a transition of the CMMN-defined lifecycle of `Stage` / `Task` (see 7.3.2). If `definitionRef` of the `PlanItem`, that is referenced by the `StartTrigger` as `sourceRef`, represents an `EventListener` or `Milestone`, the value of `standardEvent` of the `StartTrigger` MUST denote a transition of the CMMN-defined lifecycle of `EventListener` / `Milestone` (see 7.3.3).
sourceRef : PlanItem[0..1]	Reference to a `PlanItem`. If the associated `PlanItem` is undergoing a state transition as specified by attribute `standardEvent` the `StartTrigger` MUST occur (in run-time).

Table 16: PlanItemStartTrigger attributes

5.4.2.2 UserEventListener

A `UserEventListener` is a `PlanItemDefinition`, which instances are used to catch events that are raised by a user, which events are used to influence the proceeding of the `Case` directly, instead of indirectly via impacting information in the `CaseFile`. A `UserEventListener` enables direct interaction of a user with the `Case`. It inherits from `EventListener`. The following table lists the attributes of class `UserEventListener`:

Attribute	Description

authorizedRoleRefs : Role[0..*]	The `Roles` that are authorized to raise the user event

Table 17: UserEventListener attributes

5.4.3 Milestone

A `Milestone` is a `PlanItemDefinition` that represents an achievable target, defined to enable evaluation of progress of the `Case`. No work is directly associated with a `Milestone`, but completion of set of `tasks` or the availability of key deliverables (information in the `CaseFile`) typically leads to achieving a `Milestone`.

5.4.4 PlanFragment

A `PlanFragment` is a set of `PlanItems` (see 5.4.5), possibly dependent on each other, and that often occur in `Case` plans in combination, representing a pattern.

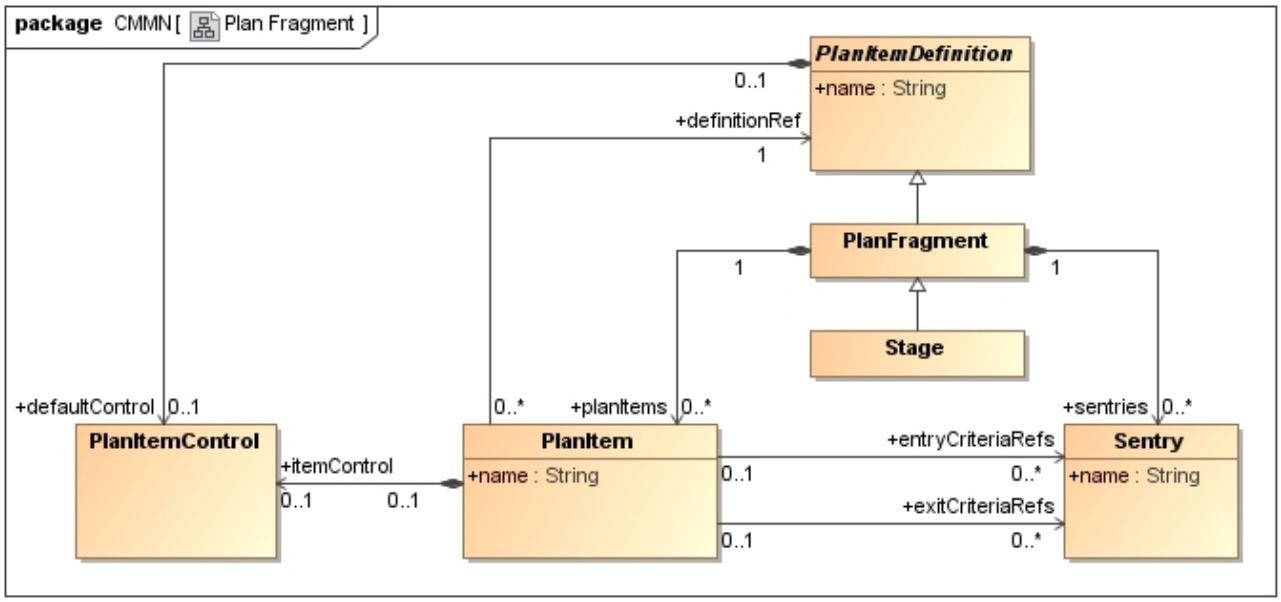


Figure 7: PlanFragment class diagram

Dependencies between `PlanItems`, in `PlanFragments`, are defined as `Sentries` (see 5.4.6). A `PlanFragment` is a container of `PlanItems` and the `Sentries` that define the criteria according to which the `PlanItems` are enabled (or entered) and terminated (or exited).

Simple examples of `PlanFragments` are:

- A combination of two `Tasks`, whereby, the completion of one `Task` satisfies the `Sentry` that enables the start of the other.
- A combination of an `EventListener` and a `Task`, whereby the occurrence of the event satisfies the `Sentry` that enables the start of the `Task`.

`PlanFragments` can represent `PlanItem`-and-`Sentry` patterns of any complexity. Simple `PlanFragments` may not contain `Sentries`. `PlanFragment` inherits from `PlanItemDefinition`, because the combination of `PlanItems` (and `Sentries`) that it contains can be added to the plan of a `Case` (instance) as a unit. Unlike other `PlanItemDefinitions`, a `PlanFragment` (that is not a `Stage`) does not have a representation in run-time, i.e. there is no notion of lifecycle tracking of a `PlanFragment` (not

being a Stage) in the context of a Case instance. Just the PlanItems that are contained in it are instantiated and have their lifecyles that are tracked.

In order to plan a combination of PlanItems that is tracked, in the plan of a Case instance, as combination, a specialization of PlanFragment should be used, called a Stage. Stage is specified in 5.4.8. Stages have lifecycles, PlanFragments (not being Stages) don't.

The class PlanFragment has the following attributes:

Attribute	Description
planItems : PlanItem[0..*]	The PlanItems that are contained by the PlanFragment.
sentries : Sentry[0..*]	The Sentrys contained by the PlanFragment.

Table 18: PlanFragment attributes and model associations

5.4.5 PlanItem

A PlanItem object is a use of a PlanItemDefinition element in a PlanFragment (or Stage).

As soon as experience is gained in applying a Case model, best practices might evolve, e.g. recognizing the usefulness, or even necessity, of applying re-usable combinations of PlanItemDefinitions. The same PlanItemDefinition might be (re-)used multiple times as part of different combinations, i.e. as part of different PlanFragments (or Stages). Hence, a PlanItemDefinition, e.g. a Task or EventListener, is defined once, and can be (re-) used in multiple PlanFragments (and Stages).

This required a separate class, PlanItem, that refers to PlanItemDefinition. Multiple PlanItems might refer to the same PlanItemDefinition. A PlanItemDefinition is (re-)used in multiple PlanFragments (or Stages) when these PlanFragments (or Stages) contain PlanItems that refer to or ("use") that same PlanItemDefinition.

Attribute	Description
name : String	The name of the PlanItem object. This attribute supersedes the attribute of the corresponding PlanItemDefinition element.
itemControl : PlanItemControl[0..1]	The PlanItemControl controls aspects of the behavior of instances of the PlanItem object. If a PlanItemControl object is specified for a PlanItem, then it MUST overwrite the PlanItemControl object of the associated PlanItemDefinition element. Otherwise, the behavior of the PlanItem object is specified by the PlanItemControl object of its associated PlanItemDefinition. PlanItemControl is specified in 5.4.11.
definitionRef : PlanItemDefinition[1]	Reference to the corresponding PlanItemDefinition object. For every PlanItem object, there MUST be exactly one PlanItemDefinition object.

	`DefinitionRef` MUST NOT represent the `Stage` that is the `casePlanModel` of the `Case`. DefinitionRef MUST NOT represent a `PlanFragment` that is not a `Stage`. This implies that a `PlanFragment`, not being a `Stage`, cannot be used as `PlanItem` inside a `PlanFragment` or `Stage`. As `PlanItems` may refer to a `PlanItemDefinition` that is a `Stage`, `Stages` can be nested. A `Stage` is said to be "nested" in another `Stage`, when the `Stage` is the `PlanItemDefinition` of a `PlanItem` that is contained in that other `Stage`, either directly, or recursively through even other `Stages`. `DefinitionRef` of a PlanItem that is contained by a `Stage` MUST NOT be that `Stage` or any `Stage` in which that `Stage` is nested.
entryCriteriaRefs : Sentry[0..*]	Reference to zero or more `Sentries` that represent the `PlanItem`'s entry criteria. `EntryCriteriaRefs` of a `PlanItem` MUST refer to `Sentries` that are contained by the `Stage` or `PlanFragment` that contains that `PlanItem`. A `PlanItem` that is defined by an `EventListener` MUST NOT have `entryCriteriaRefs`.
exitCriteriaRefs : Sentry[0..*]	Reference to zero or more `Sentries` that represent the `PlanItem`'s exit criteria. `ExitCriteriaRefs` of a `PlanItem` MUST refer to `Sentries` that are contained by the `Stage` or `PlanFragment` that contains that `PlanItem`. A `PlanItem` that is defined by an `EventListener` or `Milestone` MUST NOT have `exitCriteriaRefs`. A `PlanItem` that is defined by a `Task` that is non-blocking (`isBlocking` set to "false") MUST NOT have `exitCreteriaRefs` .

Table 19: PlanItem attributes

5.4.6 Sentry

A `Sentry` "watches out" for important situations to occur (or "events"), which influence the further proceedings of a `Case` (and hence their name).

A `Sentry` is a combination of an "event and/or condition". When the event is received, a condition might be applied to evaluate whether the event has effect or not. `Sentries` may take the following form:

1. An event part and a condition part in the form
   on <event> if <condition>
   or

2. An event part in the form
   on <event>
   or
3. Just a condition part in the form
   if <condition>

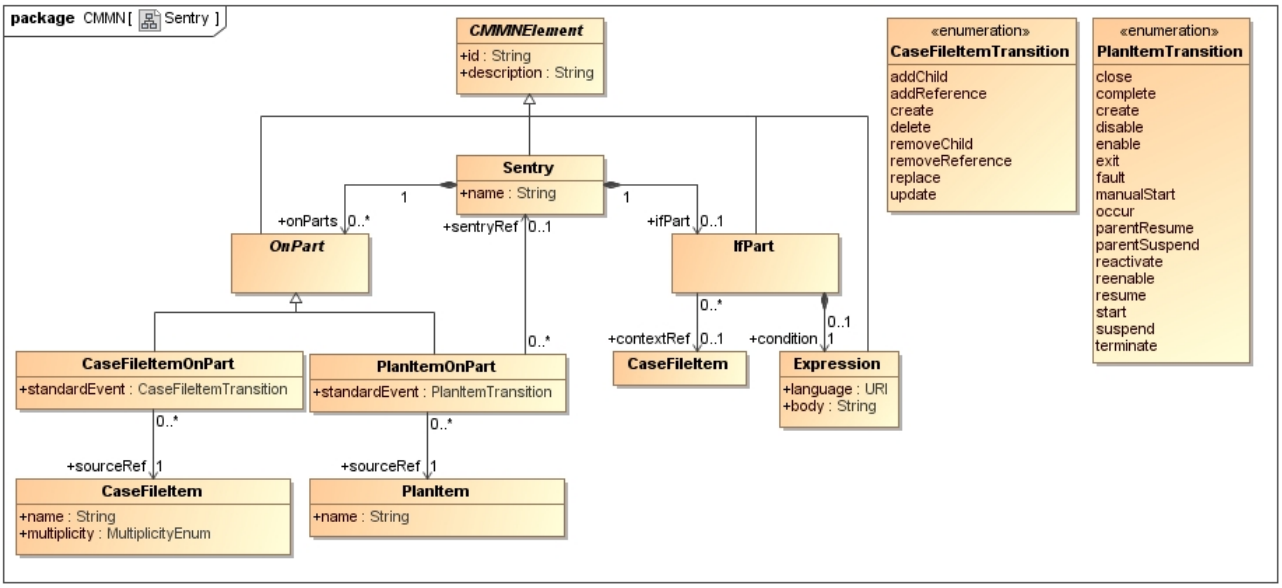


Figure 8: Sentry class diagram

As discussed in section 5.4.2, CMMN defines of a set of "standard events", based on transitions in CMMN-defined lifecycles, that is capable of capturing any event that is relevant in the context of a `Case`. This includes timer events, case information events and user events.

A `Sentry` may consist of two parts:

- Zero or more `OnParts`. An `OnPart` specifies the event that serves as trigger. When the event is catched, the `OnPart` is said to "occur".
- Zero or one `IfPart`. The `IfPart` specifies a condition, as `Expression` that evaluates over the `CaseFile`. If all `OnParts` of a `Sentry` have occurred, and its `IfPart` (if existent) evaluates to "true", the `Sentry` is said to be "satisfied".

A `Sentry` that is satisfied actually triggers the `PlanItem` that refers to it (see Figure 7):

- When the `Sentry` is referenced by one of the `PlanItem`'s `entryCriteriaRefs`, the `PlanItem` (its instance) will transit, based on the entry criteria-related transition in its lifecycle: a `Task` or `Stage` will be enabled, and a `Milestone` will be achieved.
- When the `Sentry` is referenced by one of the `PlanItem`'s `exitCriteriaRefs`, the `PlanItem` will transit, based on the exit criteria-related transition in its lifecycle: a `Task` or `Stage` will be terminated (exited).

Chapter 7 will analyze the relationship between `Sentries` and lifecycles in detail.

`Sentry` inherits from `CMMNElement` and has the following attributes:

Attribute	Description

name : String	The name of the `Sentry`.
onParts : OnPart[0..*]	Defines the `OnParts` of the `Sentry`.
ifPart : IfPart[0..1]	Defines the `IfPart` of the `Sentry`.

Table 20: Sentry attributes

A `Sentry` MUST have an `IfPart` or at least one `OnPart`.

5.4.6.1 OnPart

The `Sentry` `OnPart` addresses the "event" aspect of a `Sentry`. The class `OnPart` is an abstract class that inherits from `CMMNElement`. It has two sub-classes: `CaseFileItemOnPart` and `PlanItemOnPart`.

5.4.6.2 CaseFileItemOnPart

The class `CaseFileItemOnPart` inherits from `OnPart` and has the following attributes:

Attribute	**Description**
standardEvent : CaseFileItemTransition	Reference to a state transition in the `CaseFileItem` lifecyle (see 7.2). The enumeration `CaseFileItemTransition` is specified in 5.4.6.2.1.
sourceRef : CaseFileItem[1]	Reference to a `CaseFileItem`. If the associated `CaseFileItem` is undergoing the state transition as specified by attribute `standardEvent`, the `OnPart` MUST occur (in run-time).

Table 21: CaseFileItemOnPart attributes

5.4.6.2.1 CaseFileItemTransition

`CaseFileItemTransition` is an enumeration that specifies transitions in the CMMN-defined lifecycle of `CaseFileItems` (see 7.2). Its values are:

CaseFileItem Lifecycle State transition	**Description**
addChild	A new child `CaseFileItem` has been added to an existing `CaseFileItem`. The lifecycle state remains Available.
addReference	A new reference to a `CaseFileItem` has been added to a `CaseFileItem`. The lifecycle state remains Available.
create	A `CaseFileItem` transitions from the initial state to Available.
delete	A `CaseFileItem` transitions from Available to Discarded
removeChild	A child `CaseFileItem` has been removed from a `CaseFileItem`. The lifecycle state remains Available.

removeReference	A reference to a `CaseFileItem` has been removed from a `CaseFileItem`. The lifecycle state remains Available.
replace	The content of a `CaseFileItem` has been replaced. The lifecycle state remains Available.
update	The `CaseFileItem` has been updated. The lifecycle state remains Available.

Table 22: CaseFileItemTransition enumeration

5.4.6.3 PlanItemOnPart

The class `PlanItemOnPart` inherits from `OnPart` and has the following attributes:

Attribute	Description
standardEvent : PlanItemTransition	Reference to a state transition in the lifecycle of a `Stage`, `Task`, `EventListener` or `Milestone` (see 7.3). The enumeration `PlanItemTransition` is specified in 5.4.6.3.1. If `definitionRef` of the `PlanItem`, that is referenced by the `OnPart` as `sourceRef`, represents a `Stage` or `Task`, the value of `standardEvent` of the `OnPart` MUST denote a transition of the CMMN-defined lifecycle of `Stage` / `Task` (see 7.3.2). If `definitionRef` of the `PlanItem`, that is referenced by the `OnPart` as `sourceRef`, represents an `EventListener` or `Milestone`, the value of `standardEvent` of the `OnPart` MUST denote a transition of the CMMN-defined lifecycle of `EventListener` / `Milestone` (see 7.3.3).
sourceRef : PlanItem[0..1]	Reference to a `PlanItem`. If the associated `PlanItem` is undergoing a state transition as specified by attribute `standardEvent` the `OnPart` MUST occur (in run-time). `SourceRef` represents a `PlanItem` that MUST be contained by the same `PlanFragment` (or `Stage`) that also contains the `Sentry` that contains the `PlanItemOnPart`.
sentryRef: Sentry [0..1]	A reference to a `Sentry`. It enforces that the `PlanItemOnPart` of the `Sentry` occurs when the `PlanItem` that is referenced by `sourceRef` transits by the exit transition in its lifecycle, due to the `Sentry` that is referenced by `sentryRef` being satisfied. An example is provided and explained in section 6.10.1, in relation to Figure 46. `SentryRef`, if specified, MUST refer to a `Sentry` that is referenced by an `exitCriteriaRef` of the `PlanItem` that is referred to as the `sourceRef` of the `PlanItemOnPart`. When `sentryRef` is specified, `standardEvent` MUST have value “exit”.

Table 23: PlanItemOnPart attributes

5.4.6.3.1 PlanItemTransition

`PlanItemTransition` is an enumeration that specifies transitions in the CMMN-defined lifecycles of `Stages`, `Tasks`, `EventListeners` and `Milestones` (see 7.3). Its values are:

PlanItem Lifecycle State transition	**Description**
close	The `casePlanModel` transitions from Completed, Terminated, Failed or Suspended to Closed
complete	The `casePlanModel`, `Stage` or `Task` transitions from Active to Completed.
create	• The `casePlanModel` transitions from the initial state to Active • The `PlanItem` transitions from the initial state to Available
disable	The `Stage` or `Task` transitions from Enabled to Disabled
enable	The `Stage` or `Task` transitions from Available to Enabled
exit	The `Stage` or `Task` transitions from Available, Enabled, Disabled, Active, Failed or Suspended to Terminated.
fault	The `Stage` or `Task` transitions from Active to Failed
manualStart	The `Stage` or `Task` transitions from Enabled to Active.
occur	The `EventListener` or `Milestone` transitions from Available to Completed.
parentResume	The `Stage` or `Task` transitions from Suspended to Available, Enabled, Disabled or Active depending on its state before it was suspended
parentSuspend	The `Stage` or `Task` transitions from Available, Enabled, Disabled or Active to Suspended
reactivate	• The `casePlanModel` transitions from Completed, Terminated, Failed or Suspended to Active • The `PlanItem` transitions from Failed to Active
reenable	The `Stage` or `Task` transitions from Disabled to Enabled
resume	• The `Task` or `Stage` transitions from Suspended to Active. • The `EventListener` or `Milestone` transitions from Suspended to Available.
start	The `Stage` or `Task` transitions from Available to Active
suspend	• The `casePlanModel`, `Stage` or `Task` transitions from Active to Suspended. • The `EventListener` or `Milestone` transitions from Available to Suspended.

terminate	• The `casePlanModel`, `Stage` or `Task` transitions from Active to Terminated • The `EventListener` or `Milestone` transitions from Available to Terminated.

Table 24: PlanItemTransition enumeration

5.4.6.4 IfPart

The `IfPart` of a `Sentry` is used to specify an (optional) condition.

The class `IfPart` inherits from `CMMNElement`, and has the following attributes

Attribute	Description
contextRef : CaseFileItem[0..1]	The context of the `IfPart`. The `caseFileItem` that serves as starting point for evaluation of the `Expression` that is specified by the `condition` of the `IfPart`. If not specified, evaluation starts at the `CaseFile` object that is referenced by the `Case` as its `caseFileModel`.
condition : Expression[1]	A condition that is defined as `Expression`. The `Expression` MUST evaluate to boolean. `Expressions` are specified in 5.4.7.

Table 25: IfPart attributes

5.4.7 Expressions

`Expressions` specify String objects that are evaluated over information in the `CaseFile`. `Expressions` do also specify the language in which the String objects MUST be specified.

`Expression` inherits from `CMMNElement`, and has the following attributes:

Attribute	Description
language : URI	The language in which the `Expression` body is specified. The language attribute is optional. The default value of the language attribute is defined by the value of `expressionLanguage` of the `Definitions` object. If a value is specified for the `language` attribute of an `Expression`, it overwrites the default for that `Expression`.
body : String	The actual expression. It MUST be valid according to the specified language.

Table 26: Expression attributes

5.4.8 Stage

A `Stage` inherits from `PlanFragment`. As `PlanFragment` it is a `PlanItemDefinition` as well, and serves as building block for `Case` (instance) plans therefore.

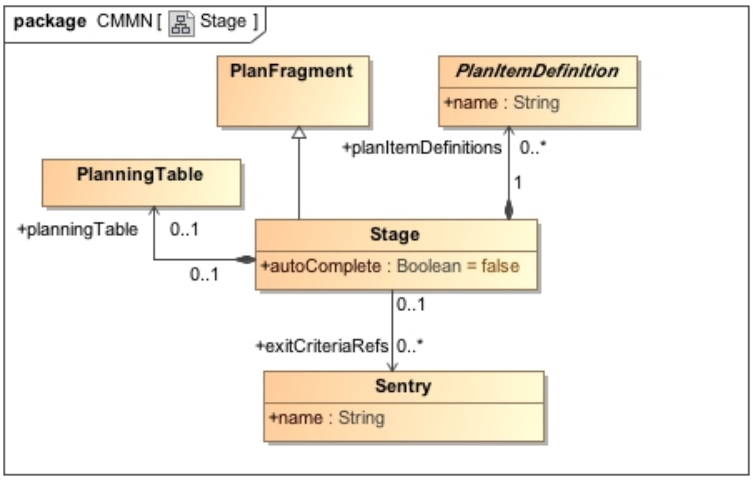


Figure 9: Stage class diagram

As a `PlanFragment`, a `Stage` can contain `PlanItems` and `Sentries`.

Unlike `PlanFragments` (that are not `Stages`), `Stages` do have run-time representations in a `Case` (instance) plan. Instances of `Stages` are tracked through the CMMN-defined `Stage` lifecycle (see 7.3.2). `Stages` maybe considered "episodes" of a `Case`, though `Case` models allow for defining `Stages` that can be planned in parallel also.

The following is supported for a `Stage`, which is not supported for a `PlanFragment` (that is not a `Stage`):

- A `Stage` can be used as `PlanItem` inside `PlanFragments` or other `Stages`.
- A `Stage` (instance) can serve as context for planning, i.e. a `Stage` can have a `PlanningTable`, to support users in planning additional ("discretionary") items into instances of the `Stage` in run-time. `PlanningTables` and `DiscretionaryItems` are specified in 5.4.9
- The `Case` refers to a `Stage` as its `casePlanModel`. This defines the "most outer" `Stage` of the `Case`.
    - This "most outer" `Stage` also contains the `PlanItemDefinitions` that are used in the `Case`.
    - This "most outer" `Stage` of the `Case` may also contain `Sentries` that serve as exit criteria for that `Stage`, and hence for the `Case`.

The class `Stage` has the following attributes:

Attribute	**Description**
planItemDefinitions : PlanItemDefinition[0..*]	This attribute lists the `PlanItemDefinition` objects available in the `Stage`, and its nested `Stages`. `PlanItemDefinitions` MUST NOT be contained by any other `Stage` than the `casePlanningModel` of the `Case`.
autoComplete : Boolean = false	This attribute controls completion of the `Stage`. If "false", a `Stage` requires a user to manually complete it, which is often appropriate for `Stages` that contain "discretionary" items (see 5.4.9.2) and/or non-required `Tasks` or `Stages`

	(see 5.4.11.2). `Stage` completion logic is specified in detail in 7.5.1.
planningTable : PlanningTable[0..1]	Defines the (optional) `PlanningTable` of the `Stage`. `PlanningTable` is specified in 5.4.9.
exitCriteriaRefs : Sentry[0..*]	Reference to zero or more `Sentries` that serve as the exit criteria for the `Stage`. `ExitCriteriaRefs` of a `Stage` MUST refer to `Sentries` that are contained by that `Stage`. Only the `Stage` that is referenced by the `Case` as its `casePlanningModel` can have `exitCriteriaRefs`. Note that it is only useful for that `Stage` to directly have `exitCriteriaRefs`, as it cannot be further nested in other `Stages` (other `Stages` can contain both `PlanItems` that represent `Stages` and the `Sentries` that impose entry and/or exit criteria on them).

Table 27: Stage attributes

5.4.9 PlanningTable

Planning is a run-time effort. A `PlanningTable` defines the scope of planning, in terms of identifying a sub-set of `PlanItemDefinitions` that can be considered for planning in a certain context. The context for planning might be:

- A `Stage`. When a `Stage` has a `PlanningTable`, that `PlanningTable` can be used, for an instance of that `Stage`, to plan instances of `Tasks` and `Stages` into that `Stage` instance.
- A `HumanTask`. When a `HumanTask` has a `PlanningTable` (see 5.4.10.4), that `PlanningTable` can be used, for an instance of that `HumanTask`, to plan instances of `Tasks` and `Stages` into the instance of the `Stage` that contains that instance of the `HumanTask`.

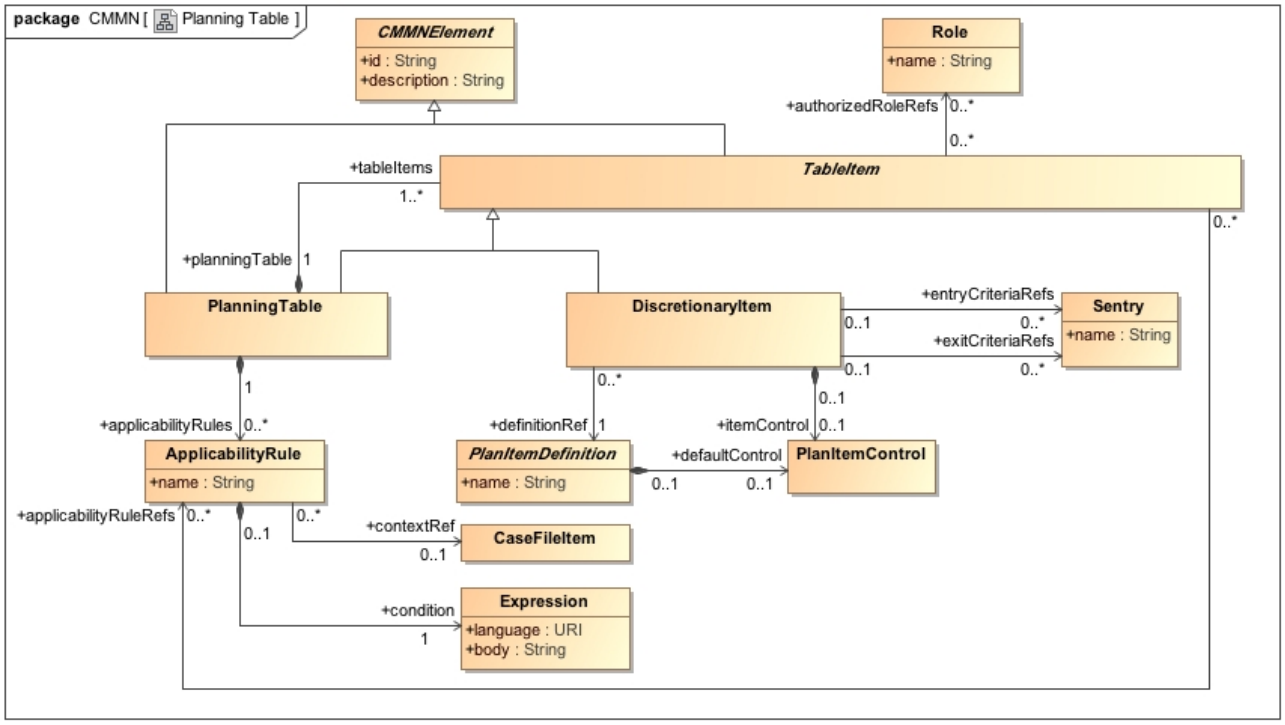


Figure 10: PlanningTable class diagram

Instances of `Tasks` and `Stages` that are defined by the same `PlanItemDefinition` might be planned based on possibly multiple `PlanningTables`. This required a separate class, `DiscretionaryItem` (see 5.4.9.2), that refers to `PlanItemDefinition`. Multiple `DiscretionaryItems` might refer to the same `PlanItemDefinition`. A `PlanItemDefinition` is (re-)used in multiple `PlanningTables` when these `PlanningTables` contain `DiscretionaryItems` that refer to or ("use") that same `PlanItemDefinition`.

For convenience, a `DiscretionaryItem` that refers to a `PlanItemDefinition` that is a `Task`, might be called a "discretionary `Task`". Similarly we can consider "discretionary `PlanFragments`" and "discretionary `Stages`". Note that `PlanFragments` that are no `Stages` can only be "discretionary", as `PlanItems` cannot refer to them (see 5.4.5). Note again that, when a `PlanFragment` (that is not a `Stage`) is used for planning, just the `PlanItems` that are contained in it are instantiated and have their lifecyles that are tracked. The `PlanFragment` (that is not a `Stage`) is not instantiated itself.

For convenience during run-time planning, in situations where a `PlanningTable` would contain potentially many `DiscretionaryItems`, it is possible to define a `PlanningTable` recursively: a `PlanningTable` containing other `PlanningTables`.

Users (`Case` workers) are said to "plan" (in run-time), when they select `DiscretionaryItems` from a `PlanningTable`, and move instances of their associated `PlanItemDefinitions` into the plan of the `Case` (instance).

It is possible to authorize `Roles` for planning of certain `DiscretionaryItems` and sub-`PlanningTables`. It is also possible to make `DiscretionaryItems` (and sub-`PlanningTables`) dynamically applicable for planning, based on conditions that evaluate over the `CaseFile`. Both `Role` authorizations and `ApplicabilityRules` (see 5.4.9.3) can dynamically control what `DiscretionaryItems`, possibly organized via sub-`PlanningTables`, are exposed to `Case` workers that are involved in planning.

Chapter 7 specifies semantics of run-time planning in detail, amongst others specifying when `Stage` instances become eligible for planning (into them) and until when planning can be performed. `PlanningTables` of `HumanTasks`, as well as the purpose of planning via `HumanTasks`, will be specified in 5.4.10.4.

`PlanningTable` inherits from `CMMNElement`, and has the following attributes:

Attribute	Description
tableItems : TableItem[1..*]	A list of `TableItem` objects (see 5.4.9.1), available for planning. A `PlanningTable` is said to be "nested" in another `PlanningTable`, when the `PlanningTable` is a `TableItem` that is contained by that other `PlanningTable`, either directly, or recursively through even other `PlanningTables`. The set of `tableItems` of a `PlanningTable` MUST NOT include that `PlanningTable` or any `PlanningTable` in which that `PlanningTable` is nested. A `PlanningTable` MUST contain at least one `TableItem`.
applicabilityRules : ApplicabilityRule[0..*]	Zero or more `ApplicabilityRule` objects.

Table 29: PlanningTable attributes

5.4.9.1 TableItem

A `TableItem` might be a `DiscretionaryItem`, or a `PlanningTable`.

`TableItem` inherits from `CMMNElement` and has the following attributes:

Attribute	Description
authorizedRoleRefs : Role[0..*]	References to zero or more `Role` objects that are authorized to plan, based on the `TableItem`.
applicabilityRuleRefs : ApplicabilityRule[0..*]	References to zero or more `ApplicabilityRule` objects. If the `condition` of the `ApplicabilityRule` object evaluates to "true", then the `TableItem` is applicable for planning, otherwise it is not. If no `ApplicabilityRule` is associated with a `TableItem`, its applicability is considered "true". A `PlanningTable` that contains a `TableItem` MUST contain the `ApplicabilityRules` that represent the `applicabilityRuleRefs` of that `TableItem`.

Table 30: TableItem attributes

5.4.9.2 DiscretionaryItem

A `DiscretionaryItem` identifies a `PlanItemDefinition`, of which instances can be planned, to the "discretion" of a `Case` worker that is involved in planning, which instances are planned into the context (see 5.4.9 and 7.6) that is implied by the `PlanningTable` that contains the `DiscretionaryItem`, either directly, or via a nested `PlanningTable`.

`DiscretionaryItem` inherits from `TableItem` and has the following attributes:

Attribute	**Description**
definitionRef : PlanItemDefinition[1]	Defines the `PlanItemDefinition` associated with the `DiscretionaryItem`, and which is the basis for planning. The `definitionRef` of a `DiscretionaryItem` MUST represent a `Task` or a `PlanFragment` (or `Stage`).
itemControl : PlanItemControl[0..1]	An optional `PlanItemControl` object. The `PlanItemControl` object controls aspects of the behavior of instances that are planned via the `DiscretionaryItem`. If the `itemControl` attribute is specified it MUST overwrite the value of attribute `defaultControl` of the `DiscretionaryItem` associated `PlanItemDefinition`
entryCriteriaRefs : Sentry[0..*]	Reference to zero or more `Sentries` that represent the `DiscretionaryItem's` entry criteria.
exitCriteriaRefs : Sentry[0..*]	Reference to zero or more `Sentries` that represent the `DiscretionaryItem's` exit criteria. A `DiscretionaryItem` that is defined by a `Task` that is non-blocking (`isBlocking` set to "false") MUST NOT have `exitCreteriaRefs` .

Table 31: DiscretionaryItem attributes

A `PlanItemDefinition` is said to be "discretionary" to a `HumanTask` or `Stage`, when the `HumanTask` or `Stage` has a `PlanningTable`, that, directly or through `PlanningTable` nesting, contains a `DiscretionaryItem` that refers to that `PlanItemDefinition`, or to a `HumanTask` or `Stage`, that has a `PlanningTable`, etc., ultimately arriving at a `HumanTask` or `Stage` that has a `PlanningTable`, that, directly or through `PlanningTable` nesting, contains a `DiscretionaryItem` that refers to that `PlanItemDefinition`.

A `Stage` MUST NOT be discretionary to itself or its nested `Stages`.

A `Stage` MUST NOT be discretionary to a `HumanTask` that is `PlanItemDefinition` of a `PlanItem` that is contained by the `Stage` or its nested `Stages`.

The `entryCriteriaRefs` and `exitCriteriaRefs` of a `DiscretionaryItem` MUST be contained in the `Stage` that also contains the `PlanningTable` that contains the `DiscretionaryItem`, directly or recursively through a hierarchy of `PlanningTables`, or in the `Stage` that also contains the `HumanTask` that has the `PlanningTable` that contains the `DiscretionaryItem`, directly or recursively through a hierarchy of `PlanningTables`.

When entryCriteriaRefs or exitCriteriaRefs of a DiscretionaryItem have OnParts that are PlanItem OnParts, these OnParts MUST have a sourceRef that is contained in the Stage that also contains the PlanningTable that contains the DiscretionaryItem, directly or recursively through a hierarchy of PlanningTables, or in the Stage that also contains the HumanTask that has the PlanningTable that contains the DiscretionaryItem, directly or recursively through a hierarchy of PlanningTables.

5.4.9.3 Applicability Rules

ApplicabilityRules are used to specify, whether a TableItem is "applicable" ("eligible", "available") for planning, based conditions that are evaluated over information in the CaseFile.

TableItems for which an associated ApplicabilityRule evaluates to "false", will not be exposed to Case workers for planning purpose.

The class ApplicabilityRule has the following attributes:

Attribute	Description
name : String	The name of the ApplicabilityRule.
contextRef : CaseFileItem[0..1]	The context of the ApplicabilityRule. The caseFileItem that serves as starting point for evaluation of the Expression that is specified by the condition of the ApplicabilityRule. If not specified, evaluation starts at the CaseFile object that is referenced by the Case as its caseFileModel.
condition : Expression[1]	The Expression that serves as condition of the ApplicabilityRule. If it evaluates to "true", then the associated TableItem is available for planning (if a Case worker is also assigned the Role that is authorized for planning based on that TableItem). Expressions are specified in 5.4.7.

Table 32: ApplicabilityRule attributes

5.4.10 Task

A Task is an atomic unit of work. Task is a base class for all Tasks in CMMN and inherits from PlanItemDefinition.

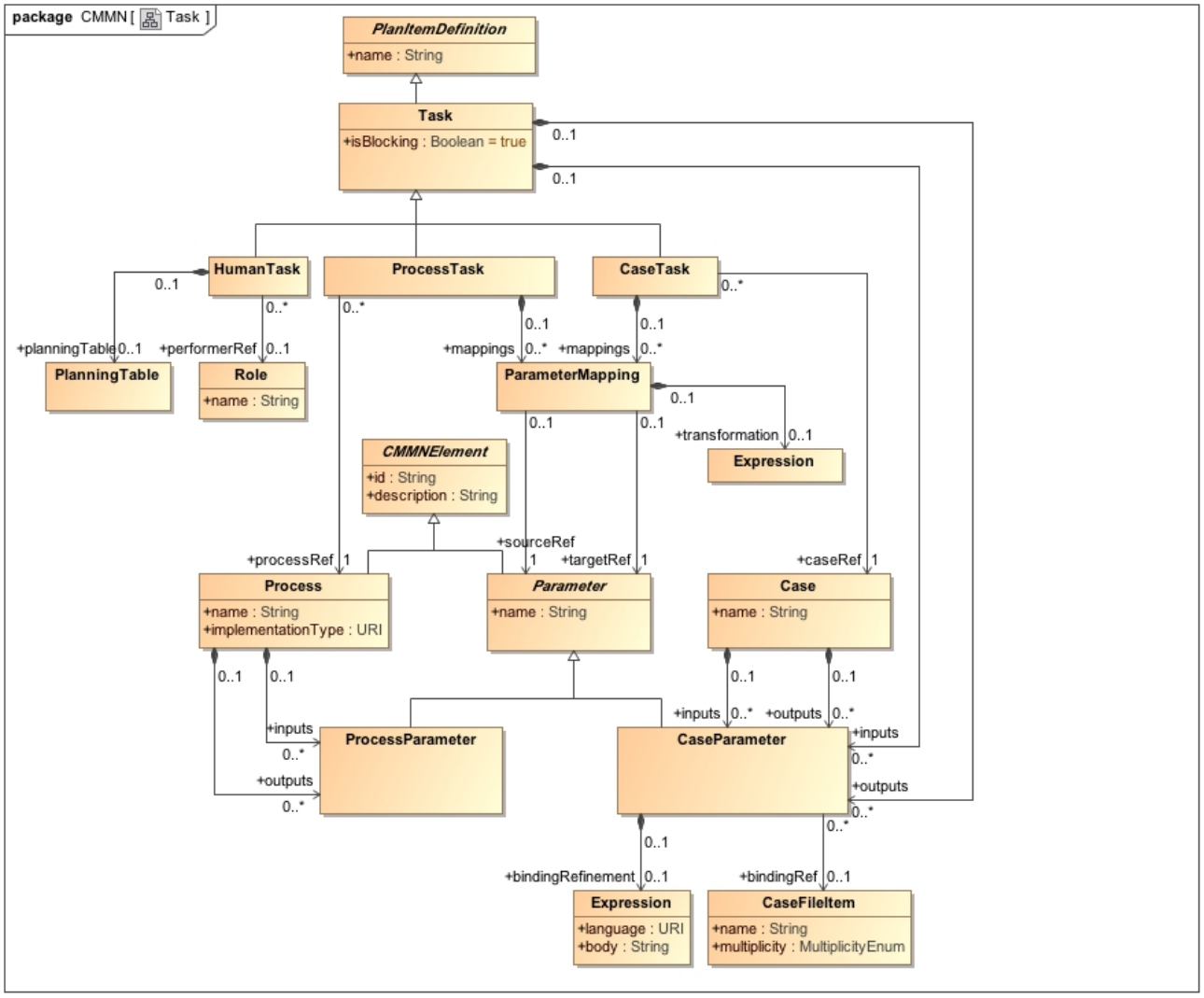


Figure 11: Task class diagram

The `Task` class has the following attributes:

Attribute	Description
isBlocking : Boolean = true	If `isBlocking` is set to “true”, the `Task` is waiting until the work associated with the `Task` is completed. If `isBlocking` is set to “false”, the `Task` is not waiting for the work to complete and completes immediately, upon instantiation. The default value of attribute `isBlocking` MUST be “true”. A `Task` that is non-blocking (`isBlocking` set to “false”) MUST NOT have `outputs`.
inputs : CaseParameter[0..*]	Zero or more `CaseParameter` objects (see 5.4.10.3) that specify the `input` of the `Task`.
outputs : CaseParameter[0..*]	Zero or more `CaseParameter` objects (see 5.4.10.3) that specify the

	`output` of the `Task`.

Table 33: Task attributes and model associations

5.4.10.1 Parameter

The class `Parameter` is an abstract base class for `CaseParameter` and `ProcessParameter`. It inherits from `CMMNElelent`, and has the following attributes:

Attribute	Description
name : String	The name of the `Parameter`.

Table 34: Parameter attributes

5.4.10.2 ParameterMapping

The class `ParameterMapping` is used for the input/output mapping of `CaseTasks` and `ProcessTasks`. It inherits from `CMMNElement` and has the following attributes:

Attribute	Description
transformation : Expression[0..1]	The transformation `Expression` transforms the parameter referred to by `sourceRef` to the parameter referred to by `targetRef`. Any expression language might be chosen for the transformation (for example XSLT, XPath, etc.) `Expressions` are specified in 5.4.7.
sourceRef : Parameter[1]	One source `Parameter`.
targetRef : Parameter[1]	One target `Parameter`.

Table 35: ParameterMapping attributes

5.4.10.3 CaseParameter

The class `CaseParameter` is used to model the inputs and outputs of `Cases` and `Tasks`.

It inherits from `Parameter` and has the following attributes:

Attribute	Description

bindingRef : CaseFileItem[0..1]	A reference to a `CaseFileItem`. When a `Task` has an `output` that is a `CaseParameter` with `bindingRef` that references a `CaseFileItem`, the effect that the execution of instances of that `Task` has on instances of that `CaseFileItem` can be observed in terms of transitions in the CMMN-lifecyle of `CaseFileItem` (see 7.2). Similarly, when a `Case` has an `input` that is a `CaseParameter` with `bindingRef` that references a `CaseFileItem`, the effect that passing on information to an instance of the `Case`, via that `CaseParameter`, has on instances of that `CaseFileItem` in the `CaseFile` of that `Case` instance, can be observed in terms of transitions in the CMMN-lifecyle of `CaseFileItem` (see 7.2). `Outputs` of `Cases` and `inputs` of `Tasks` are merely concerned with retrieval of `CaseFileItem` (instances) from the `CaseFile` of a `Case` instance.
bindingRefinement : Expression[0..1]	An optional `Expression` to further refine the binding of the `CaseParameter` to the `CaseFileItem`, that it is referenced by the `bindingRef` of the `CaseParameter`. For example, if the `bindingRef` would refer to a `CaseFileItem` that represents a purchase order, the `bindingRefinement` might be used to effectively reduce the collection of referenced purchase orders to a particular purchase order (note that `multiplicity` of the `CaseFileItem` might be greater than zero), or to effectively refer to (an) associated `CaseFileItem`(s), such as (a) purchase order line(s). `Expressions` are specified in 5.4.7.

Table 36: CaseParameter attributes

5.4.10.4 HumanTask

A `HumanTask` is a `Task` that is performed by a `Case` worker.

When a `HumanTask` is not "blocking" (`isBlocking` is "false"), it can be considered a "manual" `Task`, i.e. the `Case` management system is not tracking the lifecycle of the `HumanTask` (instance).

A `HumanTask` can have a `PlanningTable`, so that the `HumanTask` can also be used for planning Though planning can also be performed based on the `PlanningTable` of a `Stage` that contains the `HumanTask`, it has sometimes advantages to also perform planning from the `HumanTask` directly, such as:

- It brings a particular perspective of planning: `TableItems` in the `PlanningTable` of a `HumanTask`, that is used as `PlanItem` inside a `Stage`, are the basis for planning of `Stages` and `Tasks` that can be considered follow-up `Stages` and `Tasks` of that particular `HumanTask`. Planning based on the `PlanningTable` of the containing `Stage`, adds instances of `Stages` and `Tasks` that are contained by (an instance of) the `Stage`, but not particularly as follow-up of that `HumanTask`. The `PlanningTable` of the `HumanTask` typically contains `TableItems` that are particularly relevant in the context of planning from that particular `HumanTask`, whereas the `PlanningTable` of the containing `Stage` might provide a wider range of `TableItems`.

- It helps to avoid the overhead of defining "arbitrary" `Stages` that just contain a single `PlanItem`: In order to have a context with a more narrowly defined `PlanningTable`, it is often not preferred to define further `Stage` nesting (by contained `Stages` that have their `PlanningTables` and that contain a `HumanTask`), but rather use a `HumanTask` with `PlanningTable`, which `HumanTask` is contained in the `Stage` directly.
- It allows to use the `Role` that is referenced by the `performerRef` of the `HumanTask` to effectively serve as the `Role` that is authorized to plan based on any `TableItem` in the `PlanningTable` of the `HumanTask`, or to enforce that `Case` workers that plan based on PlanItems in that PlanningTable have to be assigned both the `HumanTask`-related `Role` and the `TableItem`-related `Roles`.

`HumanTask` inherits from `Task`, and has the following attributes:

Attribute	Description
planningTable : PlanningTable[0..1]	An optional `PlanningTable` associated to the `HumanTask`. A `HumanTask` can be used for planning, and its `PlanningTable` might contain `TableItems` that are useful in the particular planning context. A `HumanTask` that is non-blocking (`isBlocking` set to "false") MUST NOT have a `PlanningTable`.
performerRef : Role[0..1]	The performer of the `HumanTask`.

Table 37: HumanTask attributes

5.4.10.5 ProcessTask

A `ProcessTask` can be used in the `Case` to call a Business `Process` (see 5.4.10.5.1).

`Parameters` are used to pass information between the `ProcessTask` (in a `Case`) and the `Process` to which it refers: `inputs` of the `ProcessTask` are mapped to `Inputs` of the `Process`, and `outputs` of the `ProcessTask` are mapped to `outputs` of the `Process`. This way instances of (elements of) `CaseFileItems` from the `CaseFile` of the `Case` can be passed to the `Process` and `outputs` of the `Process` can be passed back and mapped to instances of (elements of) `CaseFileItems`.

When a `ProcessTask` is "blocking" (`isBlocking` is "true"), the `ProcessTask` is waiting until the `Process` associated with the `ProcessTask` is completed. If `isBlocking` is set to "false", the `ProcessTask` is not waiting for the `Process` to complete, and completes immediately, upon its instantiation and calling its associated `Process`.

The class `ProcessTask` inherits from `Task`, and has the following attributes

Attribute	Description
processRef : Process[1]	A reference to a `Process` (see 5.4.10.5.1).
mappings : ParameterMapping[0..*]	Zero or more `ParameterMapping` objects. A `ParameterMapping` of a `ProcessTask` specifies how an `input` of the `ProcessTask` is mapped to an `input` of the called `Process` and how an `output` of the called `Process` is mapped to an `output` of the `ProcessTask`.

Table 38: ProcessTask attributes

5.4.10.5.1 Process

A `Process` in CMMN is an abstraction of `Processes` as they are specified in various `Process` modeling specifications, in particular the ones that are listed in Table 40.

The class `Process` inherits from `CMMNElement` and has the following attributes

Attribute	Description
implementationType : URI	The implementation type of the Business `Process`. It MUST be provided in URI format
inputs : ProcessParameter[0..*]	Zero or more `inputs` of the Business `Process`
outputs : ProcessParameter[0..*]	Zero or more `outputs` of the Business `Process`

Table 39: Process attributes

The following `implementationTypes` are defined to support various Business `Process` modeling standards:

Implementation Type URI	Description
http://www.omg.org/spec/CMMN/ProcessType/BPMN20	The `Process` to call is implemented in BPMN 2.0
http://www.omg.org/spec/CMMN/ProcessType/XPDL2	The `Process` to call is implemented in XPDL 2.x
http://www.omg.org/spec/CMMN/ProcessType/WSBPEL20	The `Process` to call is implemented in WS-BPEL 2.0
http://www.omg.org/spec/CMMN/ProcessType/WSBPEL1	The `Process` to call is implemented in WS-BPEL 1.x

Table 40: Process Implementation Types

5.4.10.6 CaseTask

A `CaseTask` can be used to call another `Case`. A `CaseTask` triggers the creation of an instance of that other `Case`, which creation denotes the initial transition in the CMMN-defined lifecycle of a `Case` instance (see 7.3).

The difference between using a `CaseTask` and a `Stage` is that a `CaseTask` calls a `Case` that has its own context, i.e. it is based on its own `CaseFile`, whereas a `Stage` represents behavior that shares the same context with the `Stage`, i.e. it is based on the same `CaseFile` and is "embedded" in the same `Case`.

`Parameters` are used to pass information between the `CaseTask` (in a `Case`) and the `Case` to which it refers: `inputs` of the `CaseTask` are mapped to `Inputs` of the `Case`, and `outputs` of the `CaseTask` are mapped to `outputs` of the `Case`. This way instances of (elements of) `CaseFileItems` can be exchanged between (`CaseFiles` of) `Cases`.

When a CaseTask is "blocking" (isBlocking is "true"), the CaseTask is waiting until the Case associated with the CaseTask is completed. If isBlocking is set to "false", the CaseTask is not waiting for the Case to complete, and completes immediately, upon its instantiation and invocation of its associated Case.

The class CaseTask inherits from Task, and has the following attributes:

Attribute	Description
caseRef : Case[1]	A reference to the Case that is called as part of the CaseTask
mappings : ParameterMapping[0..*]	Zero or more ParameterMapping objects. A ParameterMapping of a CaseTask specifies how an input of the CaseTask is mapped to an input of the called Case and how an output of the called Case is mapped to an output of the CaseTask.

Table 41: CaseTask attributes

5.4.11 PlanItemControl

PlanItemControls define aspects of control of instances of Tasks, Stages, EventListeners and Milestones. They are defined in relation to their "origins" in the model - PlanItems and DiscretionaryItems - and maybe defaulted by PlanItemControls that are defined in relation to the PlanItemDefinitions to which the PlanItems and DiscretionaryItems refer to via their definitionRef.

PlanItemControls may specify the following:

- Under which conditions will Tasks and Stages, once enabled, start manually or automatically. This is specified by ManualActivationRules, as part of PlanItemControls (see 5.4.11.1).
- Under which conditions will Tasks, Stages and Milestones be "required" to complete or terminate before their containing Stage can complete. This is specified by RequiredRules, as part of PlanItemControls (see 5.4.11.2)
- Under which conditions will Tasks, Stages and Milestones need to be repeated. This is specified by RepetitionRules, as part of PlanItemControls (see 5.4.11.3).

Run-time semantics in relation to these rules will be specified in chapter 7.

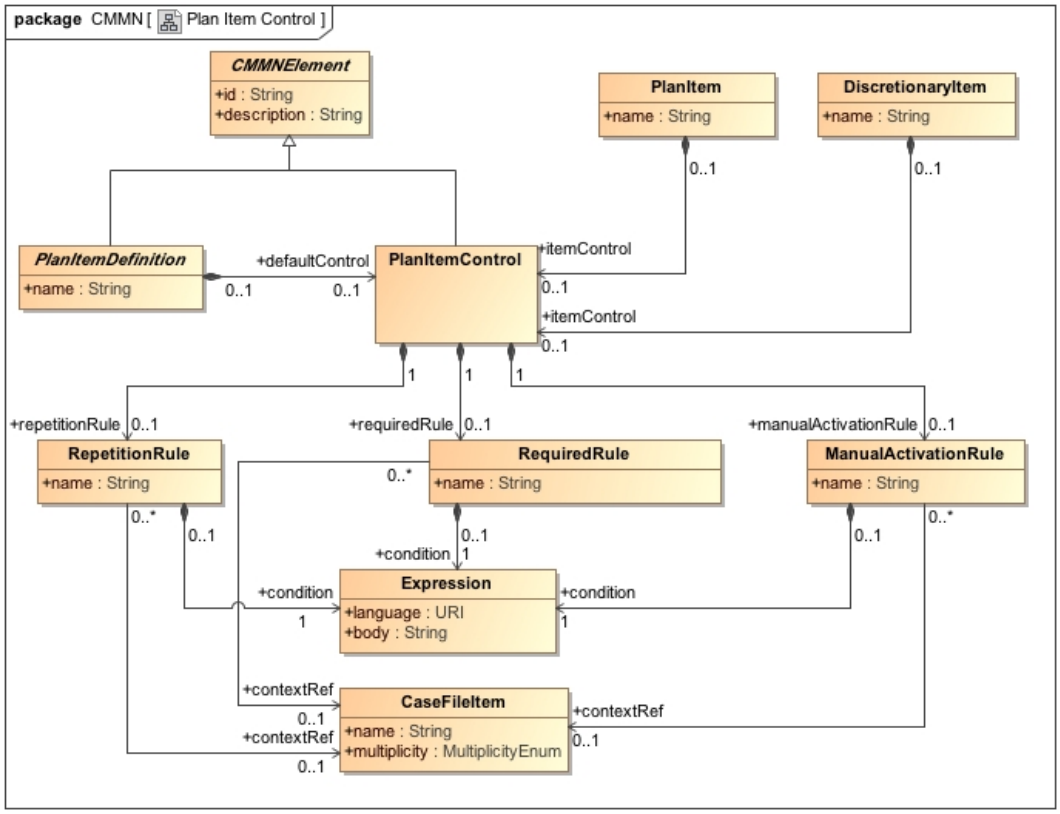


Figure 12: PlanItemControl class diagram

The class `PlanItemControl` inherits from `CMMNElement` and has the following attributes:

Attribute	Description
manualActivationRule :ManualActivationRules[0..1]	Optional `ManualActivationRule`, as contained by the `PlanItemControl`. A `ManualActivationRule` comprises of an `Expression` that MUST evaluate to boolean. If no `ManualActivationRule` is specified then the default is considered “true”. A `PlanItemControl` that is the `defaultControl` of an `EventListener` or `Milestone`, or that is the `itemControl` of a `PlanItem` or `DiscretionaryItem` that is defined by an `EventListener` or `Milestone`, MUST NOT contain a `ManualActivationRule`.
requiredRule : RequiredRule[0..1]	Optional `RequiredRule`, as contained by the `PlanItemControl`. A `RequiredRule` comprises of an `Expression` that MUST evaluate to boolean. If no `RequiredRule` is specified, the default is “false”. A `PlanItemControl` that is the

	defaultControl of an EventListener, or that is the itemControl of a PlanItem or DiscretionaryItem that is defined by an EventListener, MUST NOT contain a RequiredRule.
repetitionRule : RepetitionRule[0..1]	Optional RepetitionRule, as contained by the PlanItemControl. A RepetitionRule comprises of an Expression that MUST evaluate to boolean. If no RepetitionRule object is specified, the default is "false". A PlanItemControl that is the itemControl of a DiscretionaryItem, MUST NOT contain a RepetitionRule. (This is because the concept of "repetition" depends on the semantics of Sentries (see 5.4.11.3), and DiscretionaryItems are not associated with Sentries.) A PlanItemControl that is the defaultControl of an EventListener, or that is the itemControl of a PlanItem that is defined by an EventListener, MUST NOT contain a RepetitionRule. A PlanItem that has a PlanItemControl that contains a RepetitionRule, MUST have an entry criterion that refers to a Sentry that has at least one OnPart. (This is because the concept of "repetition" depends on the semantics of Sentries with onParts (see 5.4.11.3).)

Table 42: PlanItemControl attributes and model associations

A PlanItemControl MUST be the itemControl of a PlanItem or DiscretionaryItem or the defaultControl of a PlanItemDefinition.

A PlanItemControl MUST contain at least one repetitionRule or one requiredRule or one manualActivationRule.

5.4.11.1 ManualActivationRule

A ManualActivationRule specifies under which conditions Tasks and Stages, once enabled, start manually or automatically.

The class ManualActivationRule inherits from CMMNElement and has the following attributes

Attribute	Description
name : String	The name of the ManualActivationRule

contextRef : CaseFileItem[0..1]	The context of the `ManualActivationRule`. The `caseFileItem` that serves as starting point for evaluation of the `Expression` that is specified by the `condition` of the `ManualActivationRule`. If not specified, evaluation starts at the `CaseFile` object that is referenced by the `Case` as its `caseFileModel`.
condition : Expression[1]	A condition that is defined as `Expression`. `Expressions` are specified in 5.4.7. An `Expression` that MUST evaluate to boolean. If the expression evaluates to "false", the instance of the `Task` or `Stage` MUST be activated automatically when it is in state Available, otherwise it MUST wait for manual activation (when it is in state Enabled) (see 7.3.2).

Table 43: ManualActivationRule attributes

5.4.11.2 RequiredRule

A `RequiredRule` specifies under which conditions `Tasks`, `Stages`, `EventListeners` and `Milestones` will be "required" to complete or terminate before their containing `Stage` can complete.

The class `RequiredRule` inherits from `CMMNElement` and has the following attributes:

Attribute	**Description**
name : String	The name of the `RequiredRule`
contextRef : CaseFileItem[0..1]	The context of the `RequiredRule`. The `caseFileItem` that serves as starting point for evaluation of the `Expression` that is specified by the `condition` of the `RequiredRule`. If not specified, evaluation starts at the `CaseFile` object that is referenced by the `Case` as its `caseFileModel`.
Condition : Expression[1]	A condition that is defined as `Expression`. `Expressions` are specified in 5.4.7. An `Expression` that MUST evaluate to boolean. If the `Expression` evaluates to "true", then the instance of the `Task`, `Stage`, or `Milestone` is required and MUST be in state Disabled, Completed, Terminated, or Failed before its containing `Stage` (instance) can complete (see 7.3 and 7.5), otherwise it is considered optional.

Table 44: RequiredRule attributes

5.4.11.3 RepetitionRule

A `RepetitionRule` specifies under which conditions `Tasks`, `Stages` and `Milestones` will have repetitions. Each repetition is a new instance of it. The trigger for the repetition is a `Sentry`, that is referenced as entry criterion, being satisfied, whereby an `OnPart` of that `Sentry` occurs. For example: A `Task` might be repeated each time a certain document is created. The `Task` (as `PlanItem`) might have an entry criterion, referring to a `Sentry`, having on `OnPart`, whereby the `onPart` refers to the `CaseFileItem` that represents the type of document, and whereby the `standardEvent` of the `OnPart` is specified as "create". When the

RepetitionRule as contained in the PlanItemControl of the Task (as PlanItem) also evaluates to "true", the Task is repeated upon creation of the document.

EventListeners cannot have RepetitionRule. The notion of repetition is not useful for UserEventListeners. However, for a TimerEventListener repetition can be defined via a timerExpression based on ISO-8601, by defining repeating intervals in it (using "R<n>/" notation).

The class RepetitionRule inherits from CMMNElement and has the following attributes:

Attribute	**Description**
name : String	The name of the RepetitionRule
contextRef : CaseFileItem[0..1]	The context of the RepetitionRule. The caseFileItem that serves as starting point for evaluation of the Expression that is specified by the condition of the RepetitionRule. If not specified, evaluation starts at the CaseFile object that is referenced by the Case as its caseFileModel.
condition : Expression[1]	A condition that is defined as Expression. Expressions are specified in 5.4.7. An Expression that MUST evaluate to boolean. If the Expression evaluates to "true", then the instance of the Task, Stage, or Milestone maybe repeated, otherwise it MUST NOT be repeated.

Table 45: RepetitionRule attributes

The following table summarizes applicability of rules associated with PlanItemControl, in relation to Tasks, Stages, EventListeners and Milestones:

	RepetitionRule	**RequiredRule**	**ManualActivationRule**
Stage	Applicable	Applicable	Applicable
Task	Applicable	Applicable	Applicable
Milestone	Applicable	Applicable	N/A
EventListener	N/A	N/A	N/A

Table 46: Applicability of PlanItemControl rules

6 Notation

The following sections provide an overview of the CMMN notation used for modeling the core constructs of a Case.

6.1 Case

The CMMN notation provides for the depiction of the behavioral model elements of a `Case` (i.e. elements of a `Case`'s `casePlanModel`). As far as modeling of information is concerned, only the information model elements (i.e. `CaseFileItems`) that are involved in the behavior of the `Case` are depicted. In other words, the CMMN notation does not provide for the visual modeling of the information model elements of the `Case`. As with many other modeling languages, there are many different ways in which to model a `Case` using CMMN and its notation. It is left to the modeler to choose the best model to capture the essence of the situation at hand for the desired purpose.

6.2 Case Plan Models

The complete behavior model of a `Case` is captured in a `casePlanModel`. A `casePlanModel` is depicted using a "Folder" shape that consists of a rectangle with an upper left smaller rectangle attached to it. The name of the `Case` can be enclosed into the upper left rectangle.

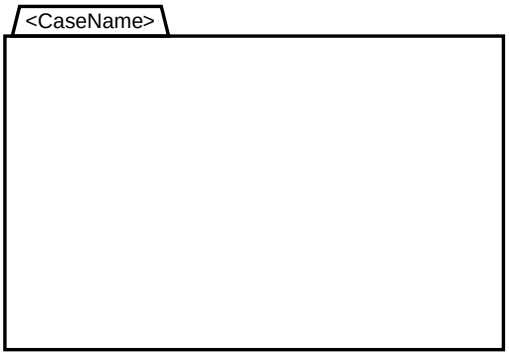


Figure 13: CasePlanModel Shape

The various elements of a `casePlanModel` are depicted within the boundary of the `casePlanModel` shape. Note that the `casePlanModel` is the outermost `Stage` that can be defined for a `Case`.

The following diagram shows an example of a `Case`'s `casePlanModel`. Although incomplete, this diagram exemplifies the basis of `Case` modeling using the CMMN notation.

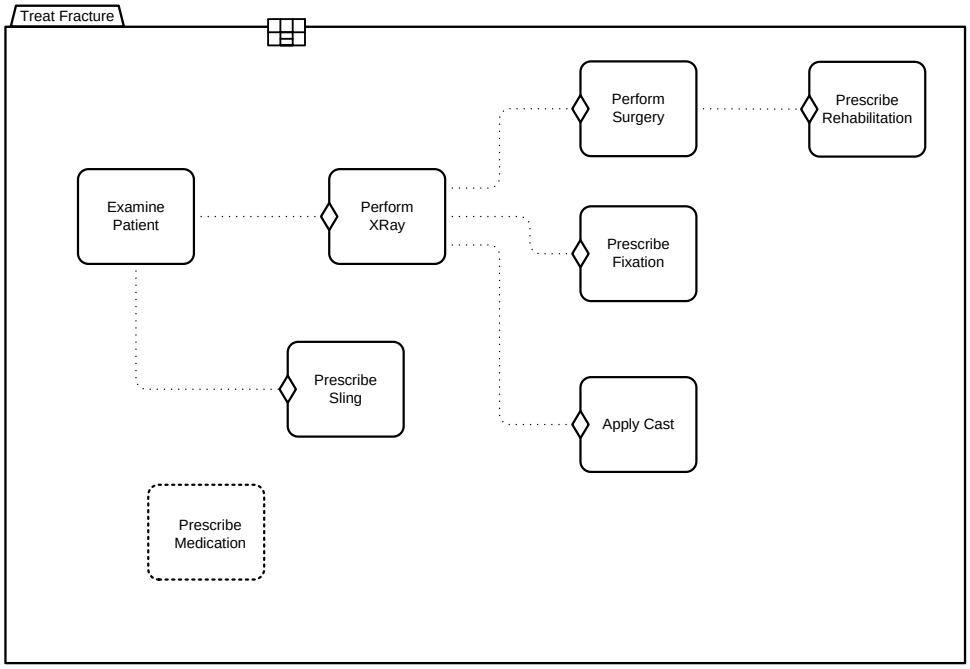


Figure 14: CasePlanModel Example

CMMN is declarative by nature, thus one should not read any meaning into the relative positioning of shapes.

6.3 Case File Items

A `CaseFileItem` is depicted by a "Document" shape that consists of a rectangle with a broken upper right corner.

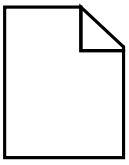


Figure 15: CaseFile**Item Shape**

6.4 Stages

A `Stage` is depicted by a rectangle shape with angled corners and a marker in the form of a "+" sign in a small box at its bottom center. When the `Stage` is expanded it is depicted by a rectangle shape with angled corners and a marker in the form of a "-" sign in a small box at its bottom center.

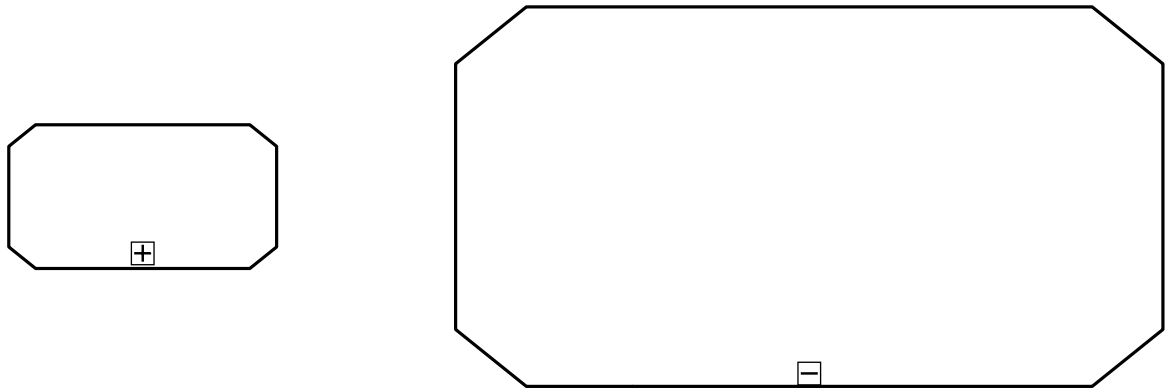


Figure 16: Collapsed Stage and Expanded Stage Shapes

A `Stage` may be discretionary (i.e used as `DiscretionaryItem` that is contained in a `PlanningTable`). A discretionary `Stage` has the shape of a rectangle with short dashed lines and angled corners and a marker in the form of a "+" sign in a small box at its bottom center, while a discretionary expanded `Stage` has the shape of a rectangle with short dashed lines and angled corners and a marker in the form of a "-" sign in a small box at its bottom center.

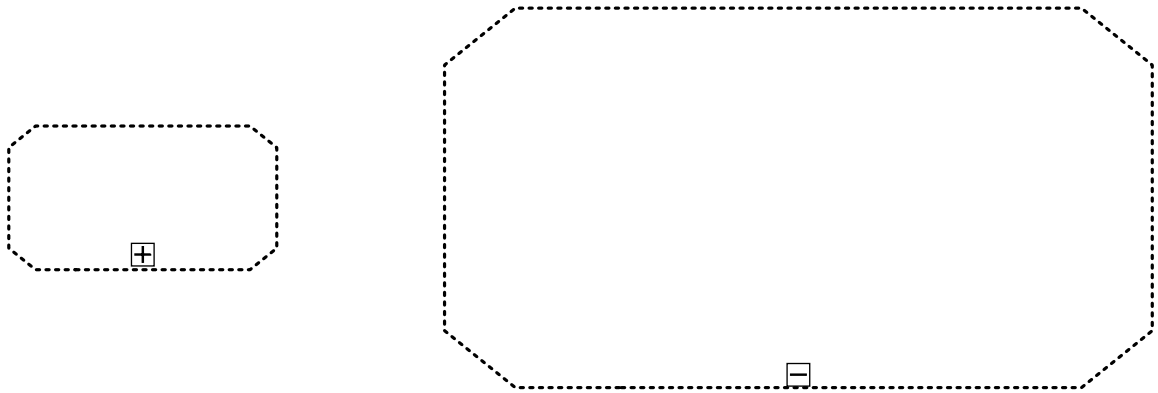


Figure 17: Discretionary Collapsed Stage and Discretionary Expanded Stage Shapes

When a `Stage` is expanded, elements that are contained in it become visible.

6.5 Entry and Exit Criterion

`PlanItem`s may have associated `Sentries`. When a `Sentry` is used as an entry criterion it is depicted by a shallow "Diamond" shape.

Figure 18: EntryCriterion Shape

When a `Sentry` is used as an exit criterion it is depicted by a solid "Diamond" shape.

Figure 19: ExitCriterion Shape

When allowed, the Entry Criterion and Exit Criterion shapes can be placed as decorator anywhere on the boundary of a shape depicting the `PlanItem`.

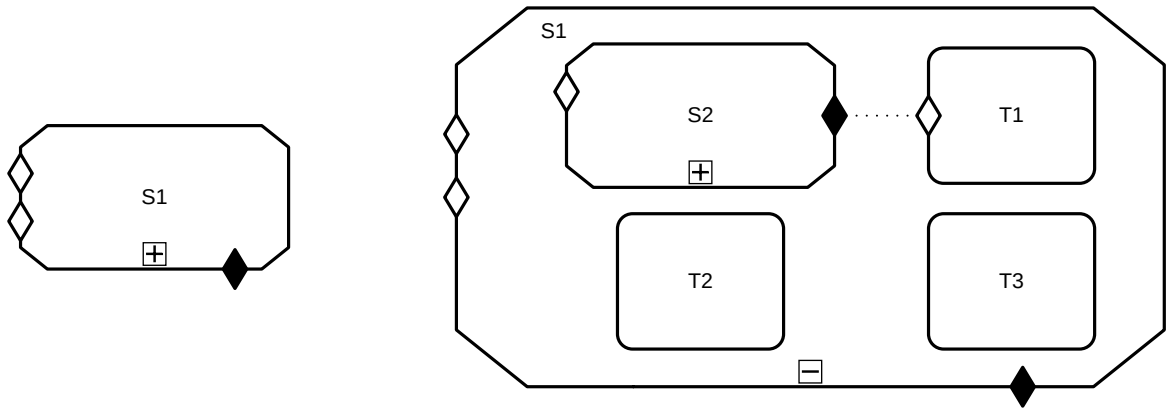


Figure 20: Collapsed and Expanded versions of a S**tage with two entry criterion, one sub** S**tage** and three T**asks**

6.6 Plan Fragments

A `PlanFragment` is depicted by a rectangle shape with dashed lines and softly rounded corners and a marker in the form of a "+" sign in small box at its bottom center. When the `PlanFragment` is expanded it is depicted by a rectangle shape with dashed lines and softly rounded corners and a marker in the form of a "-" sign in a small box at its bottom center.

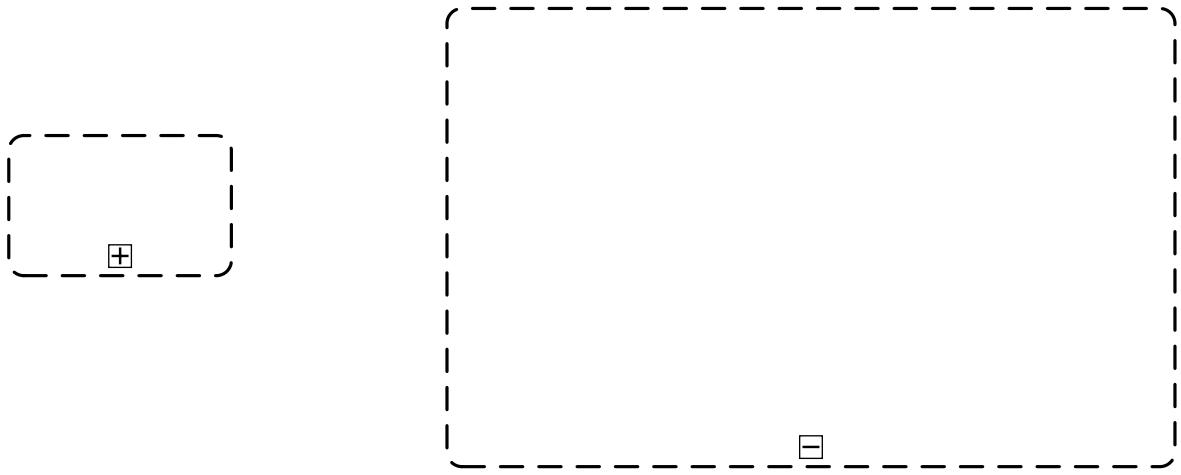


Figure 21: Collapsed PlanFragment and Expanded PlanFragment Shapes

When a `PlanFragment` is expanded, elements contained in it become visible.

6.7 Tasks

A `Task` is depicted by a rectangle shape with rounded corners.

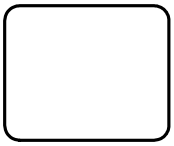


Figure 22: Task Shape

A `Task` may be discretionary (i.e. used as `DiscretionaryItem` contained in a `PlanningTable`). A discretionary `Task` is depicted by a rectangle shape with dashed lines and rounded corners

Figure 23: Discretionary Task

A `Task` may be associated with one or more entry criteria `Sentries` and one or more exit criteria `Sentries`.

The following example illustrates a `Task` with one entry criterion and one exit criterion.

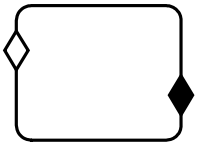


Figure 24: Task with one entry criterion and one exit criterion

6.7.1 Human Task

A `HumanTask` has two possible depictions. If the `HumanTask` is non-blocking (i.e. `isBlocking` set to "false"), it is depicted by a rectangle with rounded corners and a "Hand" symbol in the upper left corner. If the `HumanTask` is blocking (i.e. `isBlocking` set to "true"), it is depicted by a rectangle with rounded corners and a "User" symbol in the upper left corner.

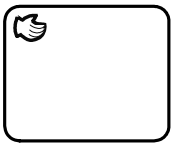


Figure 25: Non-blocking HumanTask Shape

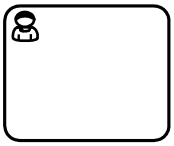


Figure 26: Blocking HumanTask Shape

A `HumanTask` may be discretionary (i.e. used as `DiscretionaryItem` contained in a `PlanningTable`). A discretionary `HumanTask` is depicted by a rectangle shape with dashed lines and rounded corners with the appropriate marker depending if it is blocking or not.

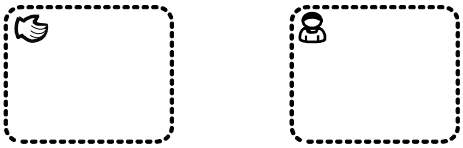


Figure 27: Non-Blocking and Blocking Discretionary HumanTasks

6.7.2 Case Task

A `CaseTask` is depicted by rectangle shape with rounded corners with a “Folder” symbol in the upper left corner.

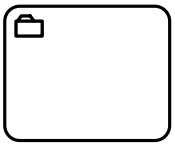


Figure 28: CaseTask Shape

A `CaseTask` may be discretionary (i.e. used as `DiscretionaryItem` containted in a `PlanningTable`). A discretionary `CaseTask` is depicted by a dash lined rectangle with rounded corners with a “Folder” symbol in the upper right corner.

Figure 29: Discretionary CaseTask Shape

6.7.2.1 Case Task for BPMN Compatibility Conformance

Tools implementing the BPMN Compatibility Conformance type SHOULD use this additional notation; this section is optional otherwise.

A `CaseTask` can also be depicted by a rectangle shape with rounded corners with a “Folder” symbol in the upper left corner, a collapsed marker and a thick border.

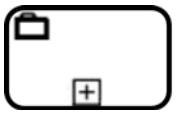


Figure 30: Alternative CaseTask shape

A discretionary `CaseTask` can also be depicted by a dash-lined rectangle with rounded corners with a “Folder” symbol in the upper left corner, a collapsed marker and a thick border.

Figure 31: Alternative Discretionary CaseTask shape

6.7.3 Process Task

A `ProcessTask` is depicted by a rectangle shape with rounded corners with a “Chevron” symbol in the upper left corner.

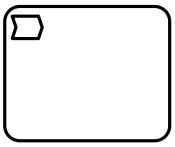


Figure 32: ProcessTask Shape

A `ProcessTask` may be discretionary (i.e. used as `DiscretionaryItem` contained in a `PlanningTable`). A discretionary `ProcessTask` is depicted by a dash lined rectangle with rounded corners with a “Chevron” symbol in the upper left corner.

Figure 33: Discretionary ProcessTask Shape

6.7.3.1 Process Task for BPMN Compatibility Conformance

Tools implementing the BPMN Compatibility Conformance type SHOULD use this additional notation; this section is optional otherwise.

A ProcessTask can also be depicted by a rectangle shape with rounded corners with an optional “Chevron” symbol in the upper left corner, a collapsed marker and a thick border.

Figure 34: Alternative ProcessTask Shapes

A discretionary ProcessTask can also be depicted by a dash-lined rectangle with rounded corners with an optional “Chevron” symbol in the upper left corner, a collapsed marker and a thick border.

Figure 35: Alternative Discretionary ProcessTask Shapes

6.8 Milestones

A `Milestone` is depicted by a rectangle shape with half-rounded ends.

Figure 36: Milestone Shape

A `Milestone` may have zero or more entry criteria.

Figure 37: Milestone with one entry criterion

6.9 EventListeners

An `EventListener` is depicted by a double line circle shape with an open center so that markers can be placed within it to indicate variations of an `EventListener`. The circle MUST be drawn with a double line.

Figure 38: EventListener Shape

A `TimerEventListener` is depicted by double line circle shape with a “Clock” marker in the center.

Figure 39: Timer**Event**Listener **Shape**

A `UserEventListener` is depicted by double line circle shape with a “User” symbol marker in the center.

Figure 40: UserEventListener Shape

6.10 Connectors

Certain dependencies between elements that are shown inside expanded Stages or PlanFragments are depicted using connectors. The shape of the connector object is a dotted line. The connector MUST not have arrowheads.

Figure 41: Connector Shape

One such depicted dependency is the `onPart` of a `Sentry`. For example, the following diagram illustrates a situation where the entry criteria of `Task` B depends on the completion of `Task` A.

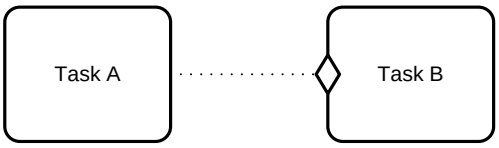


Figure 42: Sentry-based dependency between two Tasks

The other type of dependency that is visualized is the dependency between a `HumanTask` and `DiscretionaryItems` in its `PlanningTable`, when the `HumanTask` is shown with its `PlanningTable` expanded. These dependencies are also depicted by the same dotted line connector.

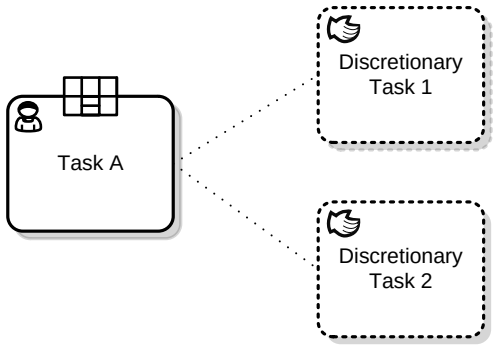


Figure 43: Dependency between a blocking HumanTask and its associated Discretionary Tasks

6.10.1 Connector Usage

Connectors that represent `Sentry` `onParts`, can be used to visualize (possibly complex) dependencies between `PlanItems`. The following picture illustrates a situation where `Task` C can be activated only if `Task` A and `Task` B complete.

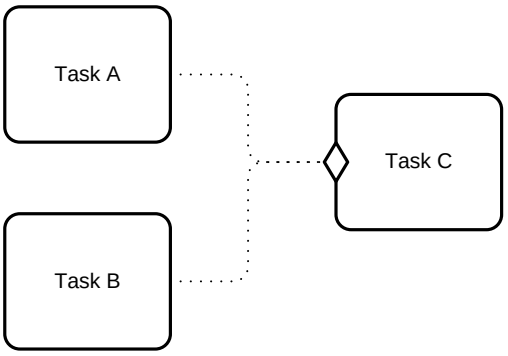


Figure 44: Using Sentry-based connectors to visualize "AND"

The following picture illustrates a situation where `Task` C can be activated if `Task` A or `Task` B completes.

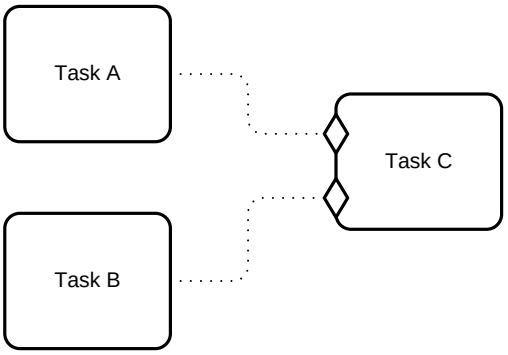


Figure 45: Using Sentry-based connectors to visualize "OR"

The following diagram illustrates a situation where `Stage` B depends on the exit criterion of `Stage` A.

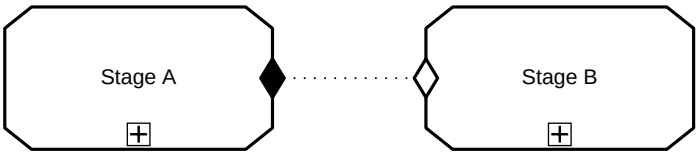


Figure 46: Using Sentry-based connector to visualize dependency between Stages

Note that the connection of the connector (i.e. `onPart` of the entry criterion `Sentry` of B) to the exit criterion `Sentry` of A visualizes the `sentryRef` of the `onPart` of the entry criterion `Sentry` of B (see 5.4.6.1).

The construct in Figure 47 maybe considered a "`Stage` transition", triggered by a particular event. `Stage` B is enabled via its entry criterion (depicted on its boundary), the `OnPart` of which may specify as `standardEvent` the termination of `Stage` A, given that it terminates based on the exit criterion (as depicted on its boundary). That exit criterion may itself has an `OnPart` (not depicted as connector) that refers e.g. to the creation of a document (`CaseFileItem` instance). So, when an instance of the document is created, `Stage` A terminates, and `Stage` B is enabled upon termination of `Stage` A, given that it terminates based on that document creation event.

The following diagram illustrates a situation where `Task` A depends on the achievement of `Milestone` A.

Figure 47: Using the Sentry-based connector to visualize dependency between a Task and a Milestone

The following diagram illustrates a situation where `Task` A depends on a `TimerEventListener.`

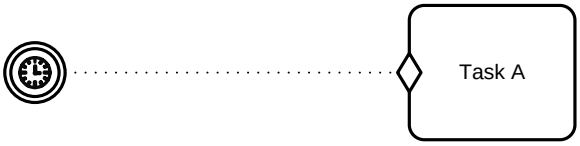


Figure 48: Using the Sentry-based connector to visualize dependency between a Task and a TimerEventListener

The following diagram illustrates a situation where `Task` A depends on a `CaseFileItem.`

Figure 49: Using the Sentry-based connector to visualize dependency between a Task and a CaseFileItem

6.11 Planning Table

A `Stage` or a `HumanTask` can have a `PlanningTable`. A `PlanningTable` is depicted by a "Table" shape composed of six cells with the center bottom cell containing a marker indicating if the `DiscretionaryItem`s are visualized or not. When `DiscretionaryItems` are NOT visualized a marker in the form of a "+" sign is present in the bottom center cell. When `DiscretionaryItem` are visualized a marker in the form of a "-" sign is present in the bottom center cell.

Figure 50: PlanningTable with DiscretionaryItems Not Visualized Shape

Figure 51: Planning Table with DiscretionaryItems Visualized Shape

The PlanningTable shape can only be placed as a decorator on the boundary of a Stage or a HumanTask object. The following example illustrates a Stage with a PlanningTable.

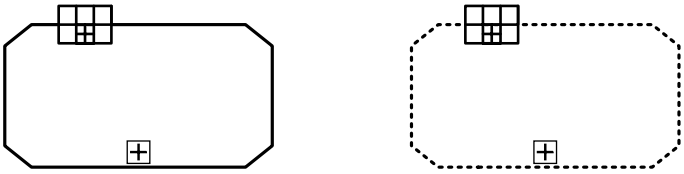


Figure 52: Stage and Discretionary Stage with PlanningTable

The following example illustrates a blocking HumanTask with a PlanningTable.

Figure 53: Blocking HumanTask and Discretionary Blocking HumanTask with PlanningTable

When a user "expands" a PlanningTable, its contained DiscretionaryItems become visible within the Stage.

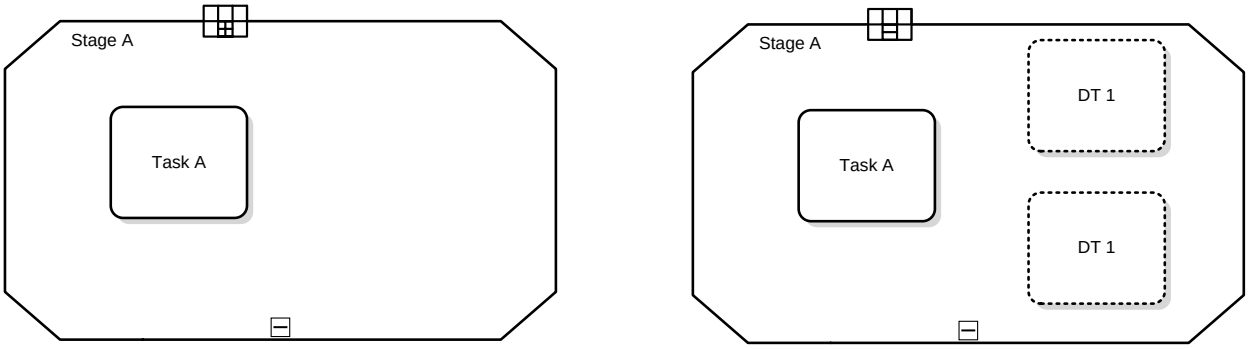


Figure 54: Stage with PlanningTable Collapsed and Expanded

When the PlanningTable of HumanTask is expanded, its contained DiscretionaryItems are visualized outside the HumanTask shape. The relationship between the DiscretionaryItems and the HumanTask is visualized with the dotted line connector.

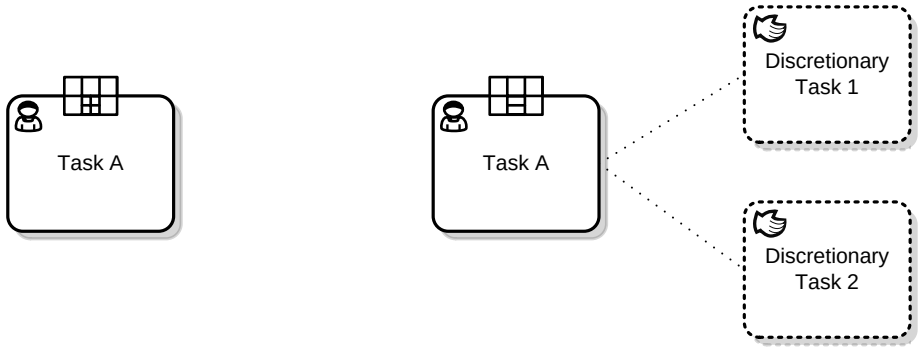


Figure 55: Blocking Human Task with DiscretionaryItems not expanded and expanded

The next four figures illustrate expansion of `PlanningTables`.

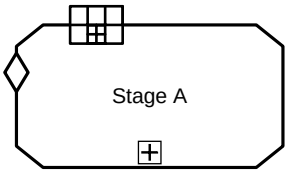


Figure 56: Collapsed Stage with Collapsed PlanningTable

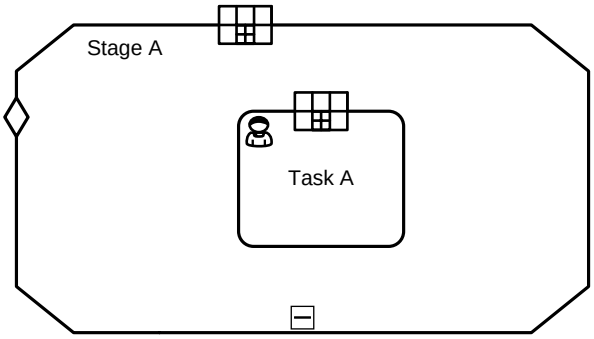


Figure 57: Expanded Stage with Collapsed PlanningTable

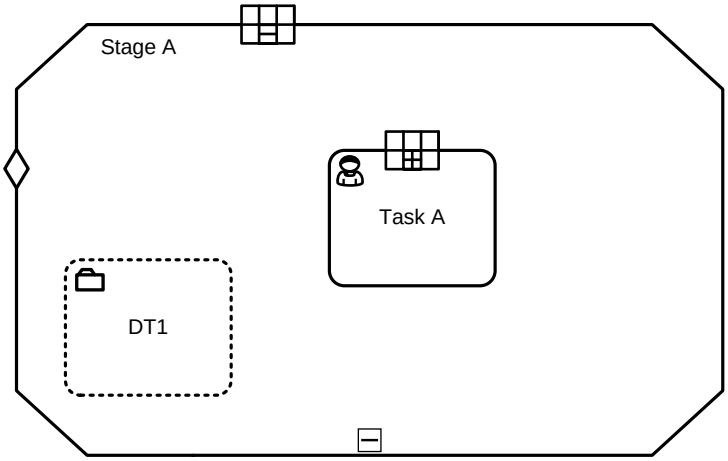


Figure 58: Expanded Stage with Expanded PlanningTable

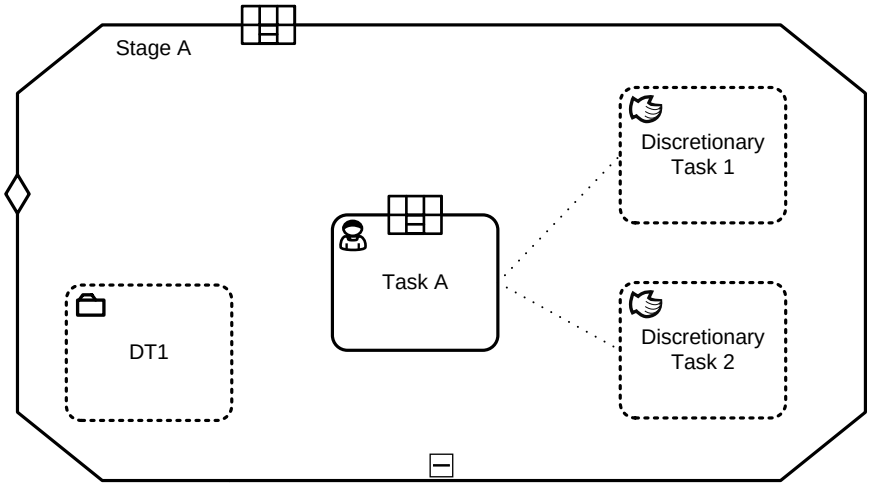


Figure 59: Expanded Stage with Expanded PlanningTable and Expanded HumanTask PlanningTable

6.12 Decorators

In order for the CMMN notation to be as expressive as possible, different shape decorators are introduced. These decorators are useful to visually indicate some particular behavior patterns of `PlanItems` and `DiscretionaryItems`.

6.12.1 AutoComplete Decorator

When a `Stage` `autoComplete` attribute is set to “true”, then an AutoComplete decorator is added to the bottom center of the `Stage` shape.

The AutoComplete Decorator is a small black square.

Figure 60: AutoComplete Decorator

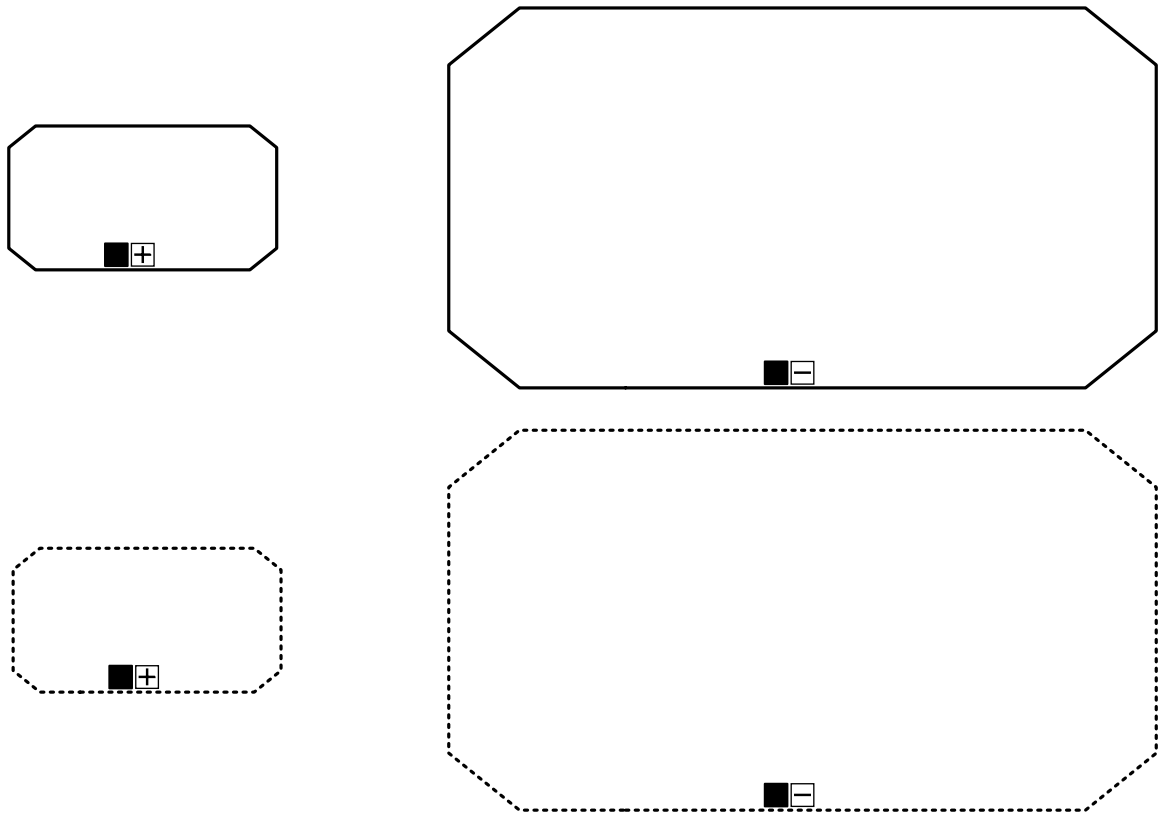


Figure 61: Stage Shape variations with AutoComplete Decorator

The next picture shows the outermost `Stage` of a `Case`, the `casePlanModel`, with AutoComplete Decorator.

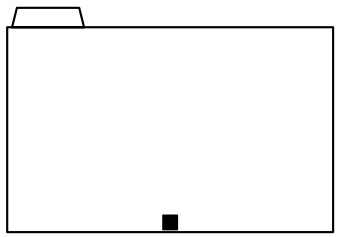


Figure 62: CasePlanModel with AutoComplete Decorator

6.12.2 ManualActivation Decorator

The Manual Activation Decorator, representing a `ManualActivationRule`, is a small white-filled triangle pointing to the right.

Figure 63: ManualActivation Decorator

The Manual Activation Decorator is visible when a `ManualActivationRule` is defined for the `PlanItem` or `DiscretionaryItem`.

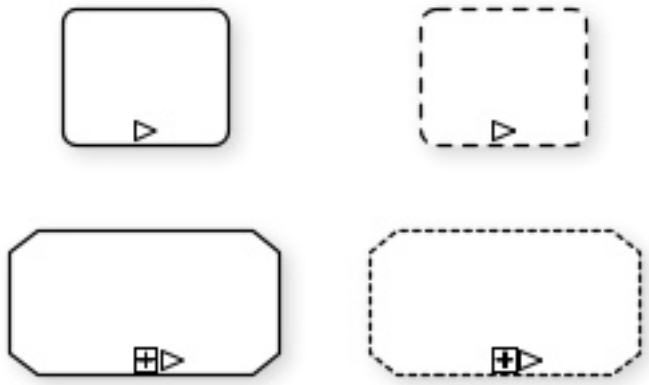


Figure 64: ManualActivation Decorator example on Task and Stage

6.12.3 Required Decorator

The Required Decorator is a bold black “Exclamation” symbol.

!

Figure 65: Required Decorator

The Required Decorator is visible when a `RequiredRule` is defined for `PlanItem` or `DiscretionaryItem`.

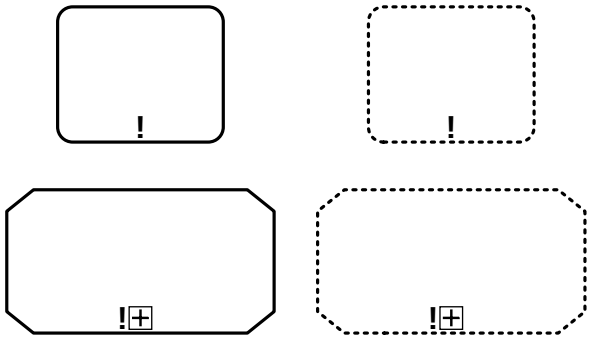


Figure 66: Required Decorator example on Task and Stage

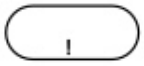


Figure 67: Required Decorator example on Milestone

6.12.4 Repetition Decorator

The Repetition Decorator, depicting a `RepetitionRule`, consists of two bold vertical bars crossed by two bold horizontal bars (identical to ASCII # symbol).

Figure 68: Repetition Decorator

The Repetition Decorator is visible when a `RepetitionRule` is defined for a `PlanItem` or `DiscretionaryItem`.

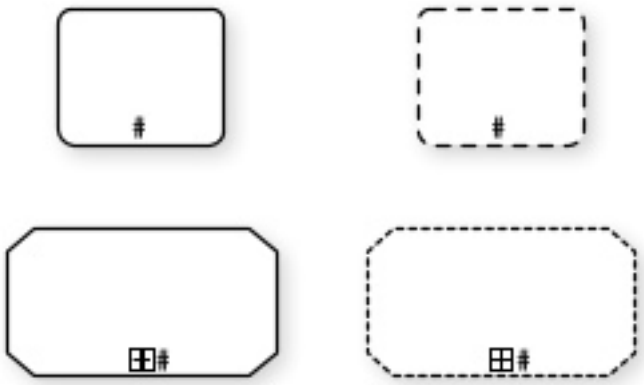


Figure 69: Repetition Decorator example on Task and Stage

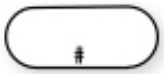


Figure 70: Repetition Decorator example on Milestone

6.12.5 Decorator Applicability Summary

Various Decorators can be added to CMMN shapes. The following table presents Decorators applicability.

Decorator Applicability	Planning Table	Entry Critrion	Exit Criterion	AutoComplete	Manual Activation	Required	Repetition
	⊞	◊	♦	■	▷	!	#
`CasePlanModel`	☑		☑	☑			

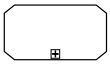
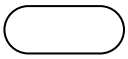
							
Stage 	☑	☑	☑	☑	☑	☑	☑
Task 	HumanTask only	☑	☑		☑	☑	☑
MileStone 		☑				☑	☑
EventListener 							
CaseFileItem 							
PlanFragment 							

Table 3: Decorators Applicability Summary Table

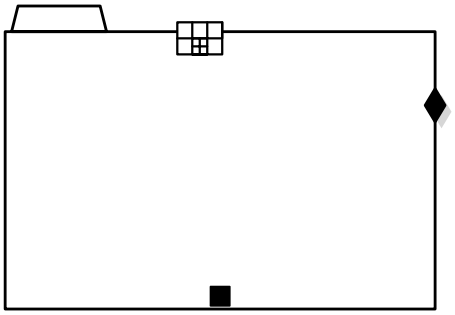


Figure 71: CasePlanModel Shape with all possible Decorators

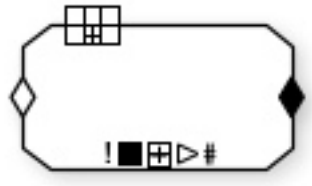


Figure 72: Stage Shape with all possible Decorators

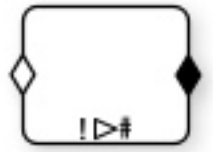


Figure 73: Task Shape with all possible Decorators

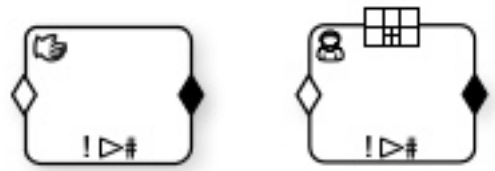


Figure 74: Non-Blocking and Blocking HumanTask Shapes with all possible Decorators

Figure 75: Milestone Shape with all possible Decorators

6.13 Examples

The following picture shows a combination of various elements, by means of a small example, which is about claims management.

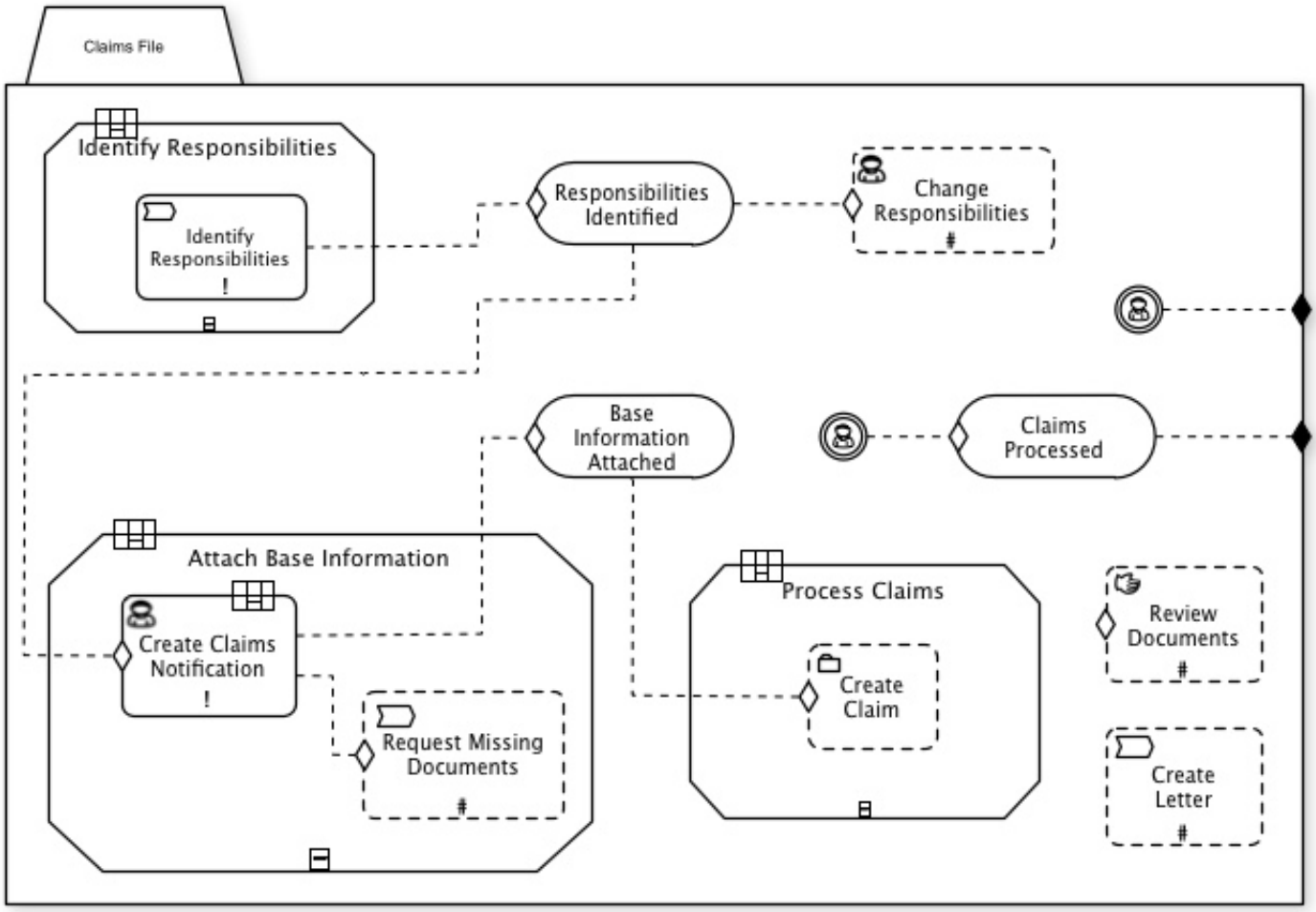


Figure 76: Claims Management Example

7 Execution Semantics

Most of the execution semantics is described by the lifecycle of important `CMMNElement` instances. In particular the lifecycle for `Task`, `Stage`, `Milestone`, `EventListener`, and `CaseFileItem` instances describe the majority of the execution semantics. In addition to the lifecycle there are behavioral property rules that also describe the behavior of a case management system.

This chapter first describes the overall semantics associated with `Case` instances. It then describes the semantics of the `caseFileModel`, and concludes with the semantics of the `casePlanModel` portion.

7.1 Case Instance

A `Case` instance is composed of information represented by a `caseFileModel` and behavior represented by a `casePlanModel`. In addition, there are roles, which correspond to humans expected to participate in the `Case`.

When a `Case` instance is created, the `caseFileModel`, `casePlanModel`, and `caseRoles` are all initialized. The `Stage` instance implementing the `casePlanModel` starts executing in an Active state (see 7.3), and while the `Case` instance is not in Closed state the `caseFileModel` can be modified, planning can occur, and human participants can be assigned to roles.

7.2 CaseFileItem Lifecycle

The following diagram illustrates the lifecycle of a `CaseFileItem` instance:

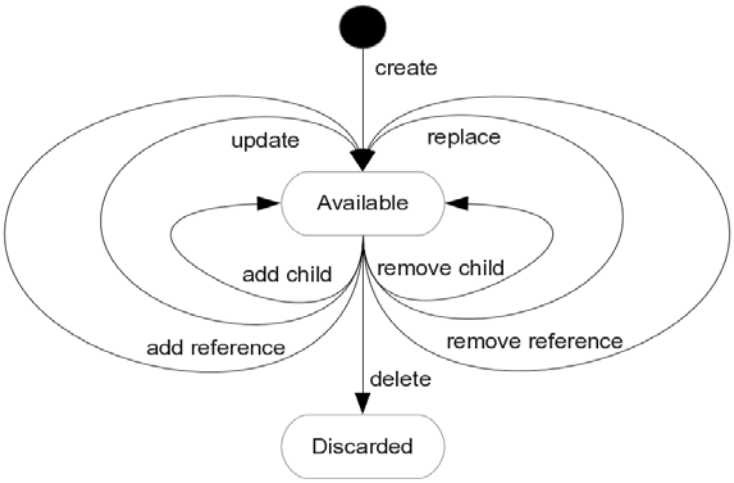


Figure 77: CaseFileItem instance lifecycle

A `CaseFileItem` instance has the following states:

State	Description
Available	In this state a `CaseFileItem` instance is available for `Case` workers to use
Discarded	A `CaseFileItem` instance in this state is considered deleted and is not available to `Case` workers or expressions

Table 47: CaseFileItem instance states

A `CaseFileItem` instance can undergo the following transitions:

Transition	From	To	Description
create	Ø	Available	Transition to the Available state when a `CaseFileItem` instance is created
update	Available	Available	Transition when a `CaseFileItem` instance property is updated
replace	Available	Available	Transition when the `CaseFileItem` instance content is replaced
add child	Available	Available	Transition when another `CaseFileItem` instance is added to the `children` relationship (meaning an entry is added to `CaseFileItem.children`)
remove child	Available	Available	Transition when another `CaseFileItem` instance is removed from the `children` relationship (meaning an entry is removed from `CaseFileItem.children`)
add reference	Available	Available	Transition when another `CaseFileItem` instance is added to the target reference relationship (meaning an entry is added to `CaseFileItem.targetRef`)
remove reference	Available	Available	Transition when another `CaseFileItem` instance is removed from the `targetRef` relationship (meaning an entry is removed from `CaseFileItem.targetRef`)
delete	Available	Discarded	Terminal state

Table 48: CaseFileItem instance transitions

A `Task` instance output MAY have an effect on `CaseFileItem` instances that are specified as output `CaseParameters` of a `Task` instance.

7.2.1 CaseFileItem operations

The following standard operations are defined for `CaseFileItem` instances to support navigation over the `CaseFile`:

Operation	Parameters	Description
getCaseFileItemInstance	**IN** itemName : String **OUT** CaseFileItem instance	Get a `CaseFileItem` instance of given `itemName`. If no `CaseFileItem` instance for the given `itemName` exists, an empty `CaseFileItem` instance MUST be returned.
getCaseFileItemInstance	**IN** itemName : String index : Integer	Get a `CaseFileItem` instance of given `itemName` and `index`. This operation MUST be used for `CaseFileItem` instances with a multiplicity greater than

	OUT CaseFileItem instance	one. The `index` is used to identify a concrete `CaseFileItem` instance from the collection of `CaseFileItem` instances. If no `CaseFileItem` instance for the given `itemName` exists, or if the `index` is out of the range of `CaseFileItem` instances, an empty `CaseFileItem` instance MUST be returned.
getCaseFileItemInstanceProperty	**IN** item : CaseFileItem instance propertyName : String **OUT** Element	Get the value of a `CaseFileItem` instance property. If `propertyName` refers to a non-existing property of the `CaseFileItem` instance, an empty Element MUST be returned. The Element returned MUST be of the specified property type for the `CaseFileItem` instance.
getCaseFileItemInstanceChild	**IN** item : CaseFileItem instance childName : String **OUT** CaseFileItem	Get a child `CaseFileItem` instance for a given `CaseFileItem` instance. The value of parameter `childName` specifies the name of the child to get. If no child of the given name exists for the `CaseFileItem` instance, an empty `CaseFileItem` instance MUST be returned.
getCaseFileItemInstanceParent	**IN** item : CaseFileItem instance **OUT** CaseFileItem instance	Get the parent `CaseFileItem` instance of a `CaseFileItem` instance. If no parent exists then an empty `CaseFileItem` instance MUST be returned.
getCaseFileItemInstanceTarget	**IN** item : CaseFileItem instance targetName : String **OUT** CaseFileItem instance	Get a target `CaseFileItem` instance for a given `CaseFileItem` instance. The value of parameter `targetName` specifies the name of the target to get. If no target of the given name exists for the `CaseFileItem` instance, an empty `CaseFileItem` instance MUST be returned.
getCaseFileItemInstanceSource	**IN** item : CaseFileItem instance **OUT** CaseFileItem instance	Get the source `CaseFileItem` instance of a `CaseFileItem` instance. If no source exists then an empty `CaseFileItem` instance MUST be returned.

Table 49: CaseFileItem instance operations

An implementation that uses XPath as expression language (see 5.1.2), MIGHT use XPath Extension Functions to implement those operations.

7.3 CasePlanModel Lifecycles

The behavior associated with `Case` models in CMMN is the result of combining a variation of the operational semantics for business artifacts managed based on the guard-stage-milestone (GSM) concept, with other concepts, such as, most notably, dynamic planning, the application of finite state machine lifecycles for `CaseFileItem`, `EventListener`, `Milestone`, `Stage` and `Task` instances, and application of so-called Behavior Property Rules (see 7.5). Further generalizations include the possibility that `PlanItemDefinitions` may have multiple, simultaneous occurrences, and the separation of `Milestones` from `Stages` (in GSM, each milestone is associated with a stage, and achieving the milestone has the effect of terminating the stage).

`Stages` contain other `PlanItems` (`Stages`, `Tasks`, `Milestones`, and `EventListeners`). The terminology used in this specification, calls the elements inside a `Stage` its children, and the container `Stage` the parent. Therefore, a child of a `Stage` is an element contained in that `Stage`. The parent of an element is the `Stage` that contains that element. This terminology refers to a single level of containment; a second level of containment may be referenced using grandchildren or grandparent. For example for a `Stage` S1 containing a single `Stage` S2 that itself contains a single `Task` T1, this specification will say that S1 is the parent of S2, and S2 is the parent of T1, T1 is the only child of S2, and S2 is the only child of S1.

This section describes the lifecycle of some important `CMMNElement` instances, including `Case` and all the `PlanItemDefinition` derived classes (`Stage`, `Task`, `Milestone`, and `EventListener`) instances.

It is important to understand that when we talk about `EventListener`, `Milestone`, `Stage` or `Task` instances we refer to the instances that originate from instantiating a `PlanItemDefinition` that is referred from a `PlanItem` or `DiscretionaryItem` associated with the corresponding `EventListener`, `Milestone`, `Stage` or `Task`.

There are nine states used in these lifecycles, and they are described in the following table.

State	Description
Active	Indicates behavior is being executed in the instance
Available	The instance is waiting for a `Sentry` to become “true” or for an event to occur, so that the instance can progress to its primary purpose (e.g., become Active or Enabled)
Closed	Terminal state. There is no activity (no behavior being executed) in the `Case` instance, and further planning in the `Case`'s `casePlanModel` is not permitted. This state is only available for the outermost `Stage` instance implementing the `Case`'s `casePlanModel`
Completed	Semi-terminal state[1] for `Case` instance, but terminal state for all other `EventListener`, `Milestone`, `Stage` or `Task` instances. There is no activity (no behavior being executed) in the element. A `Case` instance could transition back to Active by engaging in planning at the outermost `Stage` instance implementing the `Case's casePlanModel`
Disabled	Semi-terminal state. Indicates a `Case` worker (human) decision to disable the instance, because it

[1] For the purpose of this specification, a semi-terminal state is a state with a transition out of the state, but it is considered terminal to calculate Completion state of its parent `Stage` instance.

State	Description
	may not be required for the Case instance at hand
Enabled	The instance is waiting for a Case worker (human) decision to become Active or Disabled
Failed	Semi-terminal state. This state indicates an exception or software failure.
Suspended	Indicates a Case worker (human) decision to temporary suspend work on an Active instance. There is no activity (no behavior being executed) in the instance, but a Case worker (human) could move the instance back to an Active state.
Terminated	Terminal state. Indicates termination by an exit criteria or a Case worker (human) decision to terminate an Active instance.

Table 50: Case, EventListener, Milestone, Stage and Task instance states

Terminal states (Closed, Completed, and Terminated) and semi-terminal states (Disabled, and Failed) are used to calculate the completion of its enclosing Stage instance. A semi-terminal state is a state with a transition out of the state, but it is considered terminal to calculate Completion state of its parent Stage instance.

7.3.1 Case Instance Lifecyle

The Case lifecycle corresponds to the Stage instance implementing the Case's casePlanModel, which in below text is referred as the outermost Stage instance of the Case instance. The outermost Stage instance is special in two areas:

1- It MUST NOT contain entry criteria.

2- That Stage instance implements the Case lifecycle described in this section, which is different than the lifecycle for all other Stage instances.

The following diagram illustrates the lifecycle of a Case instance, by illustrating the lifecycle of the Case's casePlanModel.

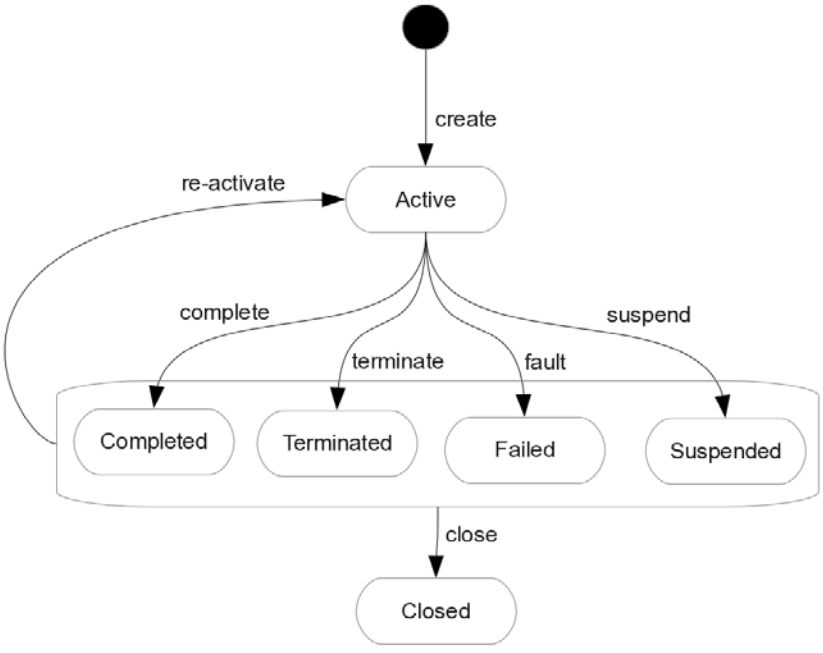


Figure 78: Lifecycle of a Case instance

A Case instance has the following states:

State	Description
Active	In this state the Case instance is executing; meaning the outermost Stage instance is in the Active state
Suspended	This state allows a Case worker (human) to temporarily suspend an executing Case instance. A Case instance MUST propagate this state to its outermost Stage instance. This state MUST then be propagated down to the outermost Stage instance's contained EventListener, Milestone, Stage and Task instances.
Completed	The Case instance is completed, when all the required Milestone, Stage and Task instances in the outermost Stage instance are completed (completed or terminated), and there are no executing (Active) Stage or Task instances.
Terminated	Terminal state. This state can be achieved by an exit criteria and also allows a Case worker (human) to terminate an executing Case instance. This state is reached when the outermost Stage instance reaches it.
Failed	Semi-terminal state. This state is reached when the outermost Stage instance reaches it. The state indicates an exception or software failure.
Closed	Terminal state. In this state no new activity is allowed in the Case. The Case instance caseFileModel and all its content becomes read only, and no new Task or Stage instances can be planned

Table 51: Case instance states

A Case instance can undergo the following transitions:

Transition	From	To	Description
create	Ø	Active	Transition to the initial state (Active) when the Case instance is created. The outermost Stage instance skips the Available state and MUST transition directly to the Active state, because that Stage instance does not have a (entry criteria) Sentry.
suspend	Active	Suspended	Transition by Case worker (human) decision. This state propagates down to the outermost Stage instance, which in turn propagates it down to all its internal EventListener, Milestone, Stage and Task instances.
terminate	Active	Terminated	Transition by Case worker (human) decision. This state propagates down to the outermost Stage instance, which in turn propagates it down to all its internal EventListener, Milestone, Stage and Task instances
complete	Active	Completed	Transition when all the required Milestone, Stage and Task instances have reached a terminal state (Closed, and Terminated) or a semi-terminal state (Completed, Disabled, and Failed), and there are no executing (Active) Stage or Task instances.
fault	Active	Failed	Transition when the outermost Stage instance reaches the Failed state due to an exception or software failure

Transition	From	To	Description
re-activate	Completed Terminated Failed Suspended	Active	Transition by a `Case` worker (human), or an administrator.
close	Completed Terminated Failed Suspended	Closed	Transition by the system, an administrator, or `Case` worker (human) when no further work or modifications should be allow for this `Case`

Table 52: Case instance transitions

7.3.2 Stage and Task Lifecycle

The following diagram illustrates the lifecycle of a `Stage` or `Task` instance:

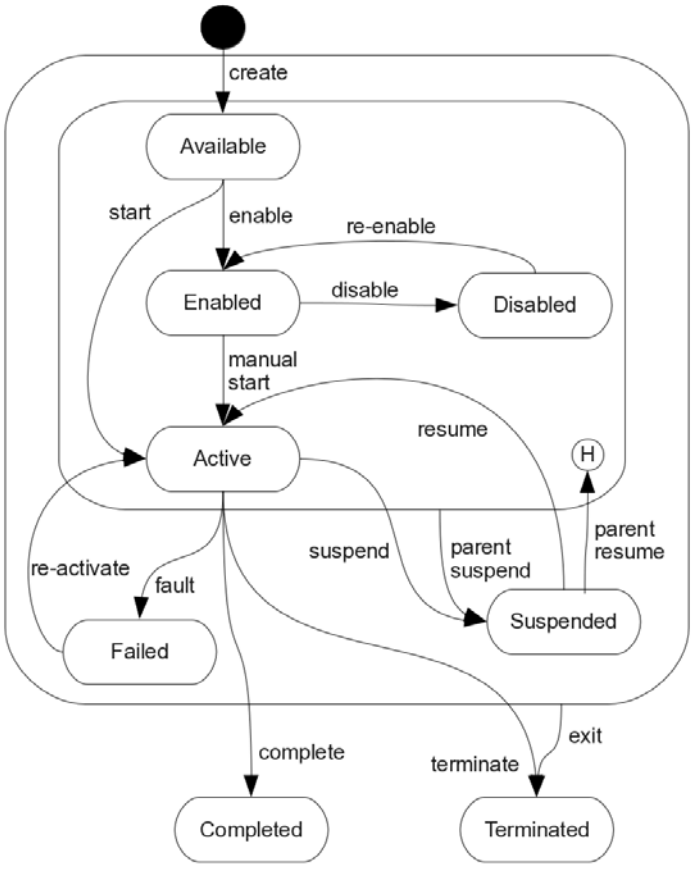


Figure 79: Lifecycle of a Stage or Task instance

A `Stage` or `Task` instance has the following states:

State	Description
Available	A `Stage` or `Task` instance becomes available when the `Stage` instance in which it resides moves into Active state. While available, the `Stage` or `Task` instance is waiting for its entry criteria (`Sentry`) to become “true”. A missing entry criteria (`Sentry`) is considered “true”.
Enabled	A `Stage` or `Task` instance in this state is waiting for a human to start or disable it. Only `Stage` or `Task` instances that require `Case` worker (human) intervention to start get into this state (`ManualActivationRule` evaluates to “true”)
Disabled	Semi-terminal state. This state is reached when a `Case` worker (human) decides the `Stage` or `Task` instance should not execute in this instance of the `Case`
Active	The `Stage` or `Task` considered instance is executing in this state. `Stage` instances in this state contain at least one `Stage` or `Task` instance in the Available, Enabled, Active, Suspended state, or `autoComplete` is set to “false”.
Suspended	This state allows a `Case` worker (human) to temporarily suspend an executing `Stage` or `Task` instance. A `Stage` instance MUST propagate this state to all its contained `EventListener`, `Milestone`, `Stage` and `Task` instances.
Failed	Semi-terminal state. This state indicates an exception or software failure
Completed	Terminal state. This state indicates normal termination of the `Stage` or `Task` instance. For a `Stage` instance it indicates all its contained `Stage` or `Task` instances MUST be either completed or terminated.
Terminated	Terminal state. This state indicates a termination by a `Case` worker (human), or termination by reaching the exit criteria sentry. A `Stage` instance MUST propagate this state to all its contained `EventListener`, `Milestone`, `Stage` and `Task` instances.

Table 53: Stage and Task instances states

A `Stage` or `Task` instance can undergo the following transitions:

Transition	From	To	Description
create	Ø	Available	Transition to the initial state (Available) when the `Stage` or `Task` instance is created. This happens when the `Stage` instance containing this `Stage` or `Task` instance transitions to Active. The `RepetitionRule` and the `RequiredRule` Boolean expressions MUST be evaluated in this transition, and their Boolean values SHOULD be maintained for the rest of the life of the `Stage` or `Task` instance.
enable	Available	Enabled	Transition when the entry criteria (sentry) becomes “true” and the `Stage` or `Task` instance requires manual intervention to transition to Active or Disabled. This transition only happens if the `ManualActivationRule` evaluates to “true” at the moment the sentry becomes “true”. The `ManualActivationRule` Boolean expression MUST be evaluated in this transition and its Boolean value SHOULD be maintained for the rest of the life of the `Stage` or `Task`

Transition	From	To	Description
			instance.
start	Available	Active	Transition when the entry criteria (sentry) becomes “true” and the `Stage` or `Task` instance does not require manual intervention. This transition only happens if the `ManualActivationRule` evaluates to “false” at the moment the sentry becomes “true”. The `ManualActivationRule` Boolean expression MUST be evaluated in this transition, and its Boolean value SHOULD be maintained for the rest of the life of the `Stage` or `Task` instance.
disable	Enabled	Disabled	Transition by `Case` worker (human) decision
manual start	Enabled	Active	Transition by `Case` worker (human) decision
suspend	Active	Suspended	Transition by `Case` worker (human) decision or propagation from outer `Stage` instance. For a `Stage` instance, this state MUST propagate to all its contained `EventListener`, `Milestone`, `Stage` and `Task` instances.
fault	Active	Failed	Transition when an exception or software failure occurs. This state MUST NOT propagate.
complete	Active	Completed	Transition when the `Stage` or `Task` instance completes normally. For a `Stage` instance, this means that all its child `Task` and `Stage` instances have reached a terminal or semi-terminal state (all child `Task` and `Stage` instances have reached disabled, terminated, completed, or fault). For a `Task` instance, this means its purpose has been accomplished (`CaseTask` instances have launched a new `Case` instance; `ProcessTask` instances have launched a `Process` instance and if output parameters are required then the `Case` or `Process` instance has completed and returned the output parameters; `HumanTask` instances have been completed by a human; etc.)
terminate	Active	Terminated	Transition by `Case` worker (human) decision or propagation from outer `Stage` instance. For a `Stage` instance, this state MUST propagate to all its contained `EventListener`, `Milestone`, `Stage` and `Task` instances.
exit	Available Active Enabled Disabled, Suspended Failed	Terminated	Transition when the exit criteria of the `Stage` or `Task` instance becomes “true”, or when the parent `Stage` instance transitions to Terminate state. This transition may represent a normal or an abnormal termination.
resume	Suspended	Active	Transition by `Case` worker (human) decision or propagation from outer Stage instance. For a `Stage` instance, this state MUST propagate to all its contained `EventListener`,

Transition	From	To	Description
			`Milestone`, `Stage` and `Task` instances.
re-activate	Failed	Active	Transition by the systems, an administrator, or by `Case` worker (human) when the source of the failure has been resolved
re-enable	Disabled	Enabled	Transition by a `Case` worker (human) decision
parent suspend	Available Active Enable Disabled	Suspended	Transition to Suspended when the parent `Stage` instance transitions to Suspended. `Stage` instances MUST propagate this state down to all its children.
parent resume	Suspended	Available Active Enable Disabled	Transition to the state previous to be suspended, when the parent stage transition out of Suspened. Stages propagate this state down to all its children

Table 54: Stage and Task instance transitions

`Stage` instances propagate down some of their states, as follows:

When Stage moves into state		Child Stages and Tasks transition as follows			Child Milestones or Event Listeners transition as follows		
Transition	**Enter state**	**Transition**	**From state**	**To state**	**Transition**	**From state**	**To state**
create, parent resume	Available	--	Ø	Ø	--	Ø	Ø
enable, re-enable, parent resume	Enabled	--	Ø	Ø	--	Ø	Ø
disable, parent resume	Disabled	--	Ø	Ø	--	Ø	Ø
start, manual start	Active	create	Ø	Available	create	Ø	Available
resume, parent resume	Active	parent resume	Available	Suspended	N/A	Available	<impossible>
resume, parent resume	Active	parent resume	Enabled	Suspended			
resume, parent resume	Active	parent resume	Disabled	Suspended			
resume, parent resume	Active	parent resume	Active	Suspended			
resume, parent resume	Active	parent resume	Suspended	Suspended	resume	Suspended	Available

resume, parent resume	Active	--	Failed	Failed(1)			
resume, parent resume	Active	--	Completed	Completed	--	Completed	Completed
resume, parent resume	Active	--	Terminated	Terminated	--	Terminated	Terminated
suspend, parent suspend	Suspended	parent suspend	Available	Suspended	suspend	Available	Suspended
suspend, parent suspend	Suspended	parent suspend	Enabled	Suspended			
suspend, parent suspend	Suspended	parent suspend	Disabled	Suspended			
suspend, parent suspend	Suspended	parent suspend	Active	Suspended			
suspend, parent suspend	Suspended	--	Suspended	Suspended	--	Suspended	Suspended
suspend, parent suspend	Suspended	--	Failed	Failed(1)			
suspend, parent suspend	Suspended	--	Completed	Completed	--	Completed	Completed
suspend, parent suspend	Suspended	--	Terminated	Terminated	--	Terminated	Terminated
fault	Failed	--	Available	Available	--	Available	Available
fault	Failed	--	Enabled	Enabled			
fault	Failed	--	Disabled	Disabled			
fault	Failed	--	Active	Active			
fault	Failed	--	Suspended	Suspended	--	Suspended	Suspended
fault	Failed	--	Failed	Failed			
fault	Failed	--	Completed	Completed	--	Completed	Completed
fault	Failed	--	Terminated	Terminated	--	Terminated	Terminated
complete	Completed	N/A	Available	<impossible>	N/A	Available	Available
complete	Completed	N/A	Enabled	<impossible>			
complete	Completed	--	Disabled	Disabled			
complete	Completed	N/A	Active	<impossible>			
complete	Completed	N/A	Suspended	<impossible>	N/A	Suspended	Suspended
complete	Completed	--	Failed	Failed			
complete	Completed	--	Completed	Completed	--	Completed	Completed
complete	Completed	--	Terminated	Terminated	--	Terminated	Terminated
exit, terminate	Terminated	exit	Available	Terminated	parent terminate	Available	Terminated
exit, terminate	Terminated	exit	Enabled	Terminated			
exit, terminate	Terminated	exit	Disabled	Terminated			
exit,	Terminated	exit	Active	Terminated			

terminate							
exit, terminate	Terminated	exit	Suspended	Terminated	parent terminate	Suspended	Terminated
exit, terminate	Terminated	exit	Failed	Terminated			
exit, terminate	Terminated	--	Completed	Completed	--	Completed	Completed
exit, terminate	Terminated	--	Terminated	Terminated	--	Terminated	Terminated

Table 55: Stage instance state top-down propagation

Notes

(1) If the exception is fixed and the restart transition is taken to Active, then it should continue transition into Suspended state.

7.3.3 EventListener and Milestone Lifecycle

The following diagram illustrates the lifecycle of an `EventListener` or `Milestone` instance:

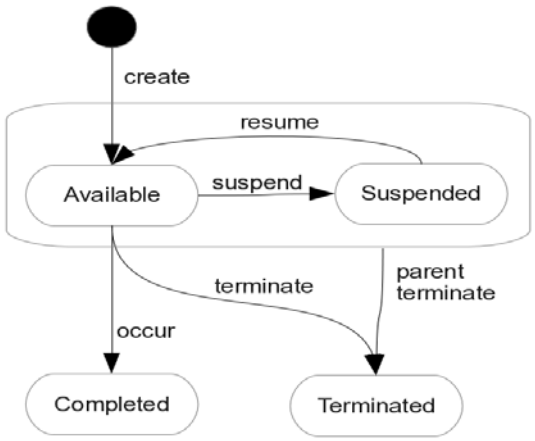


Figure 80: Lifecycle of an EventListener or Milestone instance

An `EventListener` or `Milestone` instance has the following states:

State	Description
Available	In this state an `EventListener` instance is waiting for the event to occur. A `Milestone` instance in this state is waiting for the `Sentry` (as entry criterion) to be satisfied.
Suspended	This state allows a `Case` worker (human) or an enclosing `Stage` instance to temporarily suspend an `EventListener` instance for which the event has not yet occurred, or to suspend a `Milestone` instance that has not been reached.
Completed	Terminal state. For Events this state indicates that the `EventListener` instance was triggered, and that the event has been consumed. For `Milestone` instances this state indicates that one of the achieving criteria of the `Milestone` instance became "true", i.e., that the Milestone has been achieved.
Terminated	Terminal state. This state indicates a termination by a `Case` worker (human) or an enclosing

State	Description
	Stage instance, indicating that a Case worker (human) is not interest anymore on the event being listened to, or in the milestone being reached.

Table 4: EventListener and Milestone instance states

An EventListener or Milestone instance can undergo the following transitions:

Transition	From	To	Description
create	Ø	Available	Transition to the initial state (Available) when an EventListener or Milestone instance is created. For a Milestone instance, the RepetitionRule and RequiredRule Boolean expression MUST be evaluated in this transition, and their Boolean value SHOULD be maintained for the rest of the life of the Milestone instance.
suspend	Available	Suspended	Transition by Case worker (human) decision or propagation from outer Stage instance.
terminate	Available	Terminated	Transition by Case worker (human) decision or propagation from outer Stage instance.
occur	Available	Completed	For event listener transitions when the event being listened by the EventListener instance does occurs. For a UserEventListener instance this transition happens when a Case worker (human) decides to raise the event. For Milestone instance transitions when one of the achieving Sentries (entry critera) is satisfied.
resume	Suspended	Available	Transition by Case worker (human) decision or propagation from outer Stage instance.
parent terminate	Available Suspend	Terminated	Transition when the parent stage transition to terminate.

Table 56: EventListener and Milestone instance transitions

7.4 Sentry

When multiple entry criteria (sentries) are used only one is required to trigger the transition of the Stage or Task instance out of Available state. The same is true for exit criteria. When multiple exit criteria (sentries) are used only one is required to trigger to transition the Stage or Task instance from Active to Terminated.

A Sentry's onPart is satisfied when one of the following conditions is satisfied:

- For a PlanItemOnPart, its Sentry referred by sentryRef has occurred.
- For a PlanItemOnPart or CaseFileItemOnPart, its sourceRef transitions into the transition described by the standardEvent (PlanItemTransition, or CaseFileItemTransition)

A Sentry is satisfied when one of the following conditions is satisfied:

- All of the onParts are satisfied AND the ifPart condition evaluates to “true”.

- All of the `onParts` are satisfied AND there is no `ifPart`.
- The `ifPart` condition evaluates to "true" AND there are no `onParts`.

7.5 Behavior Property Rules

Dynamically evaluated rules are used to derive Boolean values that can influence the execution of a `Case` instance. These are called, collectively, *Behavior Property Rules*. These rules are:

- Applicability rule (see 5.4.9.3)
- Stage.autocomplete (see 5.4.8)
- ManualActivationRule (see 5.4.11.1)
- RequiredRule (see 5.4.11.2)
- RepetitionRule (see 5.4.11.3)

In this section we consider how the semantics of these rules is related to transitions of the lifecycles of `EventListener`, `Milestone`, `Stage` resp. `Task` instances.

7.5.1 Stage.autoComplete

The following table describes the termination criteria of `Stage` instances based on the `autoComplete` attribute.

	`autoComplete` = true	`autoComplete` = false
`Stage` instance completion criteria	There are no Active children, AND all required (`requiredRule` evaluates to "true") children are in {Disabled, Completed, Terminated, Failed}	There are no Active children AND (all children are in {Disabled, Completed, Terminated, Failed} AND there are no `DiscretionaryItems`) OR (Manual Completion AND all required (`requiredRule` evaluates to "true") children are in {Disabled, Completed, Terminated, Failed})

Table 57: Stage instance termination criteria

In other words, a Stage instance SHOULD complete if a user has no option to do further planning or work with the `Stage` instance.

7.5.2 ManualActivationRule

The `ManualActivationRule` determines whether the `Task` or `Stage` instance should move to state Enabled or Active. This rule is evaluated and used when one of the entry criterions of the `Task` or `Stage` instance is satisfied. If this rules evaluate to "true" the `Task` or `Stage` instance transitions from Available to Enabled, otherwise it transitions from Available to Active. This rule impacts `Stage` or `Task` instances in Available state.

7.5.3 RequiredRule

The `RequiredRule` determines whether the `Milestone`, `Stage` or `Task` instance having this condition MUST be in the Completed, Terminated, Failed or Disabled state in order for its parent `Stage` instance to transition into the Completed state. This rule MUST be evaluated when the `Milestone`, `Stage` or `Task` instance is instantiated and transitions to the Available state, and their Boolean value SHOULD be maintained for the rest of the life of the `Milestone`, `Stage` or `Task` instance. If this rule is not present, then it is considered "false". If this rule evaluates to "true", the parent `Stage` instance MUST NOT transition to

Complete state unless this Milestone, Stage or Task instance is in the Completed, Terminated, Failed or Disabled state. This rule impacts Stage instances in Available state.

7.5.4 RepetitionRule

This rule MUST be evaluated when the Milestone, Stage or Task instance is instantiated and transitions to the Available state, and their Boolean value SHOULD be maintained for the rest of the life of the Milestone, Stage or Task instance.

Stage and Task instances with a RepetitionRule evaluating to "true" will create an instance every time an entry criterion with an onPart is satisfied. Under that condition a new instance is created and because the entry criteria is satisfied it moves from the Available state to either Active or Enabled state depending on the ManualActivationRule.

7.5.5 ApplicabilityRule

This rule is evaluated and used for planning. It impacts planning by a HumanTask or into a Stage instance. During planning the only DiscretionaryItems that MUST be shown to the Case Worker (in the authorizedRoleRef) are those, for which the ApplicabilityRule evaluates to "true".

7.6 Planning

Planning is constrained to certain states in the lifecycle of the Stage or HumanTask instance as described in the following table.

Contain a Planning Table	States for which planning is allow
casePlanModel	Active, Failed, Suspended, Completed, Terminated
Stage instance	Active, Available, Enabled, Disabled, Failed, Suspended
HumanTask instance	Active

Table 58: Planning constrained to Case, Stage and Task instance lifecycles

If a Stage instance is in Active state, then the planned PlanItems are instantiated immediately after planning completes. If the Stage instance is in another valid planning state, the planned PlanItems are instantiated when the Stage instance transitions to Active state. When a Stage instance has a PlanningTable, the TableItems of that PlanningTable can be used for planning. The resulting instances of the planning MUST be added to the Stage instance.

Case workers planning at a particular HumanTask instance are constrained to use the PlanningTable for that HumanTask instance. The resulting instances of the planning MUST be added to the parent Stage instance of the HumanTask instance. Those planned PlanFragments, Stages or Tasks are instantiated immediately after planning completes (because the parent Stage instance in which the planning task is taking place is in Active state).

7.7 Connector

Connectors are optional visual elements only and do not have associated execution semantics.

8 Exchange Formats

8.1 Interchanging Incomplete Models

It is common for `Case` 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 user) first defines a high-level model and then passes it on to another person to complete or refine the model.

Such "incomplete" models are ones in which not all of the mandatory model attributes have been filled in yet or the cardinality lower bound of attributes and associations has not been satisfied.

XMI allows for the interchange of such incomplete models. In CMMN, we extend this capability to interchange of XML files based on the CMMN XML-Schema. In such XML files, implementers are expected to support this interchange by:

- Disregarding missing attributes that are marked as "required" in the CMMN XML-Schema.
- Reducing the lower bound of elements with "minOccurs" greater than 0.

8.2 Machine Readable Files

CMMN 1.0 machine-readable files, including XSD and XMI files can be found in OMG Document bmi/2013-12-01, which is a zip file containing all the files:

- XML-Schema (XSD) files are found under the XSD folder of the zip file, the main file is XSD/CMMN10.xsd
- XMI files are found under the XMI folder of the zip file, the main file is XMI/CMMN10.xmi

8.3 XSD

8.3.1 Document Structure

A domain-specific set of `Case` model elements is interchanged in one or more CMMN files. The root element of each file MUST be <cmmn:definitions>. The set of files MUST be self-contained, i.e. all definitions that are used in a file MUST be imported directly or indirectly using the <cmmn:import> element.

Each file MUST declare a "targetNamespace" that MAY differ between multiple files of one `Case` model. CMMN files MAY import non-CMMN files (such as XSD's and BPMN files) if the contained elements use external definitions.

8.3.2 References within CMMN XSD

All CMMN elements contain ID's and within the CMMN XML-Schema, references to elements are expressed via these ID's. The XML-Schema IDREF (for a reference with multiplicity 1) and IDREFS (for references with multiplicity greater than 1) types are the traditional mechanisms used for referencing by ID's within a single XML file. The CMMN XSD supports referencing by ID, across files, by utilizing QNames. A QName consists of two parts: An (optional) namespace prefix and a local part. When used to reference a CMMN element, the local part is expected to be the ID of the element.

For example, consider the following Case

```
<case name="Fraud Investigation" id="Fraud_Investigation_Case_ID1">
 …
</case>
```

When this Case is referenced from another file, the reference would take the following form

```
caseRef=″case_ns:Fraud_Investigation_Case_ID1″
```

where “case_ns” is the namespace prefix associated with the case namespace upon import, and “Fraud_Investigation_Case_ID1” is the value of the ID attribute for the Case.

The CMMN XML-Schema utilizes IDREF and IDREFS wherever possible and resorts to QName only when references can span multiple files. In both situations however, the reference is still based on ID’s.